NUREG-1872, Vol. 1

Draft Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site

Draft Report for Comment

Main Report

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP). The proposed action requested in Southern's application is for the NRC to (1) approve a site within the existing Vogtle Electric Generating Plant (VEGP) boundaries as suitable for the construction and operation of a new nuclear power generating facility and (2) issue an ESP for the proposed location at the VEGP site, adjacent to the existing VEGP Units 1 and 2.

In its application, Southern proposes a plan for redressing the environmental effects of certain site-preparation and preconstruction activities (i.e., those activities allowed by Title 10 of the Code of Federal Regulations (CFR) 50.10(e)(1), performed by an ESP holder under 10 CFR 52.25). In accordance with the plan, the site would be redressed if the NRC issues the requested ESP (including the site redress plan), the ESP holder performs these site preparation and construction activities, the ESP is not referenced in an application for a construction permit or combined operating license, and no alternative use is found for the site.

This EIS includes the NRC staff's analysis that considers and weighs the environmental impacts of constructing and operating new units at the VEGP site or at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's preliminary recommendation to the Commission regarding the proposed action. The NRC staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued as proposed. The staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the staff's Safety Evaluation Report that is anticipated to be published in May 2008. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by Southern; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. In addition, in making its recommendation, the staff determined that there are no environmentally preferable or obviously superior sites. Finally, the staff has concluded that the site preparation and preconstruction activities allowed by 10 CFR 50.10(e)(1) requested by Southern in its application will not result in any significant adverse environmental impact that cannot be redressed.

Contents

Figures

Tables

Executive Summary

On August 14, 2006, the U.S. Nuclear Regulatory Commission (NRC) received an application from Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP) for a site within the Vogtle Electric Generating Plant (VEGP) site, adjacent to the existing VEGP Units 1 and 2. The site is located in Burke County, Georgia, approximately 42 km (26 mi) southeast of Augusta, Georgia. An ESP is a Commission approval of a location for siting one or more nuclear power facilities and is a separate action from the filing of an application for a construction permit (CP) or combined license (COL) for such a facility. An ESP is not a license to build a nuclear power plant; rather, the application for an ESP initiates a process undertaken to assess whether a proposed site is suitable should Southern decide to pursue a CP or COL.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321) directs that an environmental impact statement (EIS) be prepared for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. Subpart A of 10 CFR Part 52 contains the NRC regulations related to ESPs. As set forth in 10 CFR 52.18, the Commission has determined that an EIS would be prepared during the review of an application for an ESP. The purpose of Southern's requested action, issuance of the ESP, is for the NRC to determine whether the VEGP site is suitable for the proposed two new units (VEGP Units 3 and 4) by resolving certain safety and environmental issues before Southern incurs the substantial additional time and expense of designing and seeking approval to construct such a facility at the site. Part 52 of CFR Title 10 describes the ESP as a "partial construction permit." An applicant for a CP or COL for a nuclear power plant or plants to be located at the site for which an ESP was issued can reference the ESP, thus reducing the review of siting issues at that stage of the licensing process. However, granting a CP or COL to construct and operate a nuclear power plant is a major federal action and would require an EIS be issued in accordance with 10 CFR Part 51.

Three primary issues – site safety, environmental impacts, and emergency planning – must be addressed in the ESP application. In its review of the application, the NRC assesses Southern's proposal in relation to these issues and determines if the application meets the requirements of the Atomic Energy Act and the NRC regulations. This EIS addresses the potential environmental impacts resulting from the construction and operation of two new units at the VEGP site.

An ESP application may refer to a plant parameter envelope, which is a set of postulated design parameters that bound the characteristics of one or more reactor designs that might be built at a selected site; alternatively, an ESP application may refer to a detailed reactor design. In its ESP application, Southern has specified the Westinghouse AP1000 as the proposed detailed reactor design.

In its application, Southern requested authorization to perform certain site-preparation activities if an ESP is issued. The application, therefore, includes a site redress plan that specifies how

Southern would stabilize and restore the site to its preconstruction condition (or conditions consistent with an alternative use) in the event a nuclear power plant is not constructed on the approved site. Additionally, Southern addressed the benefits of the proposed action (e.g., the need for power). In accordance with 10 CFR 52.18, the EIS is focused on the environmental effects of construction and operation of a reactor, or reactors, that have characteristics that fall within the postulated site parameters.

Upon acceptance of the Southern application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent (71 FR 58882) to prepare an EIS and conduct scoping. The staff held a public scoping meeting in Waynesboro, Georgia, on October 19, 2006, and visited the VEGP site in October 2006. Subsequent to the scoping meeting and the site visit and in accordance with the provisions of NEPA and 10 CFR Part 51, the staff determined and evaluated the potential environmental impacts of constructing and operating new units at the VEGP site. Included in this EIS are (1) the results of the NRC staff's analyses, which consider and weigh the environmental effects of the proposed action (i.e., issuance of the ESP) and of constructing and operating two additional nuclear units at the ESP site; (2) mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the staff's recommendation regarding the proposed action.

During the course of preparing this EIS, the staff reviewed the application, including the Environmental Report (ER) submitted by Southern; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NRC review standard RS-002, *Processing Applications for Early Site Permits*, to conduct an independent review of the issues. The review standard draws from the previously published NUREG-0800, *Standard Review Plans for the Review of Safety Analysis for Nuclear Power Plants*, and NUREG-1555, *Environmental Standard Review Plan (ESRP)*. In addition, the staff considered the public comments related to the environmental review received during the scoping process. These comments are provided in Appendix D of this EIS.

Following the approach used in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance – SMALL, MODERATE, or LARGE – developed by NRC using guidelines from the Council on Environmental Quality. Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

> SMALL – Environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the draft EIS to allow members of the public to comment on the results of the NRC staff's review.

The staff plans to conduct a public meeting near the VEGP site to describe the results of the NRC environmental review, respond to questions, accept public comment, and provide members of the public with information to assist them in formulating comments on this EIS. After the comment period, the staff would consider and disposition all the comments received. These comments would be addressed in Appendix E of the final EIS.

The staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued as proposed. The staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the staff's Safety Evaluation Report anticipated to be published in May 2008.

This recommendation is based on (1) the application, including the ER submitted by Southern; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of public comments related to the environmental review that were received during the scoping process; and (5) the assessments summarized in the EIS, including the potential mitigation measures identified in the ER and this EIS. In addition, in making its recommendation to the Commission, the staff has determined that there are no environmentally preferable or obviously superior sites among the alternative sites considered. Finally, the staff has concluded that the site-preparation and preconstruction activities allowed by 10 CFR 50.10(e)(1) would not result in any significant adverse environmental impact that cannot be redressed.

Abbreviations/Acronyms

AADT	Average Annual Daily Traffic
ac	acre(s)
ac-ft	acre-feet
ADAMS	Agencywide Document Access and Management System
ADCNR	Alabama Department of Conservation and Natural Resources
ADEM	Alabama Department of Environmental Management
AEC	Atomic Energy Commission
ALNHP	Alabama Natural Heritage Program
ANSP	(The) Academy of Natural Sciences of Philadelphia
APE	Area of Potential Effect
AQCR	Air Quality Control Region
AQI	Air Quality Index
ASMFC	Atlantic States Marine Fisheries Commission
AWEA	American Wind Energy Association
BEIR	Biological Effects of Ionizing Radiation
BMP	best management practices
Bq	becquerel
Bq/yr	becquerel per year
BTS	Bureau of Transportation Statistics
BTU	British thermal unit(s)
BTU/hr	British thermal units per hour
BWR	boiling water reactor
°C	degree Celsius
CDC	U.S. Center for Disease Control and Prevention
CDF	core damage frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second (water flow)
Ci	curies
Ci/yr	curies per year
Ci/MTU	curies per metric ton uranium
cm	centimeter(s)
cm/s	centimeters per second
CO	carbon monoxide
CO_2	carbon dioxide
COL	combined license
CORMIX	Cornell Mixing Zone Expert System
CP	construction permit
CSSI	Coastal Sound Science Initiative
CWIS	cooling water intake structure

CWS	circulating water system
CSX	CSX Transportation, Inc.
d	day
dBA	decibel(s)
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
ECHD	East Central Health District
EIA	Energy Information Administration
EIS	environmental impact statement
ELF	extremely low frequency
EMC	Electric Membership Corporation
EMF	electromagnetic field(s)
EPA	U.S. Environmental Protection Agency
EPD	Environmental Protection Division
EPRI	Electric Power Research Institute
ER	Environmental Report
ESA	Endangered Species Act
ESP	early site permit
ESRP	Environmental Standard Review Plan
°F	degree Fahrenheit
FAA	Federal Aviation Administration
Farley	Joseph M Farley Nuclear Plant
FCAA	Federal Clean Air Act
FCWA	Federal Clean Water Act (also known as the Clean Water Act)
FERC	Federal Energy Regulatory Commission
FES	Final Environmental Statement
FR	*Federal Register*
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft/s	feet per second
ft^3/yr	cubic feet per year
FWS	U.S. Fish and Wildlife Service
gal	gallon(s)
gal/d/ft	gallon(s) per day per foot
gal/yr	gallon(s) per year
GBq	gigabecquarel
GDHR	Georgia Department of Human Resources
GDNR	Georgia Department of Natural Resources
GDOT	Georgia Department of Transportation
GEIS	generic environmental impact statement
GOPBP	Georgia Office of Planning and Budget Policy
GOSA	Governor's Office of Student Achievement
GPC	Georgia Power Company

gpd	gallons per day
gpm	gallons per minute
GPSC	Georgia Public Service Commission
GTC	Georgia Transmission Corporation
ha	hectare(s)
Hatch	Edwin I Hatch Nuclear Plant
HLW	high-level waste
hr	hour
hz	hertz
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiation Protection
IGCC	integrated gasification combined cycle
in.	inch(es)
in./s	inch(es) per second
Inc.	Incorporated
INEEL	Idaho National Engineering and Environmental Laboratory
IRP	Integrated Resource Plan
ISFSI	Independent Spent Fuel Storage Installation
ISWA	Integrated Waste Services Association
kg	kilogram(s)
kg/ac	kilogram(s) per acre
kg/ha/mo	kilogram(s) per hectare per month
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt
kVh	kilovolt hour
L	liter(s)
lb	pound(s)
LC50	Lethal Concentration 50 is the concentration of a chemical that kills 50% of the sample population
L/d	liter(s) per day
L/d/m	liter(s) per day per meter
L/s	liter(s) per second
lbs/ac/mo	pounds per acre per month
lbs/acre	pounds per acre
LLC	limited liability company
LPZ	low population zone
LWR	light-water reactor
m	meter(s)
m/s	meter(s) per second
m^2/s	square meter(s) per second
m^3/d	cubic meter(s) per day
m^3/s	cubic meter(s) per second
m^3/yr	cubic meter(s) per year

MBq	million Becquerel(s)
MCL	maximum concentration limit
MEAG	Municipal Electric Authority of Georgia
MEI	maximally exposed individual
mg/l	milligram(s) per liter
MGD	million gallons per day
mGy/yr	milligray per year
mi	mile(s)
mi^2	square mile(s)
MIT	Massachusetts Institute of Technology
mL	milliliter(s)
MOX	mixed oxide fuel
mph	miles per hour
mR	milliroentgen(s)
mrad	millirad(s)
mrem	millirem(s)
mrem/hr	millirem(s) per hour
mrem/yr	millirem(s) per year
MSL	mean sea level
mSv	millisievert(s)
mSv/yr	millisievert(s) per year
MT	metric ton(s) (or tonne[s])
MTBE	methyl tert-butyl ether
MTU	metric ton(s)-uranium
MTU/yr	metric ton(s)-uranium/per year
MW	megawatt(s)
MWd/MTU	megawatt-days per metric ton of uranium
MW(e)	megawatts electric
MWh	megawatt hour(s)
MW(t)	megawatts thermal
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NAS	National Academy of Sciences
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NCES	National Center for Education Statistics
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act of 1969
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act of 1966
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration

NOAA-CSC	National Oceanic and Atmospheric Administration's Coastal Service Center
NO_x	nitrogen oxide
NPCC	Northwest Power and Conservation Council
NPDES	National Pollutant Discharge Elimination System
NPF	Nuclear Power Facility
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRSAL	National Resource Spatial Analysis Laboratory
NSA	New South Associates
NSC	National Safety Council
NSPS	new source performance standards
OCGA	Official Code of Georgia
OECD	Organization for Economic Co-operation and Development
OPC	Oglethorpe Power Corporation
OSHA	Occupational Health and Safety Administration
PARS	Publicly Available Records System
pCi/L	picocuries per liter
PM	particulate matter
$PM_{2.5}$	particulate matter smaller than 2.5 micrometers
PM_{10}	particulate matter smaller than 10 micrometers
PNNL	Pacific Northwest National Laboratory
POR	period of record
PPE	plant parameter envelope
ppm	parts per million
PRA	probabilistic risk assessment
PSD	prevention significant deterioration
PWR	pressurized water reactor
RAI	Request(s) for Additional Information
RCRA	Resource Conservation and Recovery Act
RDC	Representative Delineated Corridor
REMP	radiological environmental monitoring program
rkm	River Kilometers
RM	River Mile
ROI	region of interest
RRCC	Robust Redhorse Conservation Committee
RSICC	Radiation Safety Information Computational Center
Ryr-1	per reactor year
SACTI	Seasonal and Annual Cooling Tower Impacts
SAMA	severe accident mitigation alternatives
SC DHEC	South Carolina Department of Health and Environmental Control
SC DNR	South Carolina Department of Natural Resources
SCE&G	South Carolina Electric and Gas
SCR	selective catalytic reduction
SDWIS	Safe Drinking Water Information System

SEARPDC	Southeast Alabama Regional Planning and Development Commission
SERC	South Eastern Reliability Council
SER	safety evaluation report
SHPO	State Historic Preservation Office/Officer
SO_2	sulfur dioxide
SO_x	sulfur oxide
Southern	Southern Nuclear Operating Company, Inc.
SPCC	Spill Prevention Control and Countermeasure Plan
SSAR	Site Safety Analysis Report
SSURGO	Soil Survey Geographic
Sv	sievert
Sv/yr	sievert per year
SWPPP	Stormwater Pollution Prevention Plan
SWS	service water system
TBq	terrebecquerel
TBq/MTU	terrebecquerel per metric ton(s)-uranium
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Offices/Officers
TLD	thermoluminescent dosimeter
tpy	tons per year
TRC	Third Rock Consultants, LLC
TRU	transuranic (waste)
UHS	ultimate heat sink
USACE	U.S. Army Corps of Engineers
USBEA	U.S. Bureau of Economic Analysis
USBLS	U.S. Bureau of Labor Statistics
USC	United States Code
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey
VEGP	Vogtle Electric Generating Plant
VOC	volatile organic compound
Westinghouse	Westinghouse Electric Company, LLC
WMA	Wildlife Management Area
WNA	World Nuclear Association
WSRC	Westinghouse Savannah River Company
χ/Q	dispersion values
yr	year(s)

1.0 Introduction

On August 14, 2006, the U.S. Nuclear Regulatory Commission (NRC) received an application from Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP) for a site within the Vogtle Electric Generating Plant (VEGP) site in Burke County, Georgia. The VEGP site and existing facilities are owned by Georgia Power Company, Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, and the city of Dalton, Georgia. Southern is the licensee and operator of the existing VEGP Units 1 and 2, and has been authorized by the VEGP co-owners to apply for an ESP for two additional units at the VEGP site.

Under the NRC regulations in Title 10 of the Code of Federal Regulations (CFR) Part 52, and in accordance with the applicable provisions of 10 CFR Part 51, which are the NRC regulations implementing the National Environmental Policy Act of 1969 (NEPA), the NRC is required to prepare an environmental impact statement (EIS) as part of its review of an ESP application. As required by 10 CFR 51.26, the NRC published in the *Federal Register* a Notice of Intent (71 FR 58882) to prepare an EIS, conduct scoping, and publish a draft EIS for public comment. The final EIS will be issued after considering public comments on the draft. A separate Safety Evaluation Report (SER) will also be prepared in accordance with 10 CFR Part 52.

1.1 Background

An ESP is a Commission approval of a site or sites for one or more nuclear power facilities. The filing of an application for an ESP is a process that is separate from the filing of an application for a construction permit (CP) or combined license (COL) for such a facility. The ESP application and review processes make it possible to evaluate and resolve safety and environmental issues related to siting before the applicant makes large commitments of resources. If the ESP is approved, then the applicant can "bank" the site for up to 20 years for future reactor siting. In addition, if the ESP includes a site redress plan, the ESP holder can conduct certain activities pursuant to 10 CFR 50.10(e)(1). An ESP does not authorize construction and operation of a nuclear power plant. To construct and operate a nuclear power plant, an ESP holder must obtain a CP and operating license or a COL, which is a separate major federal action and would require that an EIS be issued in accordance with 10 CFR Part 51.

As part of its evaluation of the environmental impacts of the action proposed in an ESP application, the NRC prepares an EIS in accordance with 10 CFR 52.18. Because site suitability encompasses construction and operational parameters, the EIS addresses impacts of both construction and operation of reactors and associated facilities. In a review separate from the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These latter two analyses are documented in an SER that presents the conclusions reached by the NRC regarding (1) whether there is reasonable assurance that two Westinghouse Electric Company, LLC (Westinghouse) AP1000 advanced light-water reactors can be constructed and operated at the VEGP site without undue risk to the health and safety of the public, (2) whether there are significant impediments to the development of emergency plans, and (3) whether site characteristics are such that adequate security plans and measures can be developed. In addition, if the applicant proposes major features of emergency plans or complete and integrated emergency plans, the SER would document whether such major features are acceptable or whether the complete and integrated emergency plans provide reasonable assurance that adequate protective measures can and would be taken in the event of a radiological emergency.

1.1.1 Site Preparation and Preliminary Construction Activities

The holder of an ESP or an applicant for a CP (10 CFR Part 50) or a COL (Subpart C of 10 CFR Part 52) that references an ESP with an approved site redress plan may, in accordance with 10 CFR 52.25(a), perform the site preparation and preliminary construction activities allowed by 10 CFR 50.10(e)(1), provided that the final ESP EIS concludes the activities would not result in any significant adverse environmental impacts which cannot be redressed. Southern provided a site redress plan as part of its ESP application (Southern 2007) to obtain authorization to conduct certain site preparation and preliminary construction activities. Activities permitted under an ESP with an approved site redress plan include preparation of the site for construction of the facility, installation of temporary construction support facilities, excavation for facility structures, construction of service facilities, and construction of certain structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents (10 CFR 50.10(e)(1)). Southern's site redress plan is discussed in more detail in Section 4.11 of this EIS.

1.1.2 ESP Application and Review

In accordance with 10 CFR 52.17(a)(2), Southern submitted an Environmental Report (ER) as part of its ESP application (Southern 2007). The ER focuses on the environmental effects of construction and operation of two Westinghouse AP1000 reactors. Southern's ER also includes an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed site (Southern 2007). An ESP ER is not required to include an assessment of energy alternatives or the benefits of the proposed action (e.g., the need for power). However, Southern did include a discussion on need for power and energy alternatives, and the analyses are evaluated in Chapters 8 and 9 of this EIS. Additionally, Southern elected to provide a discussion of benefits and costs of the proposed action in its application. Therefore, the staff also performed this analysis, which is provided in Chapter 11 of this EIS.

The NRC standards for review of an ESP application are outlined in 10 CFR 52.18. As does Southern in its ER (Southern 2007), this EIS focuses on the environmental effects of construction and operation of two Westinghouse AP1000 reactors, and includes an evaluation of alternative sites to determine whether there is any obviously superior alternative to the VEGP site.

The NRC staff conducts its reviews of ESP applications in accordance with guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004). The review standard draws from the previously published NUREG-0800, *Standard Review Plans for the Review of Safety Analysis for Nuclear Power Plants* (NRC 1987), and NUREG-1555, *Environmental Standard Review Plan (ESRP)* (NRC 2000). RS-002 provides guidance to NRC staff reviewers to help ensure a thorough, consistent, and disciplined review of any ESP application.

During the review of a CP or COL application referencing an ESP, the staff will assess the environmental impacts of the construction and operation of a specific plant design. If the environmental impacts addressed in the EIS written at the ESP stage are found to be bounding by the staff, no additional analysis of these impacts is required. However, environmental impacts not considered or not bounded at the ESP stage would be assessed at the CP or COL stage. In addition, measures and controls to limit adverse impacts should be identified and evaluated for feasibility and adequacy in limiting adverse impacts at the ESP stage, where possible, and at the CP or COL stage. As a result of the staff's environmental review of the ESP application, the staff may determine that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24. In this EIS, the staff has identified when and how assumptions and bounding values limit its conclusions on the environmental impacts to a particular resource.

Following requirements set forth in 10 CFR Part 51, on October 5, 2006, the NRC published a Notice of Intent in the *Federal Register* to prepare an EIS and conduct scoping (71 FR 58882). On October 19, 2006, the NRC environmental staff (and technical experts from the Pacific Northwest National Laboratory [PNNL] who were retained to assist the staff) held a scoping meeting to obtain public input on the scope of the environmental review. To gather information and to become familiar with the sites and their environs, the NRC and PNNL team visited the VEGP site in October 2006 and the alternative sites (Joseph M. Farley Nuclear Plant [Farley], Edwin I. Hatch Nuclear Plant [Hatch], and the Barton site [Barton]) in November 2006. During the VEGP site visit, the staff and its contractors met with Southern staff, public officials, and the public. The staff reviewed the comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A list of the organizations contacted is provided in Appendix B. Other documents related to the VEGP site were reviewed and are listed as references where appropriate.

To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts using Council on Environmental

Quality guidance (40 CFR 1508.27). Using this approach, the NRC established three significance levels – SMALL, MODERATE, or LARGE. The definitions of the three significance levels are as follows:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

This EIS presents the staff's analysis, which considers and weighs the environmental impacts of the proposed action at the VEGP site, including the environmental impacts associated with construction and operation of reactors at the site, the impacts of construction and operation of reactors at alternative sites, the environmental impacts of alternatives to granting the ESP, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's preliminary recommendation to the Commission regarding the issuance of the ESP for the VEGP site.

A 75-day comment period will begin on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the draft EIS to allow members of the public to comment on the results of the NRC staff's review. A public meeting will be held near the site during the public comment period. During this public meeting, the staff will describe the results of the NRC environmental review, respond to questions related to the review, and provide members of the public with information to assist them in formulating their comments.

1.2 The Proposed Federal Action

The proposed Federal action is issuance, under the provisions of 10 CFR Part 52, of an ESP for the VEGP site for two new Westinghouse AP1000 reactors. In addition, Southern proposes a plan for redressing the environmental effects of certain site preparation and preliminary construction activities (i.e., those activities allowed by 10 CFR 50.10(e)(1)) performed by an ESP holder under 10 CFR 52.25. In accordance with the redress plan, the site would be redressed if (1) the NRC issues the requested ESP (containing the site redress plan), (2) the ESP holder performs these site-preparation and preliminary construction activities, (3) the ESP is not referenced in an application for a CP or COL, and (4) no alternative use is found for the site. While the applicant is not currently proposing construction and operation of a new unit, this EIS analyzes the environmental impacts that could result from the construction and operation of new units at the VEGP site or at one of the three alternative sites. These impacts are analyzed to determine if the proposed ESP site is suitable for the addition of the new units and whether any of the alternative sites is considered obviously superior to the proposed site.

The site proposed by Southern is located in Burke County, Georgia, approximately 42 km (26 mi) southeast of Augusta, Georgia. The site is completely within the confines of the current VEGP site, with the proposed new Units 3 and 4 to be adjacent to the existing Units 1 and 2.

In this EIS, the proposed site is evaluated for construction and operation of two Westinghouse AP1000 reactors, with a total combined thermal power rating of 6800 MW(t). The new units would use a closed-cycle cooling system and require a single natural draft cooling tower for each unit.

1.3 The Purpose and Need for the Proposed Action

The purpose and need for the proposed action (i.e., issuance of an ESP) is to provide stability in the licensing process by addressing safety and environmental issues before plants are built rather than after construction is completed. This process allows for early resolution of many safety and environmental issues that may be identified for the ESP site. In the absence of an ESP, safety and environmental reviews of applications for CPs and operating licenses under 10 CFR Part 50 continue during plant construction. Alternatively, all safety and environmental issues would have to be addressed at the time of the staff's review of a COL submitted under 10 CFR Part 52 if no ESP for the site were referenced. Although actual construction and operation of the facility would not take place until a COL is granted, certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COL is granted. As a result, without the ESP review process, there could be a considerable expenditure of funds, commitment of resources, and passage of time before site safety and environmental issues are finally resolved.

1.4 Alternatives to the Proposed Action

Section 102(2)(C)(iii) of NEPA states that EISs are to include a detailed statement on alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including in an EIS a chapter that discusses the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). Chapter 9 of this EIS discusses the environmental impacts of four categories of alternatives: (1) the no-action alternative, (2) energy source alternatives, (3) system design alternatives, and (4) site alternatives. The Commission determined that evaluation of energy alternatives is not required for an ESP. However, Southern included a discussion of energy alternatives in its ER; therefore, the staff conducted an evaluation of energy alternatives.

The three alternative sites that are considered are all owned by Southern. Plant Hatch is located in Georgia, and Plant Farley and the Barton site (a greenfield site) are located in Alabama. Plant Hatch and Plant Farley both currently have operating nuclear reactors. The environmental analysis of the alternative sites was performed using reconnaissance-level information. Chapter 9 also includes sections discussing (1) Southern's region of interest for identification of alternative plant sites, (2) the methodology used by Southern to select alternative sites and the proposed VEGP site, and (3) generic environmental issues consistent among alternative sites. Chapter 10 compares the environmental impacts at the VEGP site to the alternative sites and to the no-action alternative and qualitatively determines whether there is an obviously superior alternative site to the proposed site.

1.5 Compliance and Consultations

Prior to construction and operation of new units, Southern is required to hold certain Federal, State, and local environmental permits, as well as meet applicable Federal and State statutory requirements. Southern (2007) provided a list of environmental approvals and consultations associated with the VEGP ESP. Because an ESP is limited to establishing the acceptability of the proposed site for future development, the authorizations Southern will need from Federal, State, and local authorities for construction and operation are not yet required; therefore, they have not been obtained. However, Southern will need to obtain the necessary authorizations to conduct the site-preparation activities specified in the site redress plan. Potential authorizations and consultations relevant to the proposed ESP are included in Appendix I. The information provided in Appendix I is based on guidance in NUREG-1555, *Environmental Standard Review Plan (ESRP)* (NRC 2000).

The staff reviewed the list and has contacted the appropriate Federal, State, Tribal, and local agencies to identify any compliance, permit, or significant environmental issues of concern to the reviewing agencies that may impact the suitability of the VEGP site for the construction and operation of the proposed two Westinghouse AP1000 reactors.

1.6 Report Contents

The subsequent chapters of this EIS are organized as follows. Chapter 2 describes the proposed site and discusses the environment that would be affected by the addition of the new units. Chapter 3 examines the power plant characteristics to be used as the basis for evaluating the environmental impacts. The evaluations described in Chapter 3 are based on the characteristics of the Westinghouse AP1000 reactor as well as site characteristics for which information is currently available. Chapters 4 and 5 examine site suitability by analyzing the environmental impacts of construction (Chapter 4) and operation (Chapter 5) of the proposed VEGP Units 3 and 4. Chapter 6 analyzes the environmental impacts of the uranium fuel cycle, transportation of radioactive materials, and decommissioning, while Chapter 7 discusses the cumulative impacts of the proposed action as defined in 40 CFR Part 1508. Chapter 8 addresses the need for power. Chapter 9 discusses alternatives to the proposed action and analyzes alternative sites, systems, and energy sources. Chapter 10 compares the proposed action with the alternatives, and Chapter 11 summarizes the findings of the preceding chapters and presents the staff's preliminary recommendation with respect to (1) the Commission's approval of the proposed site for an ESP based on the staff's evaluation of environmental impacts and (2) the conclusions regarding the site redress plan.

The appendices provide the following additional information.

- Appendix A – Contributors to the Environmental Impact Statement

- Appendix B – Organizations Contacted

- Appendix C – Chronology of NRC Staff Environmental Review Correspondence Related to Southern Nuclear Operating Company Inc., Application for Early Site Permit at the VEGP Site

- Appendix D – Scoping Meeting Comments and Responses

- Appendix E – Draft Environmental Impact Statement Comments and Responses (Reserved)

- Appendix F – Key Early Site Permit Consultation Correspondence Regarding the VEGP Early Site Permit

- Appendix G – Supporting Documentation on Radiological Dose Assessment

- Appendix H – Authorizations and Consultations

- Appendix I – VEGP Site Characteristics, AP1000 Design Parameters and Site Interface Values

- Appendix J – Statements Made in the Environmental Report Considered in the NRC Staff's Environmental Review.

1.7 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy,* Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy,* Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

71 FR 58882. October 5, 2006. "Southern Nuclear Operating Company, Inc., Vogtle ESP Site; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register.*

National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

Southern Nuclear Operating Company, Inc. (Southern). 2007. *Southern Nuclear Operating Company, Vogtle Early Site Permit Application: Environmental Report, Rev. 2.* Southern Company, Birmingham, Alabama.

U.S. Nuclear Regulatory Commission (NRC). 1987. *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants.* NUREG-0800, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Environmental Standard Review Plan (ESRP) for Environmental Reviews for Nuclear Power plants, Main Report.* NUREG-1555, Vol. 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2004. *Processing Applications for Early Site Permits.* RS-002, Washington, D.C.

2.0 Affected Environment

The site proposed by Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP) is located in Burke County, Georgia, within the existing boundaries of the current Vogtle Electric Generating Plant (VEGP). The VEGP property is owned by Georgia Power Company (GPC), Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, and the city of Dalton (Dalton Utilities). The site is located on the shores of the Savannah River approximately 24 km (15 mi) east-northeast of Waynesboro, Georgia, and 42 km (26 mi) southeast of Augusta, Georgia. Two operating nuclear generating units (Units 1 and 2) are currently located on the VEGP site. The station location is described in Section 2.1, with the land, meteorology and air quality, geology, radiological environment, water, ecology, socioeconomics, historic and cultural resources, and environmental justice of the site presented in Sections 2.2 through 2.10, respectively. Section 2.11 examines related Federal projects, and references are presented in Section 2.12.

2.1 Site Location

Southern's proposed location for the proposed VEGP Units 3 and 4 are within the VEGP site (see Figure 2-1). The center line of the proposed VEGP Units 3 and 4 would be located approximately 640 m (2100 ft) west and 120 m (400 ft) south of the center of Unit 2 containment building. Unit 4 would be located approximately 240 m (800 ft) west of Unit 3.

The VEGP site is located in rural Burke County. The nearest population center that has more than 25,000 residents is Augusta. Figure 2-2 shows the location of VEGP in relationship to the counties and important cities and towns within an 80-km (50-mi) radius of the site. The VEGP site is generally bounded by River Road, Hancock Landing Road, and the Savannah River. Access to the site is from River Road. Barge access is available from the Savannah River, and a railroad spur runs to the site from the Norfolk Southern Savannah-to-Augusta track. The community of Girard is located approximately 13 km (8 mi) to the south. Rhodes Air Ranch, a privately owned airstrip, is located north of the VEGP site. The VEGP site occupies approximately 1282.5 ha (3169 ac) of land, and it is located directly across the Savannah River from the U.S. Department of Energy's (DOE's) Savannah River Site (Southern 2007a).

2.2 Land

This section discusses land-related issues for the VEGP site. Section 2.2.1 describes the site and the vicinity around the site. Section 2.2.2 discusses the existing and proposed transmission line rights-of-way. Section 2.2.3 discusses the region, defined as the area within 80 km (50 mi) of the VEGP site boundary.

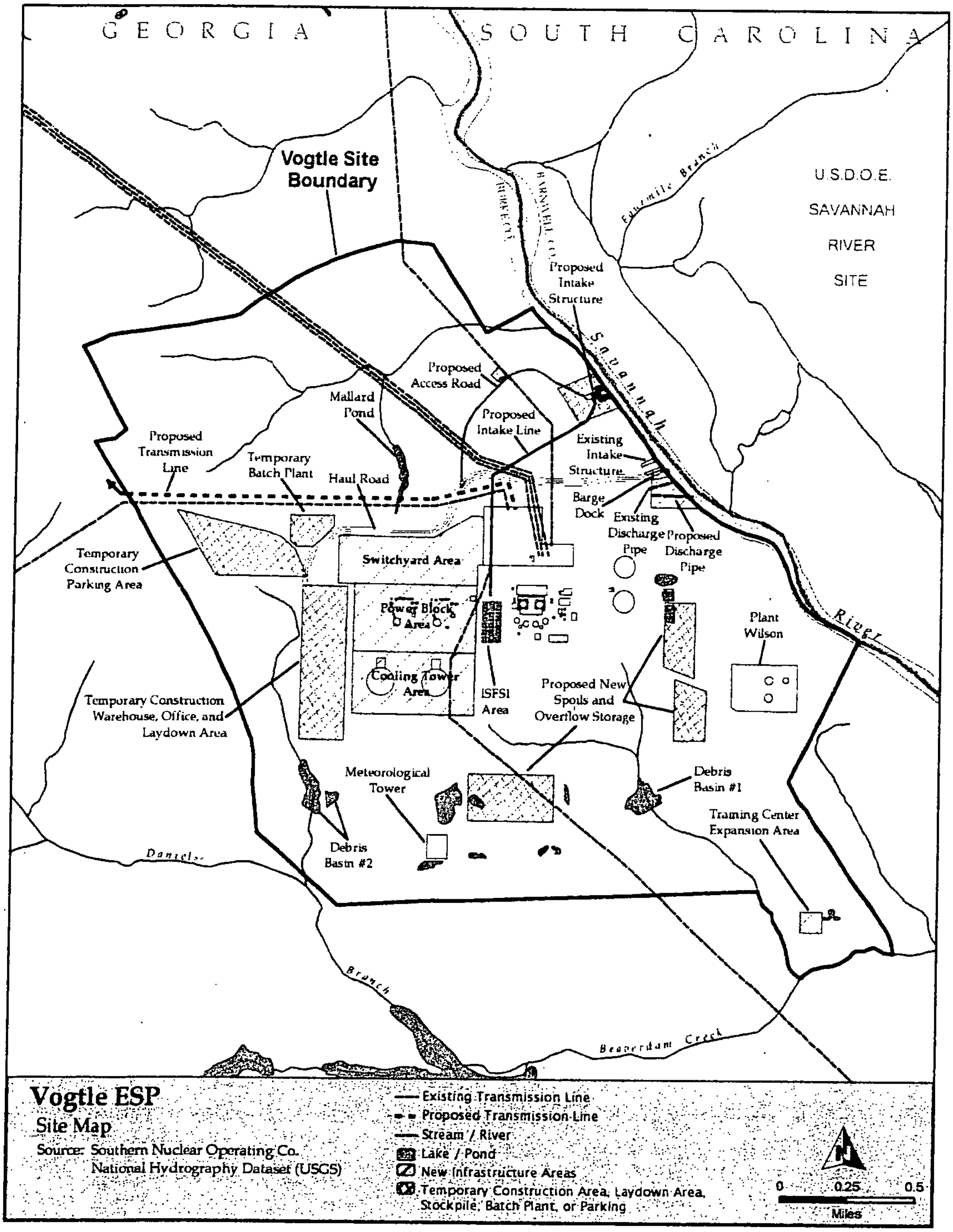
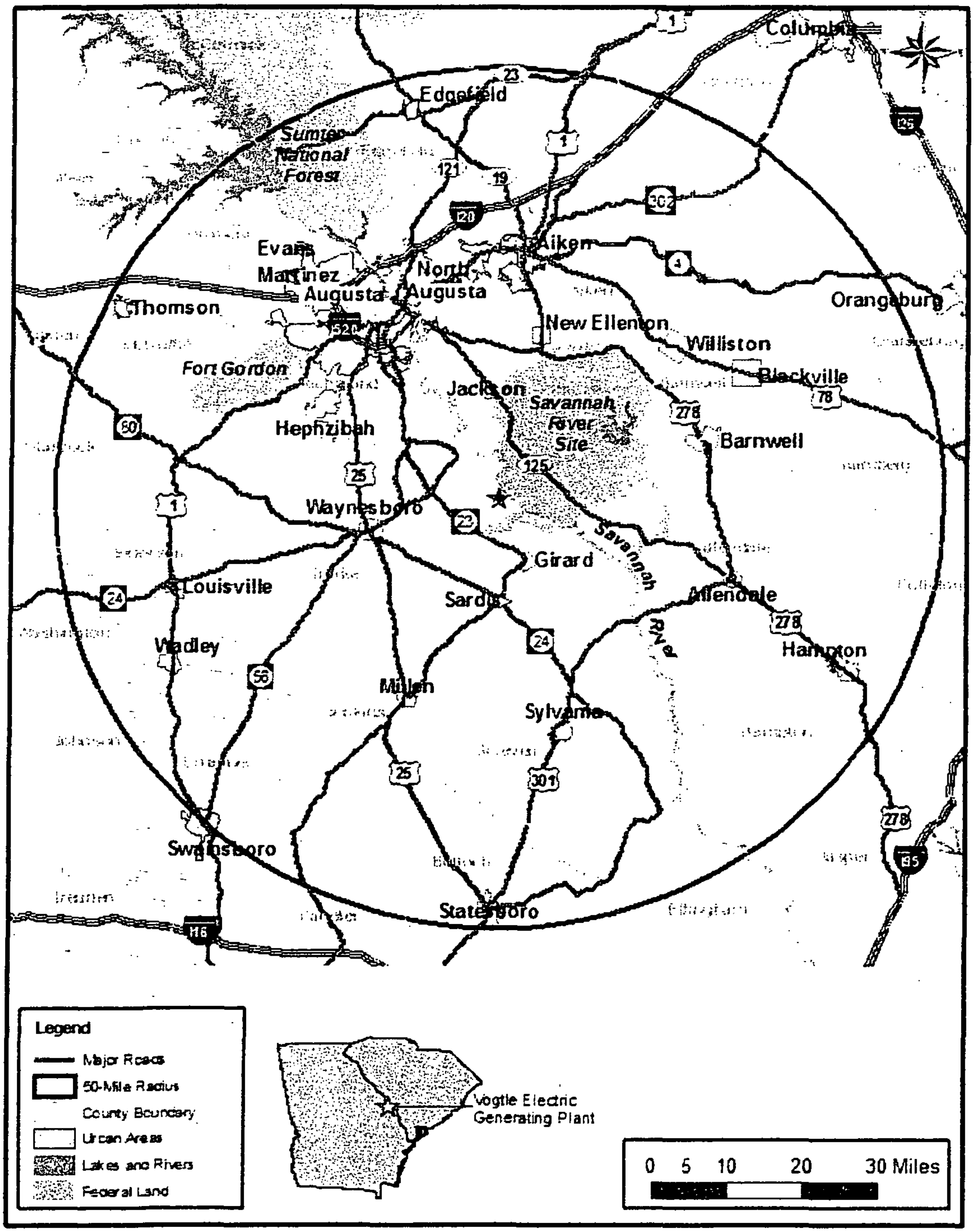


Figure 2-1. Proposed VEGP Site Footprint (Southern 2007b, 2007c)



1 **Figure 2-2**. The VEGP Site and the 80-Km (50-Mi) Vicinity (Southern 2007a)

2.2.1 The Site and Vicinity

The VEGP site comprises 1282.5 ha (3169 ac) in an unincorporated area of Burke County, Georgia. The VEGP site, including the planned footprint for the proposed VEGP Units 3 and 4, is shown in Figure 2-1.

The VEGP site contains two existing nuclear generating units, VEGP Units 1 and 2, which are licensed by the U.S. Nuclear Regulatory Commission (NRC) and have a combined net electric generating capacity of 2297 MW(e). Unit 1 began commercial operation in March 1987, and Unit 2 began commercial operation in March 1989. The oil-fired Plant Wilson is also located on the VEGP site. Plant Wilson is a 354-MW(e) peaking power generating facility owned by GPC (Southern 2007a). Together, the two existing nuclear units, Plant Wilson, auxiliary facilities such as the training center, and transmission line rights-of-way occupy approximately 320 ha (800 ac) of the VEGP site. The remaining VEGP site includes approximately 661.3 ha (1634 ac) of pine forest, 247.7 ha (612 ac) of hardwood forest, and 38.8 ha (96 ac) of open areas including mowed grass (Southern 2007a). Four small ponds and three small unnamed streams are located on the VEGP site (Figure 2-1).

The VEGP site boundary is located on a bluff adjacent to the southwest bank of the Savannah River. The centerline of proposed VEGP Units 3 and 4 would be approximately 640 m (2100 ft) west and 120 m (400 ft) south of the center of the existing Unit 2 containment building. The Unit 4 containment building would be approximately 244 m (800 ft) west of the Unit 3 containment building (Southern 2007a).

The 803-km^2 (310-mi^2) Savannah River Site is located immediately across the Savannah River from the VEGP site. The Savannah River Site has restricted access that is controlled by the DOE and its contractors. The VEGP site is approximately 24 km (15 mi) east-northeast of Waynesboro, the county seat of Burke County, and 42 km (26 mi) southeast of Augusta, Georgia. Features within a 10-km (6-mi) radius of the VEGP site are shown in Figure 2-3.

Most of the VEGP site is separated from the Savannah River floodplain by steep bluffs. The Savannah River is not a wild and scenic river as that term is defined at Title 36 of the Code of Federal Regulations (CFR) 297.3.

Access to the VEGP site is from River Road to the east of the site on a spur road owned by the VEGP site owners (see Figure 2-3). A railroad spur runs to the VEGP site from the Norfolk Southern Savannah-to-Augusta track. No natural gas pipelines traverse the VEGP site.

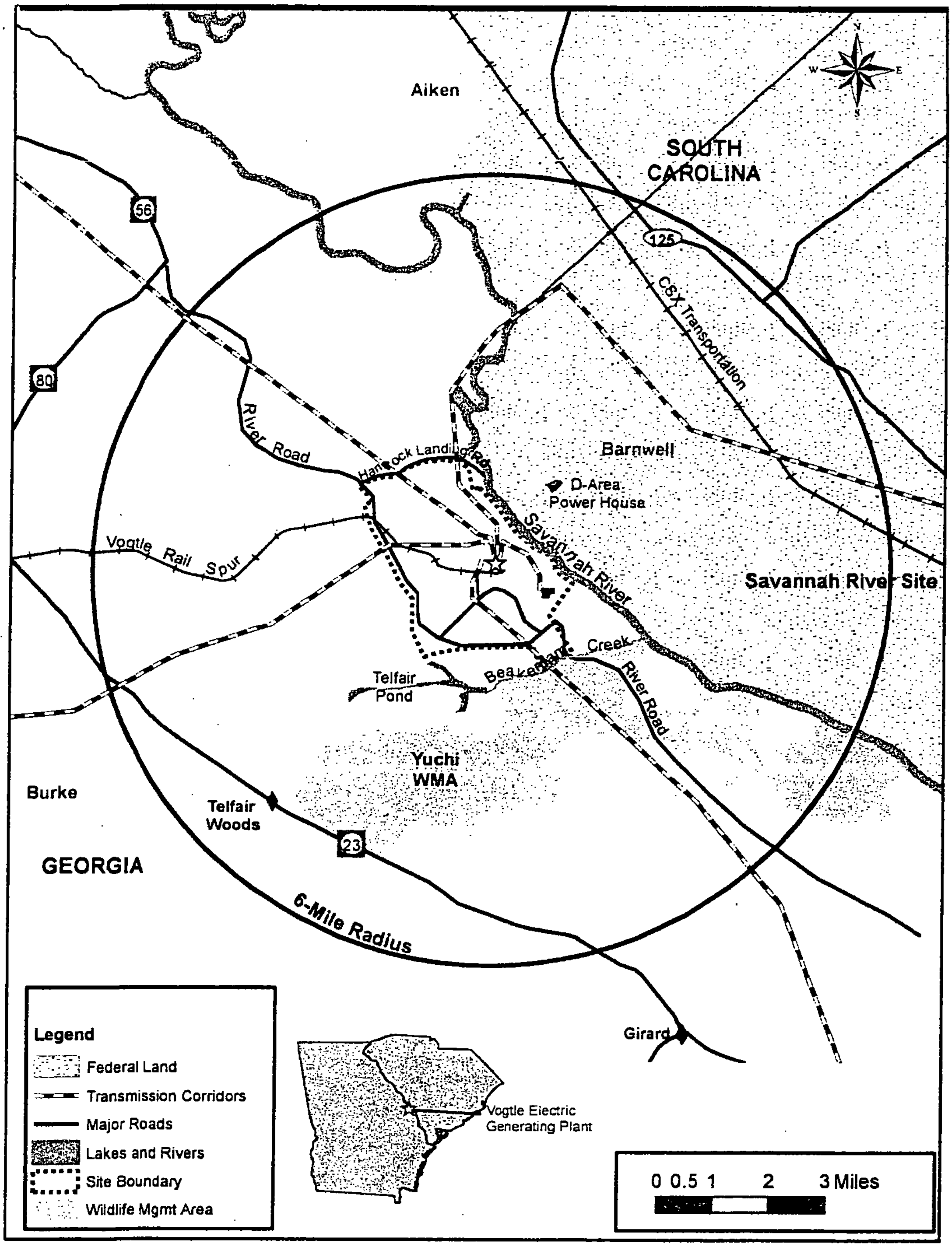


Figure 2-3. The VEGP Site and 10-Km (6-Mi) Vicinity (Southern 2007a)

Currently, no zoning applies to the VEGP site. The GPC maintains a land management plan for the VEGP site. None of the site constitutes prime farmland as that term is defined by the U.S. Department of Agriculture Natural Resources Conservation Service at 7 CFR 657.5(a). No mineral deposits or mines occur in Burke County (Southern 2007a).

The topography in the vicinity of the VEGP site consists of low rolling hills with elevations ranging from 24 m (80 ft) to 85 m (280 ft) above mean sea level (MSL). The vicinity of the VEGP site on the Georgia side of the Savannah River is primarily rural undeveloped land with a few homes and small farms. The 3160-ha (7800-ac) Yuchi Wildlife Management Area (WMA) managed by the Georgia Department of Natural Resources (GDNR) is south of the VEGP site (see Figure 2-3). The GPC provides access to the Savannah River at a boat landing immediately downstream of the VEGP site.

Approximately 46 percent of the land in Burke County is agricultural, 43 percent is forest, and 9 percent are wetlands (Southern 2007a). Burke County is not within the portion of Georgia covered by the Coastal Zone Management Act (GDNR 2003).

2.2.2 Transmission Line Rights-of-Way

The existing transmission system supporting VEGP Units 1 and 2 has two 500-kV lines and four 230-kV transmission lines in four rights-of-way (Southern 2007a). An additional 230-kV transmission line to Plant Wilson can provide offsite power to the VEGP site in case of emergency. The existing transmission system in the vicinity of the VEGP site is shown in Figure 2-3.

The Scherer 500-kV transmission line right-of-way generally runs west from the VEGP site to Plant Scherer, north of Macon, Georgia. The Scherer transmission line right-of-way is approximately 248 km (154 mi) long and 46 m (150 ft) wide in most areas, although it is up to 120 m (400 ft) wide in some locations. The Thalmann 500-kV transmission line right-of-way generally runs to the south of the VEGP site to the West McIntosh substation north of Savannah, Georgia. The Thalmann right-of-way is approximately 256 km (159 mi) long and 46 m (150 ft) wide. The South Augusta right-of-way contains three 230-kV transmission lines. The right-of-way runs north from the VEGP site to the Goshen and Augusta Newsprint substations. Two lines run approximately 31 km (19 mi) to the Goshen substation in a 83.8-m (275-ft)-wide right-of-way. A third line runs to 27 km (17 mi) in the South Augusta right-of-way and then branches off for approximately 5 km (3 mi) to the Augusta Newsprint substation in a 30- to 38.1-m (100- to 125-ft)-wide right-of-way. The South Carolina Electric and Gas (SCE&G) right-of-way contains a 230-kV transmission line. The right-of-way runs north and east for 7.2 km (4.5 mi), crosses the Savannah River, and then runs an additional 27 km (17 mi) to a substation operated by SCE&G on the DOE Savannah River Site. The portion of the right-of-way in Georgia is 38.1 m (125 ft) wide; the portion in South Carolina is 30 m (100 ft) wide.

2.2.3 The Region

The region surrounding the VEGP site is shown in Figures 2-2 and 2-3. Waynesboro, the County Seat of Burke County, and the Burke County communities of Girard and Sardis are shown in Figure 2-2. The principal highways, parks, wildlife refuges, national forests, and military installations in proximity to the VEGP site also are shown in Figures 2-2 and 2-3. There are no tribal lands for Federally recognized Indian Tribal entities within the region.

All or portions of 16 counties in Georgia and 12 counties in South Carolina are within 80 km (50 mi) of the VEGP site. Seventy-nine percent of employees currently working at the VEGP site reside in Burke, Columbia, and Richmond Counties in Georgia. Land use within these three counties is shown in Table 2-1.

Table 2-1. Land Use in Burke, Columbia, and Richmond Counties, Georgia

Land Uses	Burke County, 1990	Columbia County, 2000	Richmond County, 2003
Residential	10,440 ha (25,800 ac)	17,480 ha (43,200 ac)	21,970 ha (54,300 ac)
Commercial	296 ha (731 ac)	979 ha (2420 ac)	2335 ha (5770 ac)
Industrial	81 ha (201 ac)	894 ha (2210 ac)	3800 ha (9400 ac)
Transportation/ Communication/ Utilities	No data	3104 ha (7670 ac)	4820 ha (11,900 ac)
Public/Institutional	3743 ha (9250 ac)	1748 ha (4320 ac)	21,410 ha (52,900 ac)
Parks/Open Space/ Conservation	No data	4170 ha (10,300 ac)	2390 ha (5900 ac)
Agriculture/Forestry/ Undeveloped	178,000 ha (440,000 ac) (includes open space)	51,400 ha (127,000 ac)	28,300 ha (70,000 ac)

Source: Southern 2007a

2.3 Meteorology and Air Quality

The following three subsections describe the climate and air quality of the VEGP site. Section 2.3.1 describes the climate of the region and area in the immediate vicinity of the VEGP site, Section 2.3.2. describes the air quality of the region, and Section 2.3.3 describes the meteorological monitoring program at the site.

2.3.1 Climate

Climatological information was obtained from the Augusta, Georgia (Bush Field), first-order National Weather Service station (NCDC 2006), which is approximately 32 km (20 mi) northwest of the VEGP site. In addition, climatological data from the nearby Savannah River Site was obtained (Hunter 2004). The Savannah River Site maintains a comprehensive meteorological observation network, and their primary observation station, called the Central Climatology site, is 13 km (8 mi) northeast of the VEGP site. Both the Augusta National Weather Service and Savannah River Site stations can be used to characterize the climate at the ESP site and surrounding region because of their comparable elevation, location within the Savannah River Valley, and long period of record.

The climate in and around the VEGP site is classified as subtropical, with long, warm, humid summers and relatively short, mild winters. Summer-like conditions generally begin in early May and continue through mid-September. During this period, the Bermuda high builds in the western Atlantic and anticyclonic (clockwise) winds transport warm, moist air into the region. Thunderstorm activity peaks in July, with a monthly average of 12 thunderstorms (NCDC 2006). Mean daily temperatures also peak in July, with a mean maximum temperature of 33.3°C (92.0°F) and a mean minimum temperature of 20.9°C (69.6°F) (NCDC 2006). The winter months of December through February are characterized by frequent periods of cooling and warming from mid-latitude, low-pressure systems and associated fronts passing through the area. Extremely cold temperatures are rare, because the Appalachian Mountains to the north and northwest generally block arctic air masses from the region. January is the coldest month of the year, with a mean daily maximum and minimum temperature of 13.6°C (56.5°F) and 0.6°C (33.1°F), respectively (NCDC 2006). Both spring and autumn tend to be short, transitional seasons. Spring is normally the windiest season, with the highest monthly mean wind speed of 3.3 m/s (7.4 mph) occurring in March. Autumn is the driest season, with a minimum monthly mean precipitation amount of 1.06 cm (2.68 in.) at Augusta (NCDC 2006) and 2.90 cm (1.14 in.) at Savannah River Site during November (Hunter 2004).

2.3.1.1 Wind

Regionally, predominant wind direction patterns exist that can be characterized by season. From late spring through early fall, the wind has a southerly component and reflects the flow associated with the Bermuda high in the Western Atlantic. Wind speeds tend to be lighter during this time, with mean speeds ranging between 2.2 to 2.7 m/s (5.0 to 6.0 mph). Through much of autumn, the prevailing wind direction is from the northeast. Then, from late fall through the early spring, winds become more westerly, as low-pressure storm systems approach the area from the west. Mean wind speeds are generally highest during this time and average around 3.1 m/s (7.0 mph) (NCDC 2006).

Based on onsite meteorological data collected from 1998 through 2002 at VEGP, the prevailing winds are from the west-southwest at both the 10- and 60-m (33- and 197-ft) levels. A secondary maximum occurs from the northeast. On a seasonal basis, the prevailing winds are from the southwest at both levels in the spring and summer. During winter, the prevailing winds are from the west-southwest; during autumn, the winds are from the northeast at both levels (Southern 2007a). This annual and seasonal wind pattern is consistent with nearby Augusta and Savannah River Site observation stations in the Savannah River Valley.

The mean annual wind speeds at the VEGP site are 2.5 m/s (5.6 mph) and 4.6 m/s (10.3 mph) at the lower- and upper-tower levels, respectively (Southern 2007a). The mean wind speed varies seasonally. At the 10-m (33-ft) level, maximum average winds of 2.8 m/s (6.3 mph) occur in the spring; minimum average winds of 2.3 m/s (5.1 mph) occur in autumn. At the 60-m (197-ft) level, maximum average winds of 5.0 m/s (11.2 mph) occur during both winter and spring; minimum average wind speeds of 4.1 m/s (9.2 mph) are observed during the summer. The annual frequency of calm winds are 0.35 and 0.05 percent for the lower and upper levels, respectively (Southern 2007a). These trends are consistent with other stations in the region.

Wind persistence is defined as a continuous flow from a given direction or range of directions. This is determined by grouping continuous hourly wind direction readings into one of sixteen 22.5-degree cardinal range directions, centered on north and continuing clockwise through a complete circle through north-northwest. The longest wind persistence event at the 10-m (33-ft) level is 24 hours from the northeast. At the 60-m (197-ft) level, the longest wind persistence event is 36 hours and is also from the northeast direction (Southern 2007a).

2.3.1.2 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between two heights. A seven-category atmospheric stability classification scheme based on temperature differences is set forth in Safety Guide 23 (AEC 1972). Categories are defined using letter designations A through G, which represent a range of atmospheric stabilities. When the temperature decreases rapidly with height, the atmosphere is unstable and atmospheric dispersion is greater. Unstable conditions are designated by categories A, B, and C, representing extreme, moderate, and slight instability, respectively. Conversely, when temperature increases with height, the atmosphere is stable and dispersion is more limited. Stable conditions are designated by categories E, F, and G, representing slight, moderate, and extreme stability, respectively. Neutral atmospheric conditions exist between slightly stable and slightly unstable conditions and is designated by category D.

Five years (1998 to 2002) of temperature difference measurements made between the 60- and 10-m (197- and 33-ft) VEGP onsite meteorological tower levels indicate that unstable categories A, B, and C occur 6.48 percent, 4.54 percent, and 7.34 percent of the time, respectively. Stable categories E, F, and G occur 28.99 percent, 13.97 percent, and 11.17 percent of the time, respectively. Neutral conditions (category D) occur 27.50 percent of the time (Southern 2007a). Seasonally, spring and summer tend to have more extremely unstable conditions because of increased solar heating occurring at the surface. Autumn and winter months exhibit more extremely stable conditions because of reduced solar heating resulting in greater radiational cooling at the surface.

2.3.1.3 Temperature

Temperature measurements made at the 10-m (33-ft) level of VEGP's onsite meteorological tower are considered to be representative of the VEGP site. The average temperature at this level for the 5-year period from 1998 through 2002 is 18.1°C (64.6°F). This value is consistent with the average temperature of 17.9°C (64.2°F) measured at the Savannah River Site (Hunter 2004) for the same period and is 0.8°C (1.5°F) higher than the longer, 30-year average measured at Augusta, Georgia (NCDC 2006). The maximum and minium temperature at the VEGP's onsite tower during the same 5-year period was 39.8°C (103.6°F) and -8.6°C (16.6°F), respectively. These temperature extremes are consistent with the range of temperatures observed at Augusta and the Savannah River Site.

2.3.1.4 Atmospheric Moisture

The moisture content of the atmosphere can be represented in a variety of ways; however, the most common are relative humidity, precipitation, and fog.

Annual precipitation amounts average around 113.23 cm (44.58 in.) at Augusta. On average, March is the wettest month, with a monthly average of 11.71 cm (4.61 in.). A secondary precipitation maximum occurs during August, with an average of 11.38 cm (4.48 in.); this maximum is the result of higher thunderstorm activity and tropical storm remnants. November is the driest month, with an average of 6.81 cm (2.68 in.) (NCDC 2006). At the Savannah River Site, the annual average precipitation amount is higher at 125.7 cm (49.5 in.) (Hunter 2004). However, similar monthly and seasonal precipitation trends exist.

The 5-year period (1998 through 2002) used in the analysis provided in the Environmental Report (ER) was an abnormally dry period in the southeast (Southern 2007a). At Augusta, Georgia, the annual average precipitation amount during this 5-year period was 99.95 cm (39.35 in) or 13.28 cm (5.23 in.) less than normal (NCDC 1999, 2000, 2001, 2002, 2003). The Savannah River Site, had an annual average of 107.85 cm (42.46 in.), which is 17.88 cm (7.04 in.) less than the normal 30-year average measured at the Savannah River Site.

Relative humidity is not measured at the VEGP site. However, relative humidity is measured at both Augusta and the Savannah River Site, and these stations are representative of the regional climate. Measurements from these stations show that relative humidity varies diurnally, with a maximum occurring during the early morning hours and a minimum occurring during the early afternoon. In Augusta, morning mean relative humidity ranges from 84 percent in January and February to 92 percent in August; afternoon mean relative humidity ranges from 45 percent in April to 56 percent in August (NCDC 2006). Similar diurnal trends in relative humidity occur at the Savannah River Site. Relative humidity also varies on a seasonal basis. The springtime months of March and April have the lowest average relative humidity of 66 percent; the mid-to-late summertime months of August and September have the highest average relative humidity of 77 percent (NCDC 2006). Overall, the annual average relative humidity is 72 percent (NCDC 2006) at Augusta and 69 percent at the Savannah River Site (Hunter 2004). On about 36 days per year, the air becomes saturated and fog forms, which limits visibility to less than 0.40 km (0.25 mi) (NCDC 2006).

The dew point temperature, which is related to relative humidity, is measured at the 10-m (33-ft) level on the VEGP onsite meteorological tower. The dew point temperature is the temperature at which air becomes saturated when it is cooled. When the ambient temperature and dew point temperature are equal, the relative humidity is 100 percent. The dew point depression, which is the difference between the ambient temperature and dew point temperature, can be used in the design of wet cooling systems and to predict the occurrence of fog. Staff analyzed VEGP onsite meteorological data at the 10-m (33-ft) level for the period of 1998 through 2002 to determine frequency of occurrence when the dew point depression was 5.0°C (9.0°F) or less. Over the 5-year period, a dew point depression of 5.0°C (9.0°F) or less occurred 39 percent of the time. September had the highest frequency of occurrence (51 percent), and May had the lowest (23 percent). These trends are consistent with the seasonal trends for relative humidity, as noted previously.

2.3.1.5 Severe Weather

The VEGP site can experience severe weather in the form of thunderstorms, hail, and tornadoes. On average, thunderstorms occur 52 days per year, with approximately 30 of those occurring during the summer months of June through August (NCDC 2006). In contrast, the months of October through January average one thunderstorm per month (NCDC 2006). Hail can sometimes accompany thunderstorms. Over the 10-year period spanning 1996 through 2005, 21 separate hail events with a diameter of 1.9 cm (0.75 in.) or greater were reported in Burke County (NCDC 2007).

From 1950 through 2005, 7 tornadoes were reported in Burke County (NCDC 2007), including one magnitude F3 tornado (i.e., wind speed between 70.6 and 92.1 m/s [158 and 206 mph]). Using tornado data for the period from January 1, 1950, through August 31, 2003, the best estimate tornado strike probability for a 1-degree box that includes VEGP is 3.76 x 10-4 (Ramsdell 2005).

Snowfall events are infrequent in the Savannah River Valley. Annually, the region receives an average of 3.6 cm (1.4 in.) of snowfall each year. Days with snowfall in excess of 2.54 cm (1.0 in.) are rare. However, a 35.6-cm (14.0-in.) snowfall event did occur in February 1973 (NCDC 2006).

Burke County is sufficiently far inland that tropical cyclones are often less than hurricane strength by the time they are in the vicinity of the VEGP site. The National Oceanic and Atmospheric Administration's Coastal Service Center (NOAA-CSC) maintains a database of tropical cyclone tracks and intensities that covers the period from 1851 through 2005. Hurricane Gracie, which moved through the region on September 29, 1959, is the strongest hurricane to pass within an 80-km (50-mi) radius of the site. Gracie was a Category 3 hurricane, with maximum sustained surface 10-m (33-ft) winds of 49.6 m/s (111.0 mph) to 58.1 m/s (130.0 mph), inclusive (NOAA-CSC 2007). In addition to Gracie, four other Category 3 hurricanes have passed within a 160-km (100-mi) radius of the site since 1851 (NOAA-CSC 2007).

2.3.2 Air Quality

The VEGP site is centrally located within the Augusta (Georgia) - Aiken (South Carolina) Interstate Air Quality Control Region (AQCR) (40 CFR 81.114). All of the counties in this AQCR are designated as in attainment or unclassified for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.314). Parts of Richland and Lexington Counties, South Carolina, which are within the Columbia Intrastate AQCR (40 CFR 81.108) and border the Augusta (Georgia) – Aiken (South Carolina) AQCR to the north-northeast, are in non-attainment with respect to the 8-hour ozone standard (40 CFR 81.341). There are no mandatory Class 1 Federal Areas within the 160-km (100-mi) radius of the VEGP site where visibility is an important issue.

The Environmental Protection Division (EPD) of the GDNR operates a statewide air-monitoring network, with more than 68 monitoring locations in 37 counties (Georgia EPD 2005). Burke County does not have a monitoring station; the closest monitoring station is located in Richmond County. Monitoring takes place throughout the year, with the exception for ozone, which is sampled from March through October. Monitoring results for this location for the years 2001 through 2005 show an exceedance with respect to the 8-hour ozone standard in 2001 (3 days), 2002 (5 days), 2004 (3 days), and 2005 (1 day) (Georgia EPD 2002, 2003, 2004, 2005, 2006). Standards were not exceeded for any other measured criteria pollutant.

The Air Quality Index (AQI) is a national standard method for reporting air-pollution levels for the general public. The AQI is based on comparison of the concentrations of six pollutants within the NAAQS. The six pollutants are ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter smaller than 10 micrometers (PM_{10}), and particulate matter smaller than 2.5 micrometers ($PM_{2.5}$). The air-pollution level for each day is placed in one of six categories based on the AQI. In order of decreasing air quality, the categories are Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, Very Unhealthy, and Hazardous.

According to the Environmental Protection Agency (EPA), AQIs are available for Richmond County (EPA 2007). From 2001 to 2005, there were no days where the AQI was classified as Unhealthy, Very Unhealthy, or Hazardous. On average, the air quality was classified as Unhealthy for Sensitive Groups on 4 days each year for this period. For the remainder of the time, the air quality was classified as Good or Moderate, with Good days far outnumbering Moderate days.

The area for which air monitoring has been conducted and AQIs have been calculated generally reflect the more densely populated Augusta city region within Richmond County. It is likely that air quality in Burke County and in the immediate vicinity of the VEGP site is better than that of Richmond County.

2.3.3 Meteorological Monitoring

The meteorological monitoring for the proposed VEGP site would consist of the current onsite monitoring program used for VEGP Units 1 and 2. The meteorological monitoring program has been in place since 1972 and is described in the ER for the ESP site (Southern 2007a). Meteorological data for the period of January 1, 1998, to December 31, 2002, were used to generate atmospheric dispersion factors (χ/Q values) to estimate radiological impacts in the areas surrounding the VEGP site.

The primary meteorological monitoring system is a 60-m (197-ft) tower instrumented at the 10-m (33-ft) and 60-m (197-ft) levels. Wind speed, wind direction, wind direction fluctuation, and temperature are measured at both levels. The vertical temperature difference is calculated by taking the difference between the measured temperature at both levels. Dew point temperature is also measured at the 10-m (33-ft) level. A tipping bucket rain gauge is used to measure precipitation near the base of the tower and is augmented with human observations. A 45-m (148-ft) backup meteorological tower is sited nearby and provides additional measurements of wind speed, wind direction, wind direction fluctuation, and temperature at the 10-m (33-ft) level. Data from both towers are collected and processed on a digital recording system that is located in a shelter near the base of the meteorological tower. These data are available locally on digital strip chart recorders that are housed within the shelter. Five-second-sampled data are averaged to 15-minute and hourly values and made available to control room and facility personnel. The data collection process utilizes an uninterruptible power supply to provide backup power for data storage and transmission in the event of power failure at the site.

The current meteorological monitoring system would remain in operation during the site preparation, construction, and operational phases of the proposed VEGP Units 3 and 4 at the VEGP site. The proposed cooling towers for these units will be 180-m (600-ft) tall and located approximately 915 m (3000 ft) north of the existing meteorological monitoring site. It is not anticipated that the presence of the new cooling towers would affect the meteorological measurements. However, the staff assumes the measurements would be examined during different phases of construction and operation for verification. If any effects are observed, such as a bias in the wind direction or wind speed, then the meteorological monitoring system may need to be relocated.

The staff reviewed the available information relative to the onsite meteorological measurements program and the data collected by the program. The staff concludes that the system provides adequate data to represent onsite meteorological conditions as required by 10 CFR 100.10 and 10 CFR 100.20. The onsite data also provide an acceptable basis for making estimates of atmospheric dispersion for design-basis accident and routine releases from the plant to meet the requirements of 10 CFR 100.11, 10 CFR 50.34, and 10 CFR 50, Appendix I.

2.4 Geology

A detailed description of the geological, seismological, and geotechnical conditions at the VEGP site is provided in Section 2.5 of the Site Safety Analysis Report (SSAR) (Southern 2007d). A summary of the geology of the proposed VEGP site is provided in Section 2.6 of the ER (Southern 2007a). In addition to characterization conducted for the existing plant, results of subsurface investigations performed as part of the ESP application provide further definition of the site geology. The staff's description of the site and vicinity geological features and the detailed analyses and evaluation of geological, seismological, and geotechnical data as required for an assessment of the site-safety issues related to the proposed VEGP site are included in the staff's safety evaluation report .

The VEGP site lies within the Coastal Plain Physiographic Province, and is approximately 60 km (40 mi) southeast of the Fall Line, which represents the transition between the Piedmont and Coastal Plain Physiographic Provinces (Figure 2.4). The Coastal Plain province is a wedge of unconsolidated and semi-consolidated sediments that increases in thickness as it extends to the southeast from the contact with the Piedmont to the edge of the continental shelf. The thickness of Coastal Plain sediments varies from less than 60 m (200 ft) at the Fall Line to 1200 m (4000 ft) at the coastline, and is approximately 300 m (1000 ft) thick at the VEGP site (Southern 2007a; Clarke and West 1997). Sediments below the site range in age from Cretaceous at depth to Quaternary at the surface. The Coastal Plain sediments are underlain by bedrock consisting of sedimentary Triassic basin rock and Paleozoic crystalline rock.

A surface topography of gently rolling hills at the VEGP site ranges in elevation from less than 24 m (80 ft) above MSL to nearly 85 m (280 ft) above MSL in the immediate vicinity of the VEGP site (Southern 2007a). Developed portions of the site have ground surface elevations of approximately 67 m (220 ft) above MSL. The Savannah River has incised the Coastal Plain sediments and formed steep bluffs exhibiting topographic relief of nearly 46 m (150 ft) from the

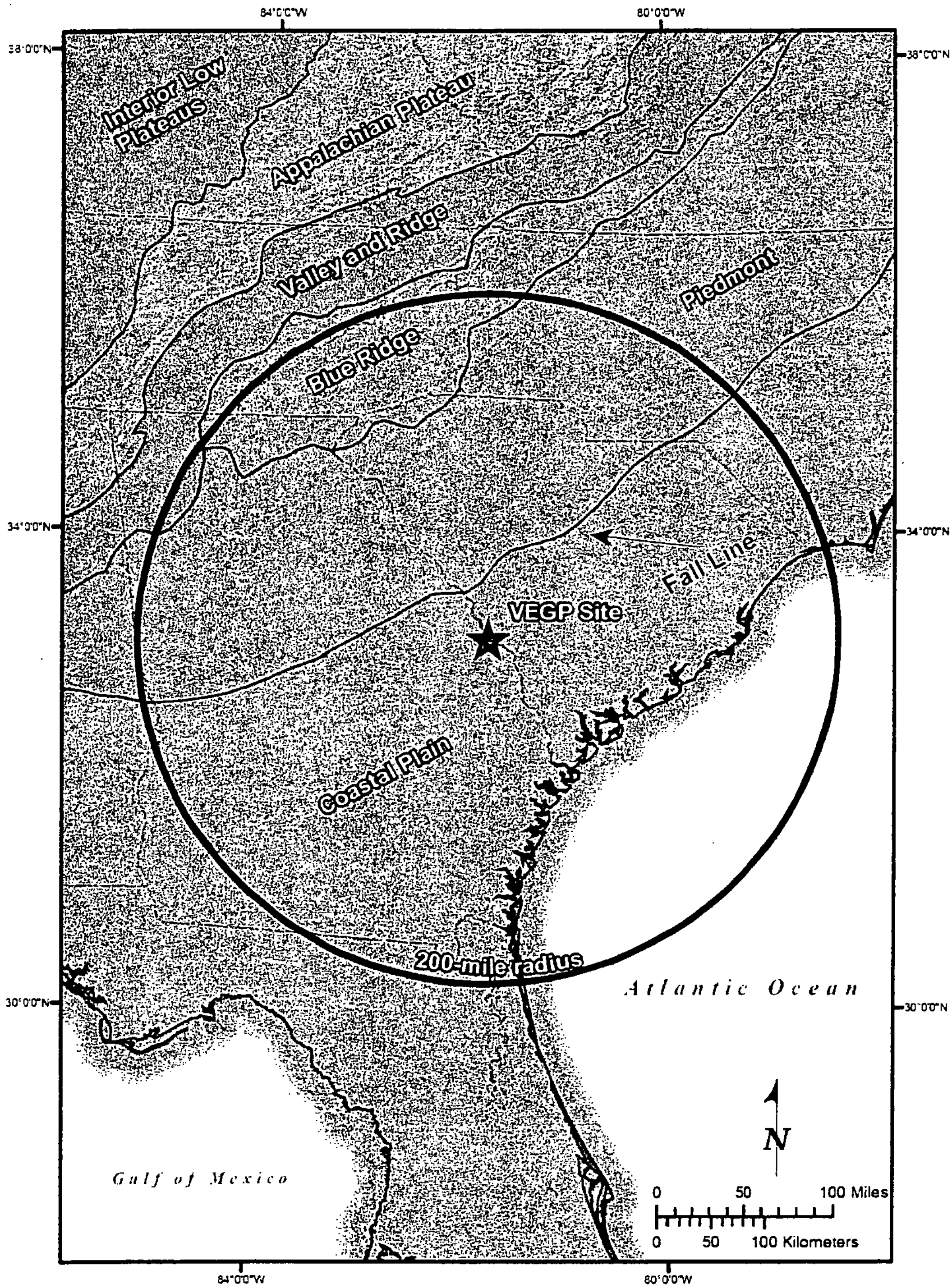


Figure 2-4. Physiographic Map (Southern 2007a)

river (approximately 24 m [80 ft] above MSL) to the developed portions of the existing VEGP site. Alluvial material that forms the floodplain of the Savannah River is 1.8 to 3.0 m (6 to 10 ft) above the river.

U.S. Geological Survey (USGS) documentation on the mineral industry of Georgia and South Carolina indicates that there are no major production areas for mineral resources in Burke County, Georgia (USGS 2003a, b). Neighboring counties with mineral resources are Richmond County, Georgia, which produces crushed stone, common clay, construction sand and gravel, and kaolin; Jefferson County, Georgia, which produces kaolin and Fuller's earth, and Aiken County, South Carolina, which produces construction sand and gravel, kaolin, crushed stone, and common clay. Other neighboring counties are not noted for major mineral production areas (USGS 2003a,b).

There is no sole-source aquifer within a 320-km (200-mi) radius of the VEGP site (EPA 2006; Southern 2007a).

The staff acquired and reviewed a recently completed USGS national assessment of the oil and gas reserves potentially existing in geologic provinces onshore and offshore of the United States (USGS 2007). Two provinces, the Appalachian Basin Province (USGS 2003c) and the South Florida Basin Province (Pollastro et al. 2001), touch on the State of Georgia. The former touches the northwest corner of the State and the latter touches the boundary with Florida, but neither are near Burke County. There is no estimate of any potential additions to oil, gas, and natural gas reserves in or near Burke Country.

2.5 Radiological Environment

A radiological environmental monitoring program (REMP) has been conducted around the VEGP site since operations began in 1987. This program measures radiation and radioactive materials from all sources, including the existing units at VEGP and the Savannah River Site. The REMP includes the following pathways: direct radiation, atmospheric, aquatic and terrestrial environments; and ground water and surface water. A pre-operational environmental operating program was conducted before 1987 to establish a baseline to observe fluctuations of radioactivity in the environment after operations began. After routine operation of Unit 1 started in 1987 and Unit 2 started in 1989, the monitoring program continued to assess the radiological impacts to workers, the public, and the environment. The results of this monitoring are documented in an annual environmental operating report for the VEGP site. The NRC staff reviewed historical data from the REMP reports for a 4-year period (2001 through 2004). Each year, Southern issues a report entitled *Annual Radioactive Effluent Release Report for the Vogtle Power Station*, which documents gaseous and liquid releases and resulting doses from VEGP. The NRC staff reviewed annual radioactive effluent release reports for calendar years 2001 through 2004 (Southern 2002, 2003a, 2004, 2005). Maximum doses to a member of the public were calculated using effluent concentration and historical meteorological data for the site. For the 4 years reviewed, the maximum annual dose to a member of the public was less than 0.001 mSv (less than 0.1 mrem) for operation of VEGP Units 1 and 2. These data show that doses to the maximally exposed individuals around the VEGP site were a small fraction of the limits specified in Federal environmental radiation standards, 10 CFR Part 20; 10 CFR Part 50, Appendix I; and 40 CFR Part 190.

Additionally, these data show that exposures or concentrations in air, water, and vegetation at locations near the plant perimeter (i.e., indicator locations) and at distances greater than 16 km (10 mi) (i.e., control locations) are comparable, if not statistically indiscernible. During the 10-year period from 1992 to 2001 the average annual direct radiation exposure at the indicator and control locations ranged from 48.0 to 54.4 mR and 48.4 to 54.4 mR, respectively (Southern 2002). The indicator and control location results are similarly comparable for drinking water, vegetation, and fish. The maximum exposure to a member of the public resulting from operation of VEGP Units 1 and 2 is a small fraction of the exposure measured at the control locations (i.e., background) and much smaller than the variability of measured exposure values (i.e., 48.4 to 54.4 mR).

Concerning the groundwater, the State of Georgia (Summerour et al. 1998) determined that elevated levels of tritium in the unconfined aquifer in Georgia originated from the Savannah River Site, are a result of atmospheric deposition from Savannah River Site releases, are well below the drinking water standard, and are not a public health threat. The USGS (Clarke and West 1997, 1998; Cherry 2006) determined that transriver flow is not responsible for the elevated tritium levels measured in the unconfined aquifer. See Sections 2.6.3.2, 7.3.2.2, and 7.8 for more information on offsite sources of tritium and other radionuclides.

2.6 Water

This section describes the hydrological processes governing movement and distribution of water in the existing environment at the VEGP site. The historic low-water periods with VEGP Units 1 and 2 in operation were considered in the analysis. However, since Savannah River discharge at the site during low-water periods is regulated by upstream dam operations, present-day operating rules adapted from U.S. Army Corps of Engineers (USACE) (USACE 2006a; NRC 2007a, b) for the upstream dams were also factored into the analysis.

2.6.1 Hydrology

This section describes the site-specific and regional hydrological features that could be altered by construction and operation of the proposed VEGP Units 3 and 4. A description of the site's hydrological features was presented in Section 2.3.1 of the ER (Southern 2007a). Hydrological features of the site related to site safety (e.g., probable maximum flood) are described by Southern in the Site Safety Analysis Report (SSAR) portion (Part 2) of the application (Southern 2007d).

2.6.1.1 Surface-Water Hydrology

The dominant hydrological feature of the VEGP site is the Savannah River, which forms the border between Georgia and South Carolina. The total size of the Savannah River watershed is approximately 27,400 km^2 (10,579 mi^2), 15,200 km^2 (5870 mi^2) of which are in Georgia, 11,700 km^2 (4530 mi^2) in South Carolina, and 464 km^2 (179 mi^2) are in North Carolina (USACE 1996). The confluence of the Seneca and Tugaloo Rivers, which is now part of Hartwell Lake, is considered the upstream end of the Savannah River (USACE 1996). The Savannah River then flows 464.9 km (288.9 mi) from Hartwell Dam to its mouth, where it enters the Atlantic Ocean at Savannah, Georgia.

The VEGP site is located at Savannah River river mile (RM) 150.9, and three large dams, constructed and operated by the USACE, lie upstream of the site. Hartwell Dam, at Savannah RM 288.9, is 222 km (138 mi) upstream of the VEGP site and is capable of storing a maximum of 4230 million m^3 (3,430,000 acre-feet (ac-ft)) (USACE 1996). The dam was completed and began storing water in February 1961 (USACE 1996). Richard B. Russell Dam, at Savannah RM 259.1, is 174 km (108 mi) upstream of the VEGP site and is capable of storing a maximum 1836 million m^3 (1,488,155 ac-ft) (USACE 1996). This was the last of the three large dams to be completed, and it began storing water in October 1983. At Savannah RM 221.6, J. Strom Thurmond Dam is 114 km (71 mi) upstream of the VEGP site. Its reservoir is capable of storing a maximum of 4564 million m^3 (3,700,000 ac-ft) of water. J. Strom Thurmond Dam, first of the three dams to be completed, began storing water in December 1951 (USACE 1996).

Between J. Strom Thurmond Dam and the VEGP site lies Stevens Creek Dam (RM 208.1), the city of Augusta (approximately RM 200), New Savannah Bluffs Lock and Dam (RM 187.7), and the mouths of several small creeks (USACE 1996). Stevens Creek Dam, operated by SCE&G, functions as a re-regulating reservoir to mitigate the large flow variations from J. Strom Thurmond Dam and to generate hydroelectric power. New Savannah Bluffs Dam, constructed and operated by USACE, is part of the inactive Savannah River Below Augusta Navigation Project (USACE 1996).

Channel modifications have been made to the Savannah River to allow for a 2.7-m (9-ft) deep by 27-m (90-ft) wide navigation channel from the Savannah Harbor to the city of Augusta. By 1980, shipping along the river had essentially ceased, and maintenance of the channel was discontinued (USACE 2006a). Consequently, Hartwell, Russell, and Thurmond dams are no longer operated for navigation, and minimum discharges from J. Strom Thurmond Dam are based on the needs of downstream water supply withdrawals without concern for navigation (USACE 2006a).

USGS flow gage 02197320, located near Jackson, South Carolina, was installed approximately 9.6 km (6 mi) upstream of the VEGP site at Savannah RM 156.8 (USGS 2002). The staff computed flow statistics for the gage's period-of-record (October 1971 to September 2002).

The average-daily discharge during the period-of-record was 250 m^3/s (8830 cfs), the maximum discharge was 623 m^3/s (22,000 cfs) (December 2, 1976; April 16, 1977; August 29, 1994; March 9, 1997; January 19, 1998), and the minimum discharge was 91.2 m^3/s (3220 cfs) (December 9, 1981). The period-of-record discharge dataset is shown in Figure 2-5.

USGS stream flow gages are typically accurate to within 5 to 10 percent of the actual stream flow (Hirsch and Costa 2004). Each flow gage dataset appearing in published USGS reports have an assigned accuracy level. USGS (2002) states that the accuracy of daily-reported discharges collected at the Jackson, South Carolina gage are within 10 percent of the true value.

Discharge passing the VEGP site is highly regulated by releases from J. Strom Thurmond Dam. Although the dams located downstream of J. Strom Thurmond Dam re-regulate the daily peaks and troughs of water released from J. Strom Thurmond Dam, they are not capable of storing any significant volumes of water. Therefore, the average discharge passing the VEGP site is directly proportional to the average quantity of flow released from J. Strom Thurmond Dam. The quantity of flow released from J. Strom Thurmond Dam is based on Drought Contingency Plan rule curves. During periods of relative water scarcity, outflow released from J. Strom Thurmond Dam is a function of the volume of water stored behind the Hartwell and J. Strom Thurmond dams (the two dams with significant storage capacity). The most recent Drought Contingency Plan developed by USACE is presented in Table 2-2 (USACE 2006a; NRC 2007a, b).

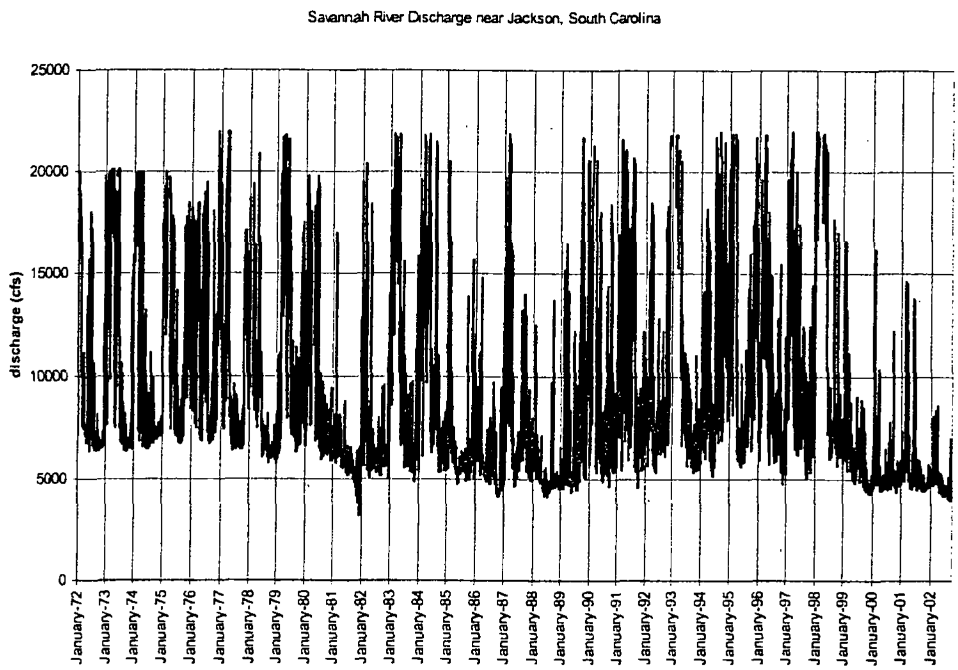


Figure 2-5. Daily Averaged Savannah River Discharge near Jackson, South Carolina (USGS 2002)

Table 2-2. Savannah River Drought Rule Curves

Drought Level	April 1 - Oct 15 Elevation (ft above MSL)	Dec 15 - Jan 1 Elevation (ft above MSL)	Action
1	Hartwell = 656 ft Thurmond = 326 ft	Hartwell = 654 ft Thurmond = 324 ft	Reduce Thurmond Dam discharge to 4200 cfs
2	Hartwell = 654 ft Thurmond = 324 ft	Hartwell = 652 ft Thurmond = 322 ft	Reduce Thurmond Dam discharge to 4000 cfs
3	Hartwell = 646 ft Thurmond = 316 ft	Hartwell = 646 ft Thurmond = 316 ft	Reduce Thurmond Dam discharge to 3800 cfs
4	Hartwell = 625 ft Thurmond = 312 ft	Hartwell = 626 ft Thurmond = 312 ft	Inflow to Thurmond Lake = Outflow from Thurmond Dam (i.e., keep reservoir at minimum conservation pool elevation)

Source USACE 2006a.

The Drought Contingency Plan rule curves were developed after the extreme drought that affected the southern United States between 1998 and 2002 (USACE 2006a). This drought exceeded the previous drought-of-record for the region, which lasted from 1986 to 1989 (USACE 1996). The impacts of these drought periods on the average-daily flows in the Savannah River near the site can be seen in Figure 2-5.

Although the Savannah River near the VEGP site is highly regulated by upstream dams, Southern developed a statistical analysis of the low flows in the Savannah River at Augusta (Southern 2007a). By examining the period between April 1986 and March 2003, Southern developed a 7Q10 low-flow statistic, which is an estimate of the lowest 7 consecutive-day average flow with a statistical recurrence interval of 10 years. The 7Q10 reported by Southern was 108.40 m3/s (3828 cfs) (Southern 2007a). Coincidentally, this low-flow statistic is approximately equal to the Drought Level 3 release (see Table 2-2) discharge from J. Strom Thurmond Dam currently in use by the USACE (USACE 2006a; NRC 2007a, b).

Savannah River water temperature data were collected by the GDNR at Shell Bluff Landing, approximately 11 river miles upstream of the VEGP site, and reported by Southern (Southern 2006a). The period of record for these monthly grab-sampled water temperature measurements was from January 30, 1973, to August 13, 1996. From these data, the following water temperature statistics were generated: minimum = 5.0°C (41.0°F), average = 17.4°C (63.4°F), median = 18.0°C (64.4°F), and maximum = 27.2°C (81.0°F).

2.6.1.2 Groundwater Hydrology

The groundwater aquifers in the region and in the vicinity of the site are described in Sections 2.3.1.2 and 2.3.3.2 of the ER (Southern 2007a). Within a 320-km (200-mi) radius of the VEGP site, there are parts of four physiographic provinces. The VEGP site lies within the Coastal Plain Physiographic province, about 48 km (30 mi) southeast of the Fall Line that separates the Piedmont province from the Coastal Plain province. The Coastal Plain sediments range in thickness from less than 60 m (200 ft) thick at the Fall Line to more than 1200 m (4000 ft) thick in an eastern-to-southeastern direction, and are approximately 300 m (1000 ft) thick at the VEGP site (Southern 2007a; Clarke and West 1997). They range in age from Holocene at the surface to Cretaceous at depth, and overlie an eastward extension of the Piedmont province, which is composed of crystalline igneous and metamorphic bedrock. The stratigraphic section for VEGP is shown in Figure 2-6. This figure details the geologic age, geologic units, hydrogeologic units, and the depth of sediments underlying the VEGP site.

Geotechnical and hydrogeological investigations performed by Southern for the ESP application have shown the site to be underlain by the Southeastern Coastal Plain aquifer system composed of the Water Table aquifer (also known as the Upper Three Runs aquifer), the Tertiary aquifer, and the Cretaceous aquifer (Southern 2007a). The upper two aquifers are separated by the Lisbon Formation, a confining unit that provides hydraulic isolation between the unconfined and confined aquifers. The lower two aquifers are separated by the Snapp Formation and Black Mingo Formation, comprising a semi-confining unit. This semi-confining unit allows some hydraulic connection between the two lower aquifers. The lowest confined aquifer system is composed of Cretaceous aged sediments, and spans from the Cape Fear Formation to the Steel Creek Formation. The middle aquifer, also a confined aquifer system, is composed of Tertiary aged permeable sands of the Still Branch sands and Congaree Formation. The uppermost aquifer is unconfined and is composed of Tertiary aged sands, silts, clays and limestone of the Barnwell Formation. The hydrostratigraphic section for the VEGP site is shown in Figure 2-6. Naming conventions for aquifers vary. In State of Georgia reports on water quality, the Barnwell Formation sediments of the Water Table aquifer are described as the Jacksonian aquifer (Donahue 2004). As the aquifers dip to the southeast, the Water Table aquifer becomes confined and is the upper Floridan aquifer, and the Tertiary aquifer becomes the lower Floridan aquifer (Clarke and West 1997; Summerour et al. 1994). During their review of numerous reports on the regional and local hydrogeology, the staff found the comparison of hydrogeologic unit naming conventions found in Figure 4 of Clarke and West (1997) to be useful.

Water Table Aquifer

The water table of the unconfined aquifer at the VEGP site is described by the tabular and graphic representations of piezometric head provided by Southern (Southern 2007a). The contour map showing the piezometric head for June 2005 is representative and is shown in Figure 2-7. The local high of the water table is approximately 50 m (165 ft) above MSL (Southern 2007a), and the hydraulic gradient indicates groundwater flow to the north towards Mallard Pond through the powerblock area and to the south from the cooling tower area for the proposed VEGP Units 3 and 4 region. The top of the Blue Bluff Marl, the unit of the Lisbon Formation that forms the base of the unconfined aquifer, shown in Figure 2-8 also has a

Geologic Time	SNC ESP Nomenclature				
Period	**Series**	**Geologic Unit**	**Hydrogeologic Unit**	**Depth (ft)**	**Elevation (ft MSL)**
Tertiary	Eocene	Bamwell Gr.	Water Table Aquifer	Ground Surface	+223
		Lisbon Fm./Blue Bluff Mbr.	Confining Unit	86	+137
		Still Branch Fm. Congaree Fm.	Tertiary Sand Aquifer	149	+74
	Paleocene	Snapp Fm. Black Mingo Fm.	Semi-Confining Unit	331	-108
Cretaceous		Steel Creek Fm.	Cretacous Aquifer	477	-254
		Gaillard Fm./ Black Creek Fm.			
		Pio-Nono Fm./ Unnamed Sands			
		Cape Fear Fm.		1049	-826

Notes: Geologic unit naming convention (Huddleston and Summerour 1996; Falls and Prowell 2001)
Regional hydrogeologic unit naming convention (Miller 1990)
Depths and elevations from boring B-1003 (Southern 2007a)

Figure 2-6. Schematic Hydrostatigraphic Column for the Southeastern Coastal Plain Aquifer System Underlying the VEGP Site (Southern 2007a)

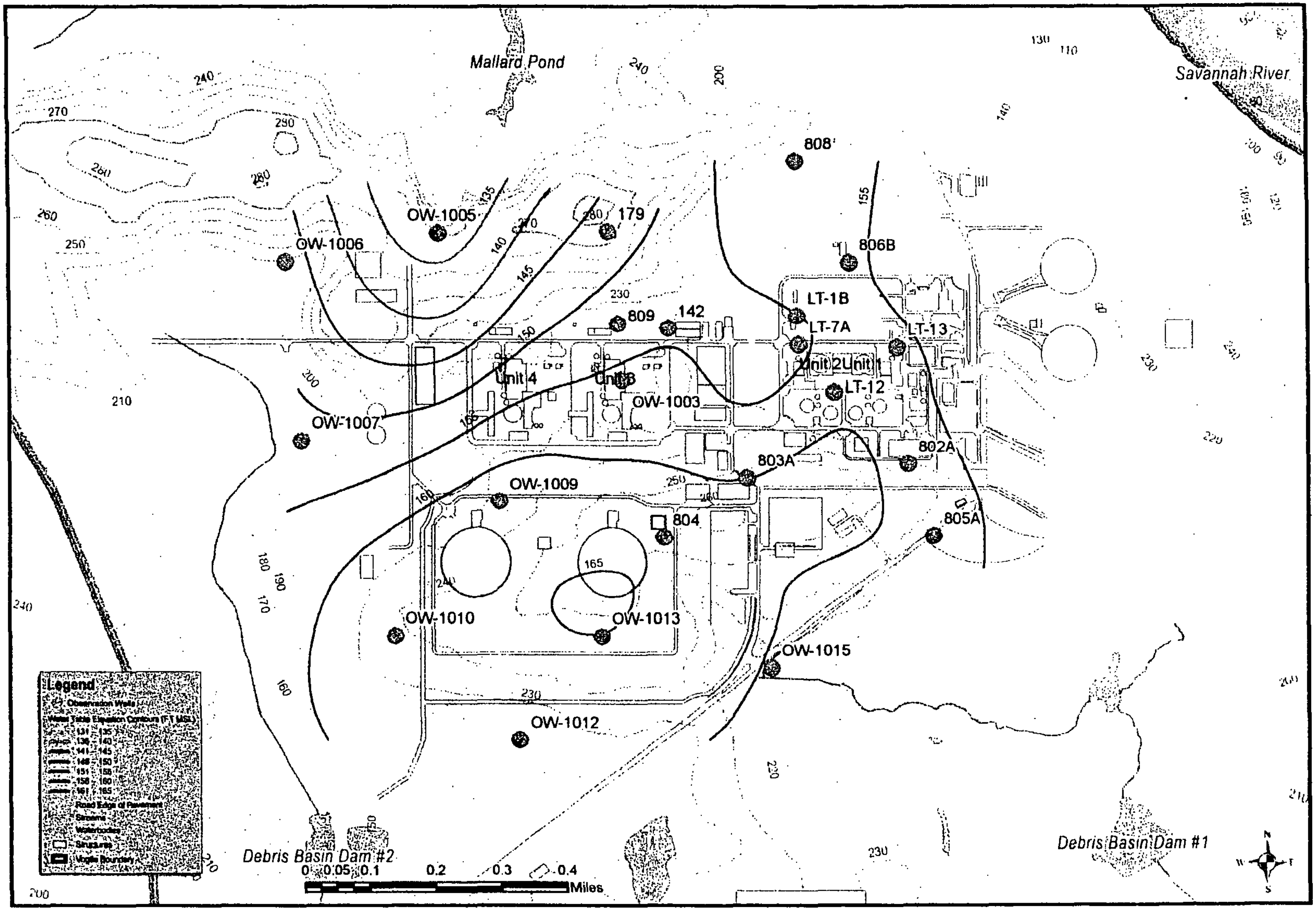


Figure 2-7. Water Table Aquifer: Piezometric Contour Map for June 2005 (Southern 2007a)

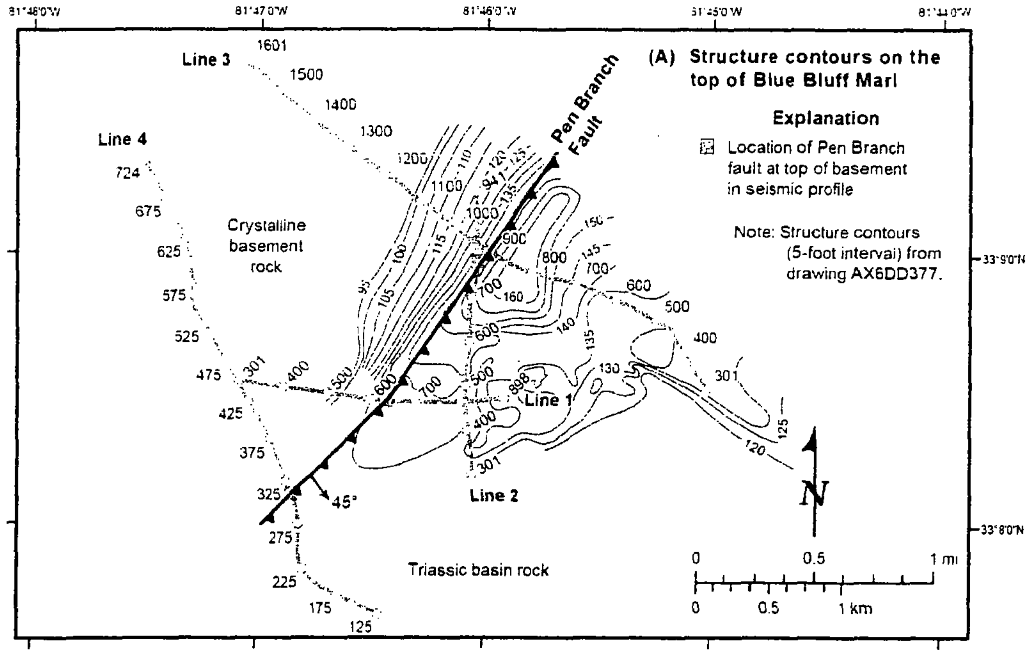


Figure 2-8. Location of the Pen Branch Fault at Top of Basement Beneath the Overlying Monocline in the Blue Bluff Marl (Southern 2007d)

maximum elevation of approximate 49 m (160 ft) above MSL but drops off sharply to the northwest as it crosses the region lying above the Pen Branch fault.

Hydraulic head and flow within the Water Table aquifer is governed by local topography and net infiltration from precipitation. Discharge from the Water Table aquifer is to local drainages (i.e., springs, streams, and ponds), the Savannah River, and wells.

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Tertiary Aquifer

The piezometric head of the confined Tertiary aquifer at the VEGP site is described by Southern in Section 2.3.1 of the ER (Southern 2007a). The contour map showing the piezometric head for June 2005 is representative and is shown in Figure 2-9. The highest plotted contour of 38.1 m (125 ft) above MSL lies to the west of the proposed site for VEGP Units 3 and 4 and drops to 27.4 m (90 ft) above MSL near the river (Southern 2007a). The contours indicate flow toward and potential interception by the Savannah River. Southern states the zero flow level or river bottom elevation is approximately 20.59 m (67.56 ft) above MSL (Southern 2007d) opposite the proposed VEGP Units 3 and 4 intake location, and this is lower than the reported base elevation of the Lisbon Formation opposite the VEGP site, portions of which are approximately 24 m (80 ft) above MSL (Southern 2007d). The USGS (Clarke and West 1997) also indicates the potential for the Savannah River to have incised the confining unit of the

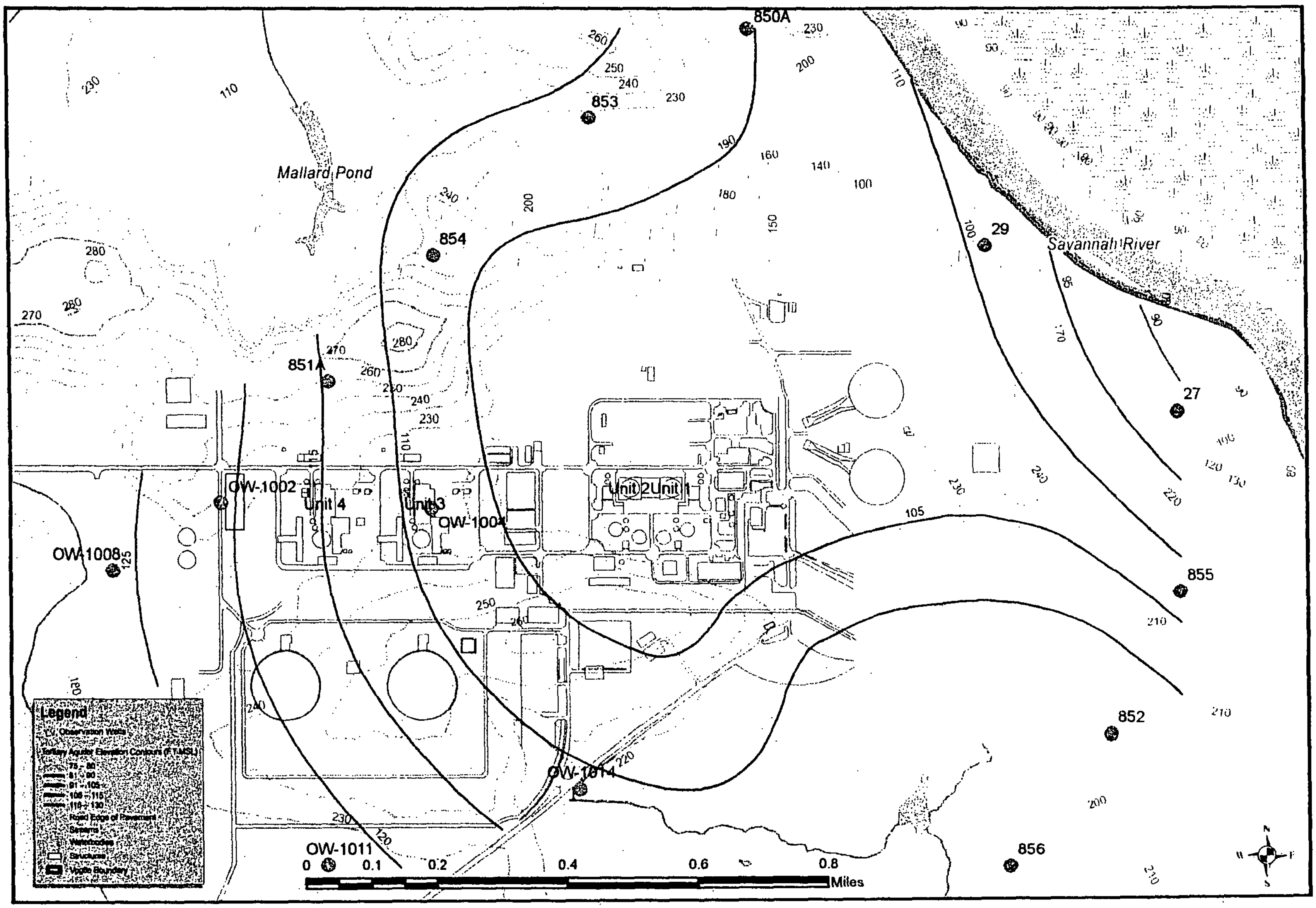


Figure 2-9. Tertiary Aquifer: Piezometric Contour Map for June 2005 (Southern 2007d)

Tertiary aquifer (the Lisbon Formation) where it intercepts the Pen Branch fault in the vicinity of the plant, and the potential for the Tertiary aquifer to discharge locally to the Savannah River alluvium.

The base of the Blue Bluff Marl forms the top of the confined Tertiary aquifer and is shown in Figure 2-10. This surface has a maximum elevation of approximately 24 m (80 ft) above MSL in the vicinity of the proposed site for VEGP Units 3 and 4 but drops off sharply to the north-northwest as it crosses the region lying above the Pen Branch fault. The base of the Tertiary aquifer is at the upper surface of the Paleocene-age Black Mingo and Snapp Formations, which are at approximately -33 m (-108 ft) above MSL. The staff concurs with Southern's interpretation that the Tertiary aquifer is confined by the Blue Bluff Marl, and is substantially, if not completely isolated hydraulically from the Water Table aquifer. Local to the VEGP site, there is a downward hydraulic gradient from the Water Table aquifer toward the Tertiary aquifer.

Recharge to the confined Tertiary aquifer occurs primarily at outcrop regions where Tertiary sediments are exposed to infiltration from precipitation. Discharge from the Tertiary aquifer occurs to the alluvial deposits underlying the Savannah River in regions where the confining unit has been incised, and to groundwater wells, natural springs, and subaqueous outcrops offshore (Southern 2007a).

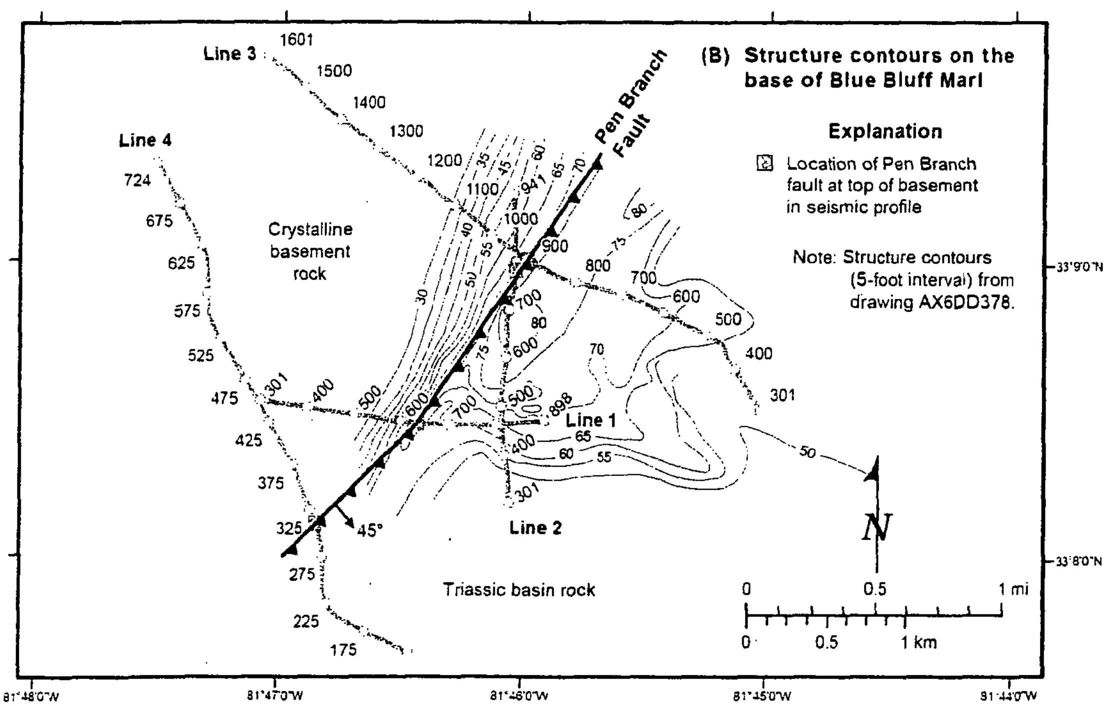


Figure 2-10. Location of the Pen Branch Fault at Top of Basement Beneath the Overlying Monocline in the Blue Bluff Marl (Southern 2007d)

Cretaceous Aquifer

The piezometric head of the confined Cretaceous aquifer at the VEGP site is represented in the contour maps shown in Figure 2-11 a,b for the years 1992 and 2002 (Cherry 2006). These two panels show the hydraulic head in upper and lower sequences of the Cretaceous aquifer, described here as the Dublin aquifer system and the Midville aquifer system, respectively. The USGS interpretation of the USGS figures indicates the hydraulic head of the Dublin aquifer system in the vicinity of the VEGP site has decreased from 49 to 43 m (160 to 140 ft) above MSL between 1992 and 2002, while the deeper Midville aquifer system has decreased from 52 to 49 m (170 to 160 ft) above MSL.

The Dublin aquifer system is confined above by the Black Mingo and Snapp formations and its groundwater is identified with the Steel Creek Formation through Black Creek Formation in Figure 2-6. The Midville aquifer system is confined above by the Midville confining unit that is located in the middle to lower portion of the Black Creek Formation (Clarke and West 1997). Groundwater of the Midville aquifer system is identified with the Pio-Nono Formation through Cape Fear Formation of the hydrostratigraphic cross section (Figure 2-6). Elevations of the upper surfaces of the hydrogeologic units identified in the B-1003 boring are shown in

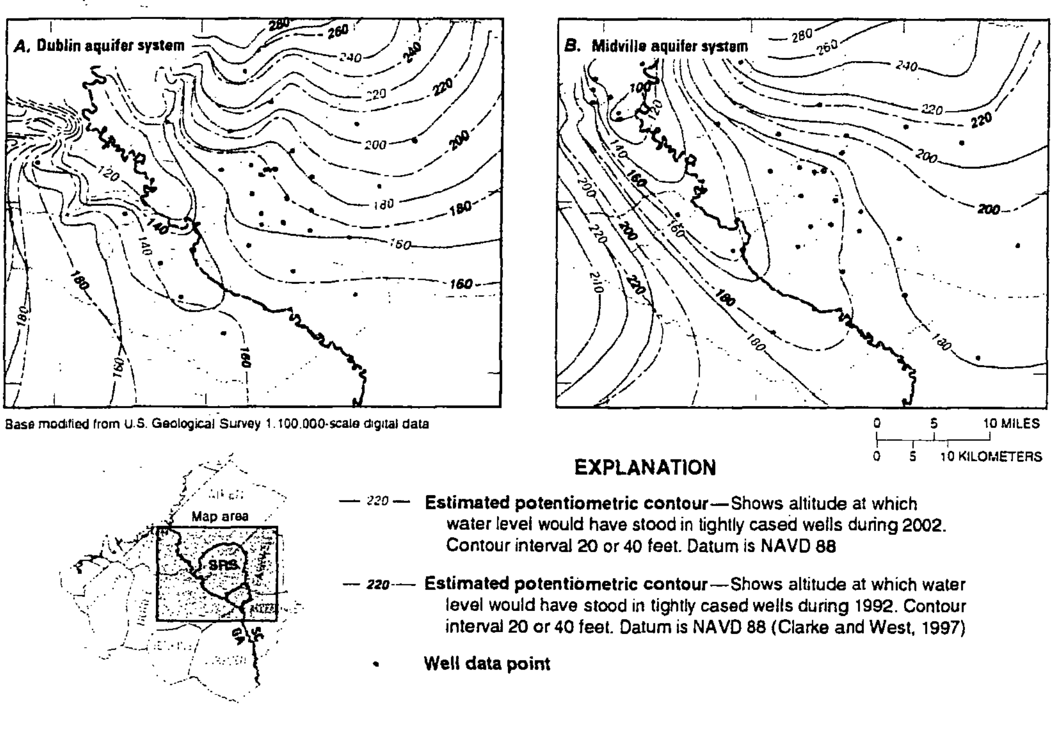


Figure 2-11. Potentiometric-Surface Maps for the (A) Dublin Aquifer System, and (B) Midville Aquifer System during 1992 and 2002, Near the Savannah River Site, Georgia and South Carolina (Cherry 2006).

Figure 2-6. The Cretaceous sediments consist of fluvial and estuarine deposits of cross-bedded sand and gravel with silt and clay interbeds. They extend from the upper surface of the Steel Creek Formation (i.e., elevation -77.4 m [-254 ft] above MSL), to the upper surface of the Triassic basin bedrock (i.e., elevation -251.8 m [-826 ft] above MSL). Local to the VEGP site, there is an upward hydraulic gradient from the Cretaceous aquifer toward the Tertiary aquifer through the semi-confining unit that separates them.

Recharge to and discharge from the Cretaceous aquifer is similar to that of the Tertiary aquifer. Recharge to the Cretaceous aquifer occurs primarily in outcrop regions near the Fall Line where Cretaceous sediments are exposed to infiltration from precipitation. Flow in the Cretaceous aquifer is initially unconfined, but as the sediments become more deeply overlain by the Tertiary deposits, they become confined beneath the Snapp and Black Mingo Formations. Discharge from the Cretaceous aquifer occurs primarily to presumed subaqueous outcrops offshore; however, the Cretaceous aquifer also discharges to alluvial deposits underlying the Savannah River in regions where the confining unit has been incised upstream of the VEGP site and to groundwater wells (Southern 2007a; Clarke and West 1997).

Groundwater and the Accessible Environment

Southern's estimates of travel time in the two uppermost aquifers, (i.e., the Water Table and Tertiary aquifers) (Southern 2007a) make it clear that the Water Table aquifer provides the most immediate pathway to the terrestrial and aquatic environment and man. Southern concludes that release from the Water Table aquifer is to a surface-water drainage headed by Mallard Pond on the VEGP site, and therefore, immediate impacts would be to potential wetlands controlled by Southern and not to the public. Review of the change in the piezometric surface in the Water Table aquifer since 1971 lead staff to conclude that alteration of the land surface, infiltration patterns, run-off patterns, and vegetation can influence the piezometric surface. The staff concludes that it is reasonable to assume that these alterations would result in Water Table aquifer flow in directions other than north-northwest through the proposed power-block area and toward Mallard Pond.

Hydraulic Properties

Measured values of aquifer and sediment properties are reported in Section 2.3.1.2.4 of the ER (Southern 2007a). Measurements completed during the ESP site investigation are supplemented by earlier reported values in the FSAR for existing VEGP Units 1 and 2 (Southern 2003b). The staff reviewed USGS reports on the regional aquifer to confirm the range of values reported by Southern (Clarke and West 1998).

Key hydraulic properties of the Cretaceous aquifer, which supplies the bulk of the groundwater required by VEGP Units 1 and 2 and would supply the groundwater required by the proposed VEGP Units 3 and 4, are the transmissivity and storage coefficient of the deep confined aquifer system. Aquifer tests conducted when the existing deep production wells were installed provide the mid-range transmissivity of 2.27×10^{-2} m^2/s (158,000 gal/d/ft), and the mean storage coefficient of 3.1×10^{-4} (dimensionless). These values are shown in the ER and used by Southern in calculations (Southern 2007a). The staff performed independent calculations and independently reviewed work conducted by the USGS to confirm these values. The USGS derived minimum and maximum ranges of transmissivity estimates based on field data (i.e., 4×10^{-5} m^2/s to 2.75×10^{-2} m^2/s [300 to 191,000 gal/d/ft]) and regional simulation (i.e., 1×10^{-6} m^2/s to 3.69×10^{-2} m^2/s 10 to 257,000 gal/d/ft) bracket the mid-range value of transmissivity identified by Southern (Clarke and West 1998). The USGS modeling effort (Clarke and West 1998) cites storage coefficients for the Cretaceous aquifers ranging from 7.1×10^{-5} to 4.4×10^{-4} that are similar to those cited by Southern (i.e., 2.1×10^{-5} to 6.60×10^{-4}).

Key hydraulic properties of the Tertiary aquifer are the hydraulic conductivity and storage coefficients, as well as the effective porosity. Southern reports the geometric mean of the hydraulic conductivity as 2.9×10^{-6} m/s (0.83 ft/day) (Southern 2007a) based on five slug tests. Storage coefficient of the Tertiary aquifer was not measured; however, Southern stated that tests on the combined Tertiary and Cretaceous aquifers suggest 1×10^{-4} is a reasonable estimate. Southern estimates an effective porosity of 31 percent. The USGS-derived minimum and maximum ranges of transmissivity estimates based on field data (i.e., 1.9×10^{-4} m^2/s to 1.31×10^{-2} m^2/s [1346 to 91,200 gal/d/ft]) and regional simulation (i.e., 1.4×10^{-5} m^2/s to 2.66×10^{-2} m^2/s [100 to 185,000 gal/d/ft]) when combined with the local thickness of the Tertiary aquifer (i.e., approximately 55 m (182 ft) bracket the central value of hydraulic conductivity found by Southern but are generally higher (Clarke and West 1998). The USGS modeling effort (Clarke and West 1998) cites storage coefficients for the Tertiary aquifer ranging from 3.0×10^{-4} to 3.7×10^{-4} that are similar to, but higher than, the value assumed by Southern (i.e., 1×10^{-4}).

Key hydraulic properties of the Water Table aquifer are the hydraulic conductivity, storage coefficient, and the effective porosity. Southern presents previously derived values for hydraulic conductivity from the Final Safety Analysis Report (FSAR) (Southern 2003b) for the Barnwell sands, silts, and clays ranging from 1.3×10^{-6} to 2.6×10^{-6} m/s (130 to 267 ft/yr) for well permeameter tests and from 9.5×10^{-8} to 2.9×10^{-6} m/s (9.8 to 302 ft/yr) for undisturbed samples in the laboratory. The potentially highly transmissive material is the Utley Limestone, and its pumping test values ranged from 3.1×10^{-5} to 1.2×10^{-3} m/s (3250 to 125,400 ft/yr). Falling and constant head tests on Utley Limestone suggest a lower range from 9.3×10^{-7} to 5.6×10^{-5} m/s (96 to 5800 ft/yr). The mean total porosity of Barnwell material is reported as 44 percent. Hydraulic conductivity and effective porosity determined recently as part of the ESP investigation yielded a geometric mean of 1.75×10^{-6} m/s (0.5 ft/d) and mean of 32 percent, respectively (Southern 2007a). Specific yield was estimated by Southern from published literature to range between 0.20 and 0.33 (Southern 2007a). The staff independently determined that the USGS-derived minimum and maximum range of transmissivity estimates based on field data, (i.e., 5.4×10^{-4} to 1.0×10^{-2} m^2/s [3700 gal/d/ft to 71,000 gal/d/ft]) (Clarke and West 1998), when combined with the local thickness of the Water Table aquifer (i.e., approximately 9 m (30 ft) are indicative the higher values of the Utley limestone portion of the Barnwell.

Interactions between the site surface and groundwater, and between aquifers

The Water Table aquifer is unconfined and recharge to it is infiltration from precipitation. Locally, discharge from the aquifer is to drainages and wells. Discharge to Utley Cave at the head of Mallard Pond (Huddlestun and Summerour 1996) is one example of unconfined aquifer discharge in the immediate vicinity of the VEGP site. The USGS (Clarke and West 1997) shows the Savannah River has incised into the Water Table aquifer in the vicinity of and downstream of the VEGP site. Thus, in addition to discharging to drainages, springs, seeps, and groundwater wells, the aquifer discharges to the alluvial deposits in the river valley. The majority of the hydraulic head data for the Water Table aquifer suggest an aquifer dominated by infiltration from precipitation and by topography. Based on potentiometric contour maps (Southern 2007a), groundwater movement from the VEGP site powerblock region appears to be toward Mallard Pond. The staff notes that an alternate conceptual model is supported by two data points. The data and alternate model are discussed in the following paragraph.

The Tertiary aquifer is believed to be confined in the vicinity of the VEGP site; however, some isolated data suggest the potential for local communication between the Water Table aquifer and the Tertiary aquifer in the immediate vicinity of the Pen Branch fault (Southern 2007a). This communication may provide a pathway from the Water Table aquifer into the uppermost confined aquifer. Hydraulic head in the Water Table aquifer ranges from 49 to 44.2 m (160 to 145 ft) above MSL over the powerblock while the Tertiary aquifer ranges from 37 to 32 m (120 to 105 ft) above MSL in the same vicinity. The anomalous data indicate a Water Table aquifer hydraulic head of 35.7 to 36.0 m (117 to 118 ft) MSL in the vicinity of monitoring wells OW-1001 and B-1004 at the eastern edge of the powerblock. Thus, groundwater flow could be downward into the Tertiary aquifer at this point. If this communication exists, it appears to be local and not linear (e.g., it is only observed at a single point). The Water Table aquifer does not appear to be strongly influenced by a line sink representing a loss of groundwater into the confined system along the entire structural feature of the Pen Branch fault. Based on potentiometric contour maps of the Tertiary aquifer (Southern 2007a), groundwater movement from the powerblock region is directed toward the Savannah River. Infiltration from precipitation recharges the aquifer in its outcrop area to the northwest of the VEGP site. Some recharge also moves through the upper and lower confining beds to recharge the Tertiary aquifer. The USGS (Clarke and West 1997) show the Savannah River has incised into the upper confining unit of the Tertiary aquifer upstream of the VEGP site, and the aquifer is believed to discharge into the Savannah River alluvium and into the river in the vicinity of the incision.

The Cretaceous aquifer is separated from the overlying Tertiary aquifer by a leaky confining unit. Heads in the vicinity of the VEGP site in the Tertiary aquifer range from 38.1 m (125 ft) above MSL east of the powerblock to 25.9 m (85 ft) MSL at the Savannah River shoreline. Heads in the Cretaceous aquifer vary but are approximately 46 m (150 ft) above MSL in the deep production wells (Southern 2006b). Thus, leakage would occur from the Cretaceous upward into the Tertiary aquifer. Some interpret seismic survey data to suggest that fractures (stress release faults) in close association with the Pen Branch fault may cut the aquitards separating aquifers within the Cretaceous sediments and aquitards separating the Tertiary and Cretaceous deposits (Summerour et al. 1998). However, the deep production wells are open to conductive zones of the aquifer from the lower portion of the confining zone above the Cretaceous sediments for nearly the entire depth of the Cretaceous sediments. Thus, communication among and between the aquifers that comprise the Cretaceous aquifer is locally a function of the wells and not only the fault structure. Based on potentiometric contour maps (Clarke and West 1997, Cherry 2006), groundwater movement in the Cretaceous aquifer system underlying the VEGP site is made complex because of the location of a groundwater divide that separates groundwater flow toward regions where the Savannah River has incised through the semi-confining units that overlay the Cretaceous sediments (upstream of the VEGP site) and groundwater flow toward the coast and presumed discharge points offshore (see Figure 2-11). It appears that in both the shallow (Dublin aquifer system) and the deep (Midville aquifer system) portions of the Cretaceous aquifer, groundwater beneath the site is moving northeast toward discharge points in the Savannah River alluvial deposits.

The contour plot (see Figure 2-11) for the Dublin aquifer system (i.e., shallow Cretaceous aquifer) also suggests that current pumping from the VEGP site deep production wells may draw water toward the VEGP site from South Carolina and Georgia's portions of the deep aquifer. The staff believes that because the Savannah River incision into the Cretaceous deposits occurs relatively far upstream from the VEGP site, there is no evidence to suggest barriers to groundwater flow from South Carolina in the deep aquifer; therefore, communication or transriver flow is possible. However, because the Savannah River does incise into the Water Table aquifer adjacent to the VEGP site and into the Tertiary aquifer adjacent to or immediately upstream of the VEGP site, there is less likelihood of transriver flow in these aquifer systems. Cherry (2006) also shows that tracer particles originating in South Carolina that are subject to transriver flow appear to be intercepted by the Savannah River alluvial deposit shortly after migrating into the State of Georgia. The staff found no evidence to suggest physical or hydraulic barriers to groundwater movement between the two states in the Cretaceous aquifer, and will examine the influence of an alternate conceptual model allowing transriver flow when evaluating the potential impact of planned deep groundwater production.

Recharge to the aquifers underlying the VEGP site is from recharge. For the confined aquifers, this recharge occurs in outcrop areas between the VEGP site and the Fall Line approximately 48 km (30 mi) to the northwest. The USGS estimated a basin-wide water budget for a 13,330 km^2 (5147 mi^2) study area extending southeast of the Fall Line and focused on the Savannah River Site and Burke County, Georgia (Clarke and West 1997, 1998; Cherry 2006). They conclude that on average groundwater discharge to the Savannah River was 34.5 m^3/s (1220 ft^3/s), and of that 13 percent or 4.36 m^3/s (154 ft^3/s) is from the regional (Cretaceous) aquifer system. Long-term average recharge was approximated by the USGS (Clarke and West 1997) by weighing the groundwater discharge values according to drainage area. Of the estimated average groundwater recharge of 36.8 cm/yr (14.5 in./yr), they estimate 17.3 cm/yr (6.8 in./yr) is to the Water Table aquifer, 14.7 cm/yr (5.8 in./yr) is to the Tertiary aquifer, and 4.8 cm/yr (1.9 in./yr) is to the Cretaceous aquifers in the study region.

2.6.1.3 Hydrological Monitoring

This section describes the hydrological monitoring programs. Thermal and chemical monitoring programs are discussed in Sections 2.6.3.3 and 2.6.3.4.

As a result of ongoing monitoring associated with the two existing units, Southern was able to consider this existing monitoring program as part of the pre-application monitoring program for the VEGP site (Southern 2007a). If the new units were built, many of these same monitoring activities would likely be continued (Southern 2007a).

Surface Water

Discharge in the Savannah River is collected by the USGS, in cooperation with Southern, near the existing barge slip on the VEGP Site. This site, named Savannah River near Waynesboro, is assigned USGS gage number USGS 021973269, and the accuracy of the USGS reported daily-discharge data is within about 10 percent of the true value (USGS 2006a).

The USGS reports discharge and reservoir storage upstream of the VEGP Site, including conditions at Hartwell, Russell, and Thurmond dams. Other USGS stream gages near the VEGP Site include (1) Savannah River at Augusta, USGS gage 02197000 (USGS 2006b), located at Savannah RM 187.4 and accurate to within 15 percent of the true discharge; (2) Savannah River near Jackson (POR October 1971 to September 2002), USGS gage 02197320 (USGS 2002), located at Savannah RM 156.8 and accurate to 10 percent of the true discharge; and (3) Savannah River at Burton's Ferry Bridge near Millhaven, USGS gage 02197500 (USGS 2006b), located at Savannah RM 118.7 and accurate to within 15 percent of the true discharge.

Southern (2007a) describes the hydrological (i.e., flow) monitoring that occurs onsite in accordance with National Pollutant Discharge Elimination System (NPDES) Permit GA0026786 and Industrial Stormwater Permit GAR000000. Discharge-monitoring locations include the following: final plant discharge, cooling tower blowdown from VEGP Units 1 and 2, wastewater retention basins for VEGP Units 1 and 2, sewage treatment plant emergency outflow, liquid radwaste systems discharge from VEGP Units 1 and 2, and the nuclear service cooling tower blowdown.

Southern states in the ER that it would prepare an Erosion, Sedimentation and Pollution Control Plan in support of the NPDES Construction Stormwater Permit. This permit is required before site preparation can commence on the new units.

If the new units are built and operated, monitoring of the discharge from the new units would likely be similar to those for the existing VEGP Units 1 and 2. Future monitoring of the Savannah River, intake structure withdrawals, and discharge outfall would be performed in coordination with required permits to be issued by the State of Georgia and obtained by Southern prior to operation of the new units.

Groundwater

Southern describes two ongoing monitoring programs measuring the drawdown or the groundwater level at the VEGP site: (1) a program that meets the GDNR EPD requirements of the groundwater use permit, and (2) the NRC groundwater monitoring program (Southern 2007a).

Southern would continue to monitor groundwater levels in support of the existing units during construction of the proposed units. Southern has committed to developing and deploying groundwater monitoring programs during construction and operation of the proposed units in coordination with the State of Georgia and the NRC (Southern 2007a).

2.6.2 Water Use

Consideration of water use requires estimating the magnitude and timing of consumptive and non-consumptive water uses. Non-consumptive water use does not result in a reduction in the available water supply. For example, water withdrawn from the river and used to wash fish from the intake screens would result in no net change in water supply to downstream water users if the same volume of water pumped from the river would eventually be returned back into the river. On the other hand, consumptive water-use results in a net reduction of the water supply available for downstream users. For instance, the circulating water system (CWS) withdraws water for normal cooling. The majority of that water is evaporated in the cooling towers, and that evaporated water would be considered a consumptive loss. The following two sections describe the consumptive and non-consumptive users of surface water and groundwater near the VEGP site.

2.6.2.1 Surface-Water Use

The existing VEGP Units 1 and 2 and the D-Area Powerhouse are the largest (consumptive) water users within proximity to the proposed VEGP Units 3 and 4. Data reported by Southern (2007a) state that average surface-water use for VEGP Units 1 and 2 was approximately 2.8 m^3/s (98.8 cfs) between January 2003 and December 2004. Between June 2004 and May 2005, the monthly average surface-water withdrawal for the Savannah River Site was 0.13 m^3/s (4.5 cfs)(Southern 2007a). This value excludes the D-Area Powerhouse, which is located on the Savannah River Site; however, it is now operated by SCE&G. For the 12-month period beginning in June 2004 and ending in May 2005, the D-Area Powerhouse used 1.94 m^3/s

(68.4 cfs) of water on-average per month (Southern 2007a). The Urquhart Station, which is also operated by SCE&G and is located upstream of the VEGP site near Augusta, withdrew 3.61 m^3/s (127.5 cfs) on-average per month during the same period (Southern 2007a).

Southern states that the nearest surface-water users downstream from the VEGP Site are the Fort James Operating Company and the Georgia Power Company, both of which are located in Effingham County, Georgia, and lie approximately 170(rkm) (106 [RM]) downstream from the site (Southern 2007a).[(a)]

Water-use data for a period of 20 years ending in the year 2000 suggested that withdrawal rates for surface water and groundwater remained nearly unchanged (Fanning 2003) in the vicinity of the VEGP site. However, projected surface water and groundwater demands in Burke County, Georgia indicate an increase of 50 percent by 2035 (Rutherford & Associates 2000). In South Carolina, combined surface water and groundwater demand is projected to increase by 50 percent between 2000 and 2045 (SCDNR 2004). Near the mouth of the Savannah River and approximately 241 km (150 mi) downstream of the site, saltwater is intruding into the Floridan aquifer because of groundwater withdrawals (GDNR 2006a). To preserve the groundwater resource in the future, existing groundwater users may shift the source of their water supply from the Floridan aquifer to water originating from the Savannah River, which would also increase demands for Savannah River water downstream of the VEGP site in the future.

2.6.2.2 Groundwater Use

Aquifers and Their Relationship to the Savannah River

Southern provides a description of groundwater use in the area affected by the proposed VEGP site in Section 2.3.2.2 of the ER (Southern 2007a). Groundwater is highly related to the geology of the site, and a description of the geology in the vicinity of the VEGP site is presented in Section 2.4 of this EIS. The groundwater resource in the vicinity of the VEGP site resides in three aquifers: the Water Table aquifer, the Tertiary aquifer, and the Cretaceous aquifer.. As implied in its name, the Water Table aquifer is unconfined, relatively shallow, and subject to seasonal and interannual changes in response to precipitation. Those using this groundwater resource generally pump at lower rates indicative of domestic household use and are exempt from the requirement of a groundwater use permit. Non-agricultural water users requiring in excess of 379,000 L/d (100,000 gpd) are required to apply for a permit in the State of Georgia (GDNR 2001). The Tertiary aquifer is the first confined aquifer and includes sands, silts, and gravels that can yield substantial groundwater. The Cretaceous aquifer is composed of a

(a) River miles are calculated from the mouth of the river or, for upstream tributaries, from the confluence with the main river (RM). The Savannah River originates at the confluence of the Seneca and Tugaloo rivers in Hart County, Georgia.

sequence of aquifers and aquitards with strata also yielding substantial groundwater to wells. The production wells for the VEGP site withdraw groundwater from the Cretaceous aquifer as do most high-production wells in the region. Several lower-yield wells at the VEGP site withdraw groundwater from the Tertiary aquifer. All existing wells at the VEGP site are under Georgia Water-Use Permit Number 017-0003, which allows a maximum monthly average pumping rate of 23,000 m^3/d (6.0 MGD) and a yearly average pumping rate of 20,800 m^3/d (5.5 MGD).

The VEGP site is located on a bluff above the Savannah River. The Water Table aquifer drains to surrounding stream channels: the Savannah River to the east, Hancock Landing drainage to the north, and Beaverdam Creek drainage to the south. This aquifer is replenished locally by net infiltration from precipitation. The base of the Blue Bluff Marl that isolates the Water Table aquifer from the Tertiary aquifer appears to be incised by the Savannah River in the immediate vicinity of the VEGP site, and the USGS notes hydraulic connection between this first confined aquifer and the Savannah River in the vicinity of the Pen Branch fault adjacent to the VEGP site and upstream of Flowery Gap Landing, somewhat upstream of the VEGP site (Clarke and West 1997). Figure 2-12 shows the extent of hydrogeologic units underlying the Savannah River. In this figure, aquifers and confining units are exposed to the Savannah River alluvial material from downstream to upstream in order of progressively older sediments. The Upper Three Runs (or Water Table) aquifer is exposed in the lower right, and the Pre-Cretaceous basement rock is exposed in the upper left (Clarke and West 1997). In the figure, the VEGP site is located adjacent to the Pen Branch fault on the Georgia shore of the Savannah River; Flowery Gap Landing is east of TR-92-6 and on the Georgia shore of the Savannah River. The Gordon aquifer in USGS nomenclature shown in this figure is denoted by the Tertiary aquifer in this EIS. USGS studies have illustrated a potential for transriver flow in the vicinity of the VEGP site; however, their models suggest that flow crossing the river in either direction upwells into the alluvial valley near the river (Clarke and West 1998; Cherry 2006). The Tertiary aquifer is replenished at upgradient outcrop locations exposed to precipitation, and locally flows toward the Savannah River. Thus, the Savannah River appears to intercept both the Water Table and Tertiary aquifers.

The confining unit overlying the Cretaceous aquifer is not incised by the Savannah River adjacent to the VEGP site (Figure 2-12). The USGS maps the incision as occurring nearly 16 km (10 mi) upstream of the site (Clarke and West 1997). Thus, the staff's interpretation of the hydrogeology is that in the vicinity of the VEGP site, aquifers and aquitards that comprise the Cretaceous aquifer are hydraulically isolated from the Savannah River and have hydraulic connection between the States of Georgia and South Carolina. Southern has disagreed, stating "Because the Savannah River serves as a groundwater discharge area for aquifers in the site area, aquifers on the South Carolina side of the river cannot affect or be adversely affected by the plant" (Southern 2007b). The Cretaceous aquifer is replenished at upgradient outcrop

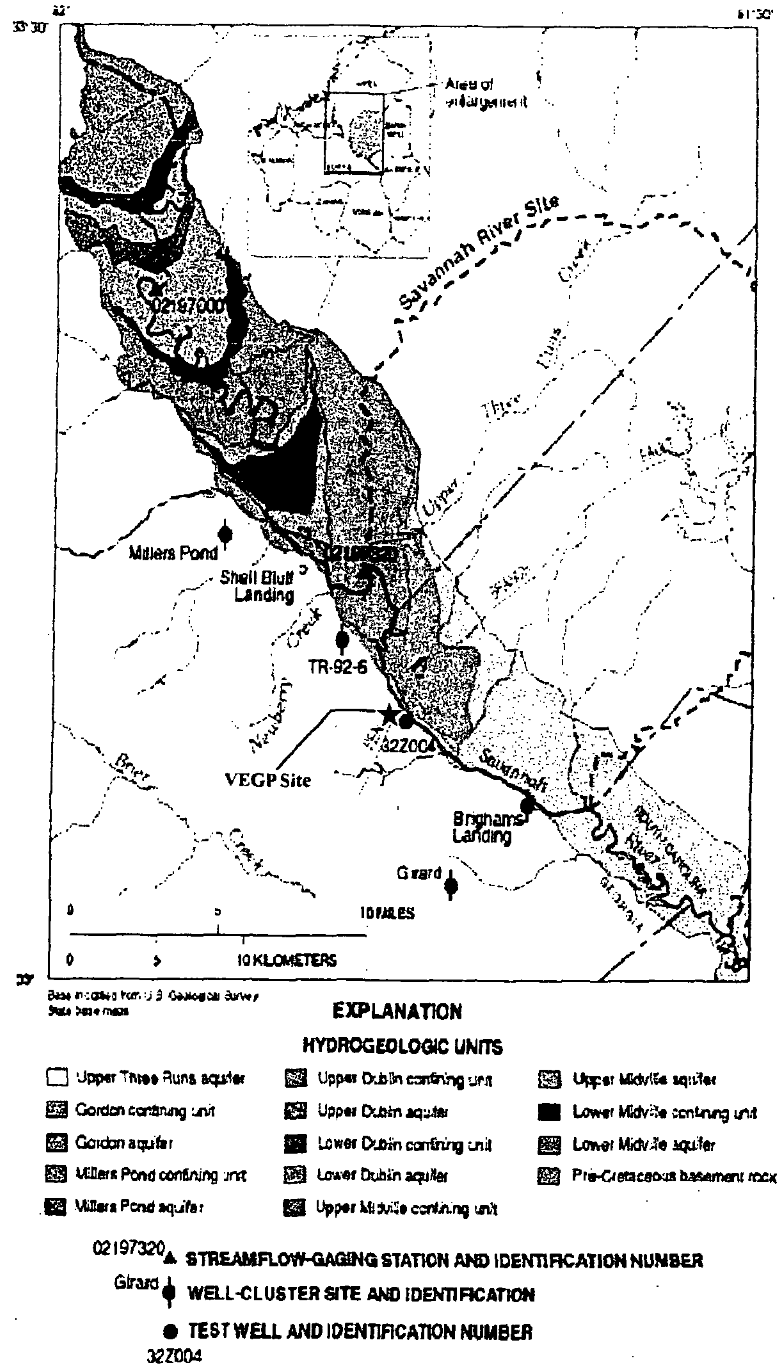


Figure 2-12. Extent of Hydrogeologic Units Underlying the Savannah River (Clark and West 1997)

locations exposed to precipitation. This aquifer system exhibits a groundwater divide downstream of the VEGP site, and locally, groundwater in the system is moving toward the incised location upstream of the site which is a hydraulic sink. Groundwater in this system that is sufficiently removed from the Savannah River laterally, flows past the divide toward the coast and discharges, in general, to downgradient groundwater wells or from subaqueous exposures of the aquifer along the continental shelf.

Average and Maximum Plant Water Use

The VEGP site maintains three wells completed in the Cretaceous aquifer and six wells completed in the Tertiary aquifer. The three wells in the Cretaceous are deep production wells with design yields of 63 to 126 L/s (1000 to 2000 gpm). These wells provide makeup water for the plant processes (e.g., 1158 million L [306 million gallons] in 2005 for VEGP Units 1 and 2 or a rate of 3.17 million L/d [0.838 MGD]) (Southern 2007a). The six wells in the Tertiary aquifer have design yields of 1.3 to 9.5 L/s (20 to 150 gpm) and provide irrigation water, potable water for the recreation area and the simulator training building, water supply for the nuclear operations garage, water supply for the security tactical training area, water supply for fire protection, and a non-potable water supply for the new plant entrance security building (e.g., 8 million L [2 million gallons] in 2005 for VEGP Units 1 and 2 or a rate of 0.0212 million L/d [0.0056 MGD]) (Southern 2007a). Thus, in 2005 the total pumping rate was 3.19 million L/d (0.843 MGD). Southern has estimated the average pumping rate for normal operation of VEGP Units 1 and 2 as 46.1 L/s (730 gpm, 1.05 MGD). Southern estimates a maximum pumping rate of 145 L/s (2300 gpm, 3.312 MGD) for VEGP Units 1 and 2 (Southern 2007a). Both the normal and maximum operation levels are for VEGP Units 1 and 2 simultaneously operating in the same mode.

Southern projects groundwater consumptive use for normal operation of proposed VEGP Units 3 and 4 as an average rate of 47.4 L/s (752 gpm, 1.08 MGD) and a maximum operation rate of 198.1 L/s (3140 gpm, 4.52 MGD) (Southern 2007a). During normal/maximum operation approximately 19.2 L/s/106 L/s (305 gpm/681 gpm) of groundwater is returned as surface water to the Savannah River (Southern 2007a). Both the normal and maximum operation water-use rates are for the proposed VEGP Units 3 and 4 simultaneously operating in the same mode.

Dewatering Experience during Construction of VEGP Units 1 and 2

Southern states that construction of the proposed VEGP Units 3 and 4 would employ a similar dewatering method as was employed for existing VEGP Units 1 and 2 (Southern 2007a). Construction of VEGP Units 1 and 2 required excavation of the sediments comprising the Water Table aquifer overlying the Blue Bluff Marl. Four pumps, each with a capacity of 32 L/s (500 gpm), were used to remove the water from the excavation site; thus, normal dewatering had a maximum capacity of 126 L/s (2000 gpm). Additional capacity was employed to remove water during at least one storm event (Southern 2003b). Data from observation wells monitored during construction of VEGP Units 1 and 2 revealed a variable response in the Water Table aquifer near the excavation site (Southern 2007a). The most distant well in the vicinity of the excavation for which a record exists, well #804, approximately 300 m (1000 ft) southwest of the excavation, was not substantially impacted (i.e., 0.6 m (approximately 2 ft) decline and subsequent recovery). Southern states that Mallard Pond continued to flow throughout the dewatering activity for existing VEGP Units 1 and 2, which lasted for more than 6 years from mid-1976 until early-1983 (Southern 2007b, d).

Water-Use Permit and the Moratorium

Since 1974, Georgia has required a groundwater use permit for all groundwater users of more than 379,000 L/d (100,000 gpd). In 1997, the State of Georgia, as part of an interim strategy to manage salt water intrusion into the Floridan aquifer, instituted a moratorium on groundwater withdrawal permits for municipal, industrial, and agricultural uses in 24 Georgia counties (GDNR 2006a). Burke County was among the 24 counties. The VEGP site is 100 km or more from regions being impacted by saltwater intrusion. In 2006, Georgia issued its permitting plan for managing salt water intrusion (GDNR 2006a). That plan identified Burke County among 19 counties that did not contribute substantially to the development or extent of salt water intrusion in coastal areas (GDNR 2006a). However, in this 19-county region of Georgia, applications for water-use permits continue to be reviewed to ensure a justified need exists, and that aggressive and practical conservation and reuse principles and wastewater management are being applied (GDNR 2006a). Southern notes in Section 2.3.2.2.2 of its ER (Southern 2007a) that groundwater wells would be completed in the Cretaceous aquifer to supply water for operation of the proposed VEGP Units 3 and 4, and that Southern would request a modification of their existing water-use permit.

Nearest Neighboring Wells

In the vicinity of the VEGP site, groundwater is used by permit holders for agriculture, industry, and municipal water supply. There are also domestic wells that withdraw relatively low quantities and wells that serve the public listed by EPA in the Safe Drinking Water Information System (SDWIS). The nearest neighboring well is a domestic well located across River Road from the VEGP site (Southern 2007a). Groundwater wells permitted by the State of Georgia are relatively distant from the VEGP site. The nearest permitted agricultural well is located 5.5 km (3.4 mi) northwest, the nearest industrial well is located 13.7 km (8.5 mi) northwest, and the nearest municipal well is located 23.3 km (14.5 mi) west-southwest. The nearest SDWIS well is located 7.9 km (4.9 mi) southwest at the DeLaigle Mobile Home Park (Southern 2007a). The agricultural and SDWIS wells were completed in Tertiary sediments, while the industrial and municipal wells were completed in Cretaceous sediments. Southern states that "...these wells are sufficiently distant from (Plant Vogtle) such that pumping these wells would have no effect on groundwater levels at Plant Vogtle" (Southern 2007a). The Savannah River Site withdraws groundwater from the deep confined aquifer at several locations (Wells and Hiergesell 2005).

The D-Area, approximately 6.4 km (4 mi) from the VEGP site, withdraws groundwater for domestic as well as process purposes. This groundwater well into the deep confined aquifer appears to be the closest potential offsite user to the VEGP site.

Historical and Future Trends in Water Use

Water-use data for a period of 20 years ending in the year 2000 suggest that withdrawal rates for surface water and groundwater remained nearly unchanged (Fanning 2003) in the vicinity of the VEGP site. Projected water demand in Burke County, Georgia, indicates an increase of 50 percent by 2035 (Rutherford & Associates 2000). In South Carolina, an increase of 50 percent is projected by 2045 (SCDNR 2004). However, despite these projections, a recent report by the USGS assigned lower groundwater pumping rates for the region in the future (i.e., through 2020) than have occurred during the recent drought (Cherry 2006). Thus, there is reason to believe that stress on the groundwater resource was highest during the recent drought and could now diminish.

In the Savannah River basin, water users depend primarily on surface water to satisfy current and future demands (GDNR 2001; SCDHEC 2005). Because of evidence of salt water intrusion in developed coastal regions, the states of Georgia, South Carolina, and Florida, and others jointly undertook an effort in the past decade to develop and apply a management plan to stabilize and halt the intrusion of salt water into the Upper Floridan aquifer (GDNR 2006a). Under the management plan, the State of Georgia would review applications for new and renewed water withdrawal permits in Burke County to ensure water quantities are justified and that permits include requirements for water conservation, water reclamation and reuse, and wastewater management. It is anticipated that groundwater users in the lower basin (i.e., in the vicinity of the observed saltwater intrusion) would be required to replace groundwater sources with surface-water sources in the future (Southern 2007a).

There are no aquifers designated as "sole source" within 320 km (200 mi) of the VEGP site (EPA 2006).

2.6.3 Water Quality

The following sections describe the water quality of surface-water and groundwater resources in the vicinity of the VEGP site. Monitoring programs for thermal and chemical water quality are also described.

2.6.3.1 Surface-Water Quality

This section describes the water quality of the Savannah River near the VEGP site, which is the only off-site surface water body that would be impacted by either the construction or operation of the new units. Southern presents a discussion of the water-quality conditions in Section

2.3.3.1 of the ER (Southern 2007a). The thermal load discharged from the two operating units results in localized elevated water temperatures in the river. Operational impacts of the proposed units on Savannah River water quality are discussed in Section 5.3.3.1 of this EIS. Monitoring programs for thermal and chemical water quality are discussed in Sections 2.6.3.3 and 2.6.3.4, respectively.

The State of Georgia has classified the water use in the Savannah River near the VEGP site as "Fishing: propagation of fish, shellfish, game and other aquatic life" (Georgia EPD 2007a). Daily average dissolved oxygen levels are required to be a minimum of 6.0 mg/L. Upstream of the VEGP site and between J. Strom Thurmond Dam (RM 221.6) and Stevens Creek Dam (RM 208.1), the Savannah River is listed as not fully supporting the designated water use for dissolved oxygen levels on the Georgia 303(d)/305(b) list (Georgia EPD 2007b). However, near the VEGP site at Savannah RM 150.9, the river is not listed as impaired by the State of Georgia. This conclusion is supported by data provided by Southern in its ER, which states that during 2003 dissolved oxygen levels near the site ranged between 6.1 mg/l and 11.4 mg/l with a mean of 8.4 mg/l.

South Carolina monitors water quality in the Savannah River near the VEGP site (SCDHEC 2003). The nearest water-quality stations upstream (Savannah River Lock and Dam: Station SV-323) and downstream (Savannah River at U.S. Highway 301, 20 km [12.5 mi] southwest of Allendale: Station SV-118) of the VEGP site are presented in SCDHEC (2003). Data presented in the report show recreational and aquatic life uses were fully supported at both sites between January 1996 and December 2000 (reporting period). Water-quality parameter trends (1984 to 2000) and the number of samples exceeding the appropriate standard (1996 to 2000) discussed in the SCDHEC report include dissolved oxygen, pH, total phosphorus, total nitrogen, turbidity, fecal coliform, ammonia, cadmium, chromium, copper, lead, mercury, nickel, and zinc. At the downstream station (SV-118), a significant increasing trend in total phosphorus concentration was noted. There was also a significant decreasing trend in pH. A decreasing trend in total nitrogen and fecal coliform bacteria concentrations suggest improving conditions for these two parameters.

In addition to Georgia and South Carolina, the DOE has monitored the water quality of the Savannah River for over 50 years. DOE monitors Savannah River water quality at sampling sites located at RM 160, RM 150.4, RM 141.5, RM 129.1, and RM 118. In 2003, the most recent year for which data are available, the data showed no indication of degradation or impairment (Southern 2007a; Mamatey 2004).

Discharges from VEGP Units 1 and 2 are controlled by a GDNR NPDES permit (permit number GA0026786 [GDNR 2004a]). The most recent permit was issued on June 30, 1999. Before the proposed VEGP Units 3 and 4 could begin to operate, Southern would be required to obtain a NPDES permit for discharges from these units. Southern would also be required to demonstrate to GDNR that the effluent limitations for the proposed VEGP Units 3 and 4 is adequate to ensure protection and propagation of a balanced, indigenous population of fish and wildlife through a Clean Water Act Section 316(a) demonstration. If determined to be necessary, GDNR may require additional monitoring before or after issuance of an NPDES permit.

2.6.3.2 Groundwater Quality

Groundwater quality in the vicinity of the proposed VEGP site is described in Section 2.3.3.2 of the ER (Southern 2007a). The GDNR Environmental Protection Division has the responsibility for protecting the groundwater resource, and maintains the Georgia Ground-Water Monitoring Network, which monitors the ambient water quality of nine aquifers (Donahue 2004). Among these aquifers is the Jacksonian system (Donahue 2004), which is close to the VEGP site and includes the Water Table aquifer, also known as the Upper Three Runs aquifer (Summerour et al. 1994). For groundwater in the vicinity of the VEGP site, the State of Georgia (Donahue 2004) reported on water quality of the Jacksonian aquifer from eight wells drawing water from the Barnwell Group. Samples were analyzed for nitrate/nitrite and volatile organic compounds, including methyl tert-butyl ether; however, no volatile organic compounds were detected. The nitrate/nitrite level was detectable in six wells, and elevated in one of them (i.e., 7.6 ppm) but below the primary maximum contamination level (10 ppm for nitrate measured as nitrogen). Donahue (2004) describes a regional issue with acidic groundwater in the outcrop areas of Cretaceous sediments (i.e., downgradient of the Fall Line), and notes that treatment may be required. The acidity is natural and may result from the inability of the sediment to neutralize acidic rainwater and from biologically influenced, acid-producing reactions between water and soils or deeper sediments. Groundwater with elevated levels of calcium-sodium bicarbonate is found in the vicinity of the VEGP site. Total dissolved solids are less than 200 ppm with lower values in the Water Table aquifer and values approaching 200 ppm in the confined aquifers (Southern 2007a). This is below the secondary standard for total dissolved solids of 500 ppm. Overall, the State of Georgia found the quality of groundwater water excellent (Donahue 2004).

As a result of saltwater intrusion observed at three locations in the Upper Floridan aquifer (in the vicinity of Hilton Head Island, South Carolina, approximately 140 km southeast, the Savannah/Chatham County pumping center in Georgia, approximately 140 km southeast, and in groundwater in the vicinity of Brunswick, Georgia, more than 200 km south-southeast of the VEGP site), the State of Georgia, in concert with others, established an interim strategy for protecting the groundwater resource in 1997 (GDNR 2006a). Included in the interim strategy was a moratorium on water-use permits for the Upper Floridan aquifer. At that time, the State of Georgia and others undertook to complete the Coastal Sound Science Initiative, a suite of studies to define and understand the saltwater intrusion challenge facing the region. At the conclusion of the Coastal Sound Science Initiative, a permitting plan (GDNR 2006a) was issued that would guide Georgia Environmental Protection Division water resource management decisions and actions. Burke County is included under the plan, and is among 19 counties identified as having minimal impact on coastal regions and the saltwater intrusion problem

(GDNR 2006a). With regard to the 19 counties, the management plan would ensure water-use permits are issued consistent with a justified need and with requirements of water conservation, water reclamation and reuse, and wastewater management.

Tritium has been identified as a pollutant in the Water Table aquifer in the vicinity of the VEGP site (Summerour et al. 1998). First discovered in 1988 in a public water supply well serving the DeLaigle Mobile Home Park a short distance from the VEGP site, it was initially believed that tritium contaminated the confined aquifer system. However, a thorough cooperative study of the region conducted by the GDNR and the USGS and described in Summerour et al. (1994, 1998), Clarke and West (1997, 1998) and Cherry (2006) has revealed:

- There are elevated levels of tritium in the Water Table aquifer in eastern Burke County, but the levels measured are well below the drinking water standard for tritium, and no public health threat exists.

- There is no evidence of regional tritium contamination of the confined Tertiary aquifer (i.e., also known as the Gordon aquifer); however, high-resolution tritium analyses show very low levels of tritium in all confined aquifers.

- The age of confined aquifer water (i.e., old water), particularly that of the deep confined system, suggest very low tritium detection results from leakage from other aquifers or contamination during drilling or sampling.

- Although assumed to be a secondary pathway for tritium found in the Georgia aquifer systems (Summerour et al. 1998), transriver flow originating in South Carolina at the Savannah River Site has been studied by the USGS (Clarke and West 1997, 1998; Cherry 2006) and found to be an unlikely source for the broadly based tritium observed in Georgia groundwater wells in the Water Table and Tertiary aquifers. The Savannah River incises the Water Table aquifer and acts as a discharge boundary for the aquifer in both Georgia and South Carolina. With regard to the Tertiary aquifer, groundwater flow is either toward the river from both states, or toward an upriver location where the river incises the Tertiary aquifer (Clarke and West 1997).

- The evidence indicates the primary pathway for tritium pollution of the Water Table aquifer is through recharge of the aquifer by atmospheric deposition of tritium released from the Savannah River Site, which is located in South Carolina and upwind of the VEGP site.

An indication of the groundwater quality of the Cretaceous aquifer underlying the Savannah River Site operated by DOE is that groundwater recovered from the deep confined Cretaceous aquifer supplies drinking water for the site (Wells 1999). To sustain this water quality, DOE has required, since the 1980s, that any substantial quantity of groundwater be recovered from the lowermost aquifer and at rates that preserve the natural head difference between aquifers

(Wells 1999). This ensures the continued existence of an upward hydraulic head gradient over most of the site between the deep aquifer and overlying aquifers that may be contaminated. This management effort preserves the natural hydraulic barrier to downward migration of contaminants, and maintains the water quality of the deep aquifer.

2.6.3.3 Thermal Monitoring

This section describes thermal monitoring programs. Southern is able to consider an ongoing monitoring programs associated with the existing VEGP Units 1 and 2 operation to provide some pre-application and pre-operational monitoring data for the VEGP site. Many of the same monitoring activities would be continued if the proposed units were completed and would become part of the operational monitoring for the proposed units. In Section 6.1 of the ER, Southern describes the existing river temperature measurements directly associated with the current site operation that were required under terms of its existing NPDES permit (Southern 2007a).

The GDNR has classified the Savannah River near the VEGP sites as "fishing" water use (GDNR 2004b). The water-quality standards for temperature are not to exceed 32°C (90°F), and at no time is the temperature of the receiving waters to be increased more than 2.8°C (5°F) above intake temperature. A provision is included that allows for use of a reasonable and limited mixing zone, however evidence must be provided that such a zone would not create an objectionable or damaging pollution condition.

The current temperature monitoring requirements do not require routine thermal monitoring (Southern 2007a). Thermal monitoring of the intake and final plant discharge is performed once every 5 years to support renewal of the NPDES permit. If determined to be necessary, GDNR may require additional monitoring before issuance of any new NPDES permits. GDNR may also require ongoing monitoring as a condition of any new NPDES permits.

2.6.3.4 Chemical Monitoring

This section describes the pre-application and operational chemical monitoring programs. As a result of ongoing monitoring associated with the existing two units, Southern is able to consider this operational monitoring program as part of the pre-application and pre-operational monitoring program for the VEGP site. Many of these same monitoring activities would be continued if the proposed VEGP Units 3 and 4 were completed, and would likely become part of the operational monitoring program. In its ER, Southern describes the chemical monitoring that is required under terms of Southern's existing NPDES permit (Southern 2007a). The surface water-quality parameters currently monitored under the NPDES permit at various locations, (i.e, not all are monitored at each location), are hydrazine, pH, free available chlorine, total residual chlorine, total chromium, total zinc, total suspended solids, oil and grease, and biological oxygen demand (Southern 2007a, GDNR 2004a). The NPDES permit obtained for the existing units specifies chemical monitoring at a variety of locations internal to the VEGP site and at the final plant discharge location.

2.7 Ecology

This section describes the terrestrial and aquatic ecology of the site and vicinity that might be affected by the design, siting, construction, operation, and maintenance of two additional units at the VEGP site. Sections 2.7.1 and 2.7.2 provide general descriptions of terrestrial and aquatic environments on and in the vicinity of the VEGP site and in the vicinity of one additional 500-kV transmission line right-of-way that would be required to distribute the additional generation from the proposed VEGP Units 3 and 4 (Southern 2007a). The proposed new transmission line right-of-way would likely connect the VEGP site with the Thomson substation 32 km (20 mi) west of Augusta. The transmission line right-of-way may cross Burke, Jefferson, McDuffie, and Warren Counties. It is anticipated it would be a 46-m (150-ft)-wide right-of-way approximately 97 km (60 mi) long (see Figure 4-1) (Southern 2007a; NRC 2007c).

Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from construction, operation, and maintenance of new nuclear power generating facilities and the new transmission line right-of-way. The descriptions are provided to support mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts. Descriptions are also provided to help compare the alternative sites to the VEGP site. Also included are descriptions of monitoring programs for terrestrial and aquatic environments.

2.7.1 Terrestrial Ecology

This section identifies terrestrial ecological resources and describes species composition and other structural and functional attributes of biotic assemblages that could be affected by the construction, operation, and maintenance of the proposed VEGP Units 3 and 4. It also identifies "important" terrestrial resources, such as wildlife sanctuaries and natural areas that might be impacted by the proposed action.

The VEGP site is approximately 1282.5 ha (3169 ac) in size and is in the sandhills of the Upper Coastal Plain Region approximately 48 km (30 mi) southeast of the Fall Line (Eco-Sciences 2007; Southern 2007a). The site has 12 soil types (Figure 2-13) and several major habitat types, including man-made or beaver-created ponds, pine plantations, native upland pines, and the bottomland hardwoods along stream drainages and adjacent to the Savannah River (NRCS 2003a; TRC 2006). Approximately 320 ha (800 ac) of the VEGP site consists of the existing Units 1 and 2 and associated auxiliary facilities, Plant Wilson (a 554-MW(e) peaking power generating facility), the training center, and transmission line rights-of-way. Previously disturbed areas onsite, including areas within the footprint for the proposed VEGP Units 3 and 4, are

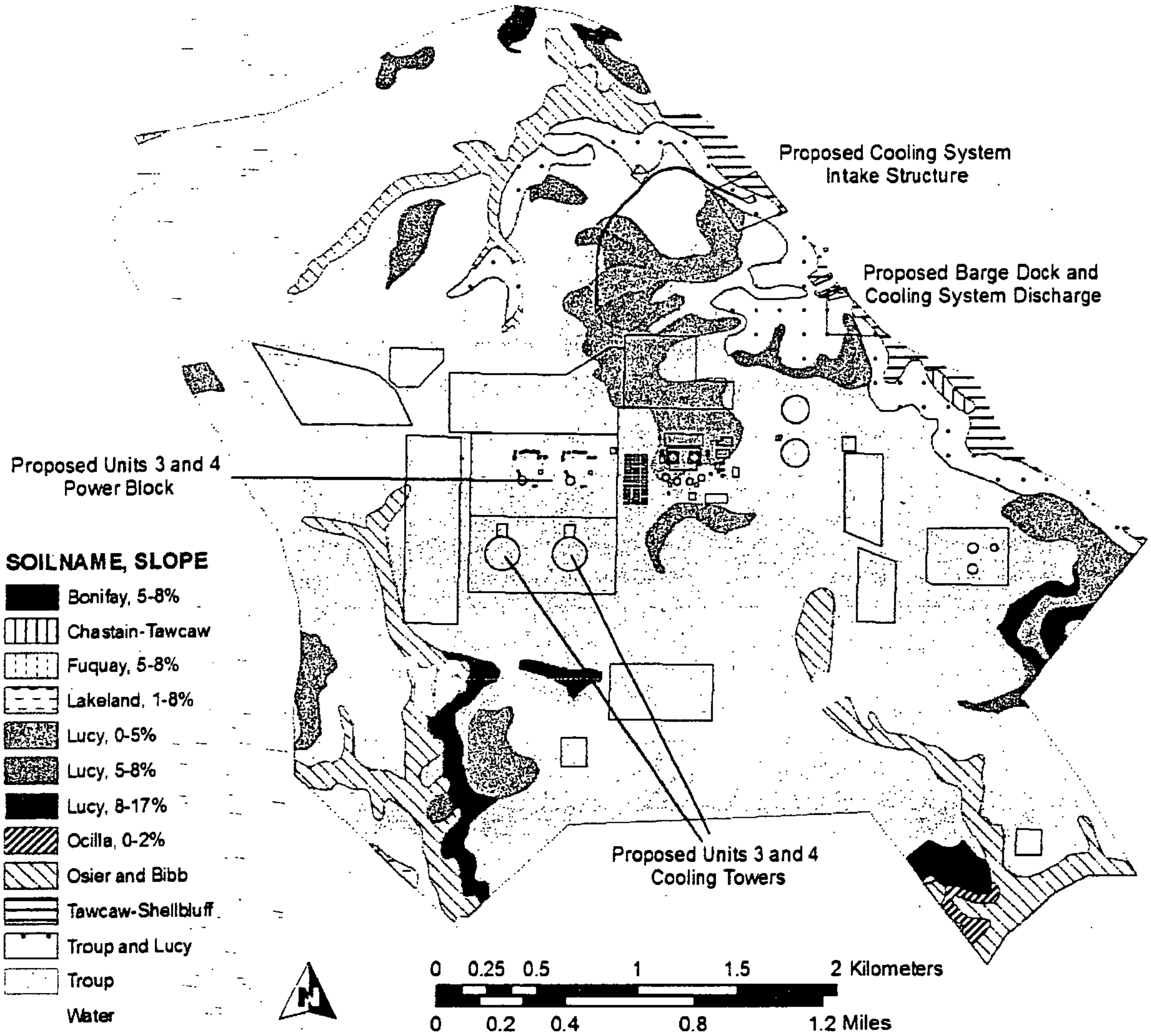


Figure 2-13. VEGP Soil Map (NRCS 2003a)

vegetated with a mix of planted pines and old field vegetation (Southern 2007a). Approximately 247.7 ha (612 ac) of hardwoods, 661.3 ha (1634 ac) of pine forests, and 38.8 ha (96 ac) of open areas such as mowed grass and old fields are on the VEGP site (Southern 2007a).

The land surrounding the VEGP site consists of both developed and undeveloped parcels. Pasture or farmland, pine plantations, and abandoned (old) fields predominate the developed portions, while much of the undeveloped land is composed of oak-hickory hardwoods and sand hill-upland pine communities (Southern 2006c, 2007a).

The Savannah River floodplain ranges from approximately 30 to 240 m (100 to 800 ft) wide at the VEGP site. However, most of the VEGP site is situated atop steep river bluffs along the Savannah River shoreline and is outside the floodplain (Southern 2007a). The top of the bluff is about 11.9 m (125 ft) above the high water mark.

Directly across the Savannah River from the VEGP site is the Savannah River Site, a DOE facility with restricted access (Southern 2007a). River swamp, bottomland hardwood, and upland pine-hardwood communities occur on the DOE Savannah River Site within 10 km (6 mi) of the VEGP site (Southern 2007a). The Savannah River Swamp comprises about 3800 ha (9400 ac) and borders the Savannah River on the southwestern edge of Savannah River Site, adjacent to the VEGP site (Wike et al. 2006).

The Yuchi WMA is immediately south of the VEGP site and is managed by GDNR for public deer and turkey hunting and primitive camping (Southern 2007a; GDNR 2006b). This WMA encompasses 3160 ha (7800 ac) and is composed of 101 ha (250 ac) of Savannah River bottom; 121 ha (300 ac) of creek bottom; 283 ha (700 ac) of mesic ravine; 2400 ha (6000 ac) of planted loblolly (*Pinus taeda*), slash (*P. elliottii*) or longleaf pine (*P. palustris*) of various ages; and 223 ha (550 ac) of native pine and mixed pine-hardwood (GDNR 2006b). Southern also maintains a public boat landing immediately downstream of the VEGP site that provides both employees and the general public access to the Savannah River for recreational purposes (Southern 2007a). In early 2003, Southern's Land Department began restoration of a forested area near the boat ramp, which included planting 26,000 longleaf pine trees and 15,000 wiregrass (*Aristida stricta*) plugs. VEGP partnered with National Wild Turkey Federation-Energy for Wildlife, GPC, and the Forestry for Wildlife Partnership on this restoration project (Southern 2006c). No other recreation areas occur within 10 km (6 mi) of the VEGP site (Southern 2007a).

The VEGP site has been designated as a Certified Wildlife Habitat since 1993. This designation is through the Wildlife Habitat Council, a non-profit, Washington D.C.-based wildlife organization (Southern 2007a). In July 2006, Southern submitted an application to the Wildlife Habitat Council for re-certification as a Certified Wildlife Habitat and was awarded this re-certification November 14, 2006 (Southern 2007b).

Although the VEGP site hosts ticks and mosquitoes, no vector-borne diseases have been reported at the site. In addition, there are no other pre-existing stresses or stressors to wildlife known to occur on the VEGP site (Southern 2006d, 2007a).

2.7.1.1 Terrestrial Communities of the VEGP Site

Wildlife Habitats on the VEGP site

The VEGP site is characterized by low, gently rolling sandy hills. Scrub oaks (turkey [*Quercus laevis*], post [*Q. stellata*] and willow oak [*Q. phellos*]), and longleaf pine occur in the upland wooded areas that were not previously cultivated. Red oak (*Q. rubra*), water oak (*Q. nigra*), and maple (*Acer sp.*) dominate the lowland hardwood areas. Bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) characterize the Savannah River floodplain. To prevent erosion, grasses and the small shrubby sericea lespedeza (*Lespedeza cuneata*) were planted in several open areas that were created during construction of VEGP Units 1 and 2 (Southern 2006c).

<u>Longleaf Pine Scrub-Oak and Oak-Hickory Upland Communities</u>

The longleaf pine-scrub oak community is found on ridge tops as well as south and west slopes in undisturbed upland areas on the VEGP site. Common canopy species in this habitat include longleaf pine, turkey oak, and bluejack oak (*Q. incana*). The shrub layer is composed of sparkleberry (*Vaccinium arboreum*), dwarf huckleberry (Gaylussacia dumosa), and yellow jessamine (*Gelsemium sempervirens*). The density and diversity of the herbaceous ground cover varies with the degree of canopy closure. Under dense shade, only clumps of slender woodoats (*Chasmanthium laxum*) are found. In more open areas, gopher weed *(Baptisia perfoliata*), jointweed (*Polygonella americana*), tread-softly (*Cnidoscolus stimulosus*), and reindeer lichen (*Cladina rangiferina*) are common (TRC 2006).

The north and east slopes in the undisturbed uplands support the more mesic oak-hickory community. The canopy in this community is mainly composed of white oak (*Q. alba*), white ash (*Fraxinus americana*), mockernut hickory (*Carya alba*), and flowering dogwood (*Cornus florida*). A few turkey oaks and a scattering of shortleaf pine (*P. echinata*) are also present (TRC 2006).

A steep bluff separates the dry upland forest from the intermittently flooded bottomland along the Savannah River. The bluff is completely wooded and in places still supports some very large trees, several in excess of 0.9 m (3 ft) in diameter. Common canopy species include oak, mockernut hickory, tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), American elm (*Ulmus americana*), basswood (*Tilia americana*), and Florida maple *(Acer barbatum*). The understory is composed of smaller trees, shrubs, and vines. Common understory species include pawpaw (*Asimina triloba*), hophornbeam (*Ostrya virginiana*), muscadine (*Vitis rotundifolia*), American beautyberry (*Callicarpa americana*), crossvine (*Bignonia capreolata*), and poison ivy (*Toxicodendron radicans*). The herbaceous ground cover varies with soil moisture. On the upper slope, where the soil is drier, Christmas fern (*Polystichum acrostichoides*), white snakeroot (*Ageratina altissima*), and several species of aster were most common. On the lower slopes and around seeps, dominant plant species include mottled trillium (*Trillium maculatum*), wild ginger (*Asarum canadense*), false nettle (*Boehmeria cylindrica*), and jewelweed (*Impatiens capensis*) (TRC 2006).

Planted Pine

The planted pine plantations on the VEGP site are of various ages and differ in the stocking rates. The plantations vary from a nearly closed canopy with very little understory, to areas that resemble old fields with only scattered pine. The sparse herbaceous ground cover in areas with a closed canopy consists of bracken fern (*Pteridium aquilinum*). In the more open areas dog fennel (*Eupatorium capillifolium*), broomsedge (*Andropogon virginicus*), and blackberry (*Rubus* sp.) are common. Loblolly and longleaf pines are the primary overstory species (TRC 2006). Pine plantations are managed through prescribed burning every 3 to 5 years, timber thinning after 20 years, and aesthetic cuts after thinning. Burning is limited to 25 to 30 percent of the upland and planted pine acreage each year (Southern 2006c). Planted loblolly plantations cover approximately 142 ha (350 ac) of lands that have been reclaimed from original plant construction (Southern 2006c).

Native longleaf pine are being reestablished by Southern on or near the VEGP site. These pines are managed on a long rotation basis, allowing the trees to live from 60 to 100 years (Southern 2006c).

Streams and Wetlands

The wetlands associated with the VEGP site include those near the Savannah River, as well as those near ponds and streams located onsite. Eco-Sciences was contracted by Southern to survey the VEGP site in December 2006 to determine where jurisdictional waters of the United States occur. They followed the three-parameter approach outlined in the USACE 1987 Wetlands Delineation Manual for the determination of jurisdictional wetland areas (USACE 1987). For the VEGP site, the USACE manual provides the legally mandated system for identifying Section 404 jurisdictional wetlands, and is based upon satisfying three criteria: the presence of hydrophytic vegetation, hydric soils, and wetland hydrology (Eco-Sciences 2007).

Approximately 69 ha (170 ac) of potential jurisdictional wetlands were identified on the site during the Eco-Sciences survey (Southern 2007b). These include 48 wetlands, 6 perennial streams, 13 intermittent streams, and 3 ephemeral streams. In early 2007, Southern submitted the Request for Jurisdictional Determination Form to the USACE and began the Section 404 permitting process (Southern 2007b).

Principal waterbodies onsite include Mallard Pond and two streams in the southern portion of the VEGP site (see Figure 2-1). Mallard Pond is a 2-ha (5-ac) pond in a hardwood cove just north of the proposed footprint for the proposed new VEGP Units 3 and 4 powerblock (Southern 2006c). A small unnamed stream at Hancock Landing drains Mallard Pond. From Mallard Pond, it flows north and east into the Savannah River. The stream is approximately 0.6 m (2 ft) to 1.2 m (4 ft) wide and less than 0.3 m (1 ft) deep, except where beavers (*Castor canadensis*) have created dams and ponds (Southern 2007a).

Two streams are located in the southern portion of the VEGP site (see Figure 2.1). One of these streams is located in the southwestern portion of the VEGP site and drains south through Debris Basin #2, into Daniels Branch and then into Telfair Pond. Telfair Pond drains to the east via Beaverdam Creek, which enters the Savannah River approximately 3.2 km (2 mi) downstream of the existing intake structure. The other small stream is in the southeastern portion of the site and flows south through the Debris Basin #1 (Southern 2007a). This unnamed tributary flows directly into Beaverdam Creek. Although Beaverdam Creek is outside the VEGP site boundary, the two small streams mentioned above are within the site. Eco-Sciences identified several wetland areas within each of these stream drainages during a jurisdictional water survey conducted in December 2006 (Eco-Sciences 2007), including wetlands associated with the two debris basins. Debris Basins #1 and #2 were originally built as stormwater retention basins during construction of VEGP Units 1 and 2.

Debris Basin #1 is about 2.4 ha (6 ac) in size, and Debris Basin #2 is about 2 ha (5 ac) (Southern 2006c). Eco-Sciences found the dominant vegetation in wetlands associated with Debris Basin #1 included black willow (*Salix nigra*), cinnamon fern (*Osmunda cinnamomea*), sweetgum, giant cane (*Arundinaria gigantea*), and red maple (*Acer rubrum*). Dominant vegetation associated with wetlands around Debris Basin #2 includes black willow, sedges (*Carex* spp.), greenbrier (*Smilax* spp.), sweetgum, and giant cane (Eco-Sciences 2007).

There is also a runoff catch pond between the two basins that was formed from a depression left after construction of VEGP Units 1 and 2. The runoff pond is about 1.2 ha (3 ac) in size and retains water throughout the year (Southern 2006c).

The natural or beaver enhanced wetlands associated with these drainages have open to closed canopies depending on water depth. In those areas with a tree canopy, the dominant species are water oak, red maple, and blackgum (*Nyssa sylvatica*). There is also a relatively dense understory of vines and shrubs composed of giant cane, trumpet creeper (*Campsis radicans*), muscadine, and American holly (*Ilex opaca*). The herbaceous ground cover is dominated by cinnamon fern and royal fern (*Osmunda regalis*) (TRC 2006).

The general habitat along the Savannah River at VEGP is a mix of hardwoods and bald cypress-water tupelo. Bald cypress and water tupelo are the dominant canopy species in the wetter sites along the river. American sycamore (*Platanus occidentalis*), boxelder (*A. negundo*), sugarberry (*Celtis laevigata*), and swamp chestnut oak (*Quercus michauxii*) occupy the slightly higher drier ground. The understory is composed of American holly, ironwood (*Carpinus* *caroliniana*), water locust (*Gleditsia aquatica*), giant cane, and buttonbush (*Cephalanthus occidentalis*). Ground cover is sparse and limited to those species that can survive both inundation and dense shade. Dominant groundcover species include richweed (*Pilea pumila*), lizard's tail (*Saururus cernuus*), sensitive fern (*Onoclea sensibilis*), and Virginia dayflower (Commelina virginica) (TRC 2006).

Southern has estimated that 9.1 ha (22.5 ac) of wetlands along the Savannah River would be affected during construction of the cooling water intake structure, the barge facility, and the discharge structure for the proposed VEGP Units 3 and 4 (Southern 2007b). Eco-Sciences (2007) identified three potential jurisdictional wetlands in the vicinity of these proposed structures. The soil in these wetlands is classified as loamy sand that is more than 91 cm (36 in.) deep. The dominant species present in two of the wetlands are bald cypress, American sycamore, and red maple. A smaller wetland (0.006 ha [0.015 ac]) is also located near the proposed water intake. The dominant species in this wetland include ironwood and giant cane.

A rare-plant survey was conducted by GDNR biologists on April 13, 2007, along the river bluffs at the proposed new water intake structure and the adjacent upland sandhill habitat. During this survey, GDNR did not observe any State-listed species (Patrick 2007).

<u>Wildlife Habitats in the Vicinity of the Proposed 500-kV Transmission Line</u>

In 2007, GPC completed a macro-corridor study to evaluate route alternatives for the proposed new 500 kV transmission line routing. The transmission line right-of-way is within the Piedmont and Coastal Plain Physiographic Regions of Georgia. The Piedmont is characterized by rolling hills and irregular plains. The soils are finely textured and can be highly erodable. The Coastal Plain is composed of mostly flat areas with some rolling hills with well-drained soils (GPC 2007). The modeled right-of-way was less than 1.6 km (1 mi) to little over 5 km (3 mi) in width and over 80 km (50 mi) in length (Southern 2007a). Using the EPRI-GTC (Electric Power Research Institute-Georgia Transmission Corporation) Transmission Line Siting Methodology, Southern and GPC identified a narrower corridor (termed the Representative Delineated Corridor [RDC]) that would be used as the basis for identifying actual routing of rights-of-way alternatives within it (see Figure 4-1). The RDC represents a narrowing of the modeled right-of-way to avoid wetlands and stream crossings and reduce the overall length and land potentially affected (GPC 2007).

There are no U.S. Forest Service Wilderness Areas, Wild/Scenic Rivers, Wildlife Refuges, State parks or national parks within the RDC (GPC 2007). The Savannah River and Brier Creek, a tributary of the Savannah River, are the primary waterways that occur in the corridor. The general wildlife habitats within the RDC include forested land, planted pine stands, open land, and open water. The exact habitat types within the new 500-kV transmission line right-of-way are not known at this time, but it is assumed it would include similar habitats. GPC has estimated the total acreage for a 46-m (150-ft)-wide hypothetical representative right-of-way within the RDC to be 416 ha (1029 ac) of land. GPC estimates that a right-of-way could contain about 23 percent forest, 32 percent planted pine, and 15 percent open land (see Table 4-1) (Southern 2007e).

Wildlife Species on the VEGP Site

Wildlife species found on the VEGP site are representative of those commonly found in eastern Georgia (Southern 2007a). There have been 19 mammal species identified on the site (Southern 2006c). Common mammals onsite include the white-tailed deer *(Odocoileus virginianus*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis)*, Eastern cottontail (*Sylvilagus floridanus*), coyote (*Canis latrans*), and gray fox (*Urocyon cinereoargenteus*). Small mammals such as moles, shrews, and a variety of mice and voles also occur onsite (Southern 2007a). Sixty species of reptiles and amphibians have been identified onsite including the American alligator (*Alligator mississippiensis*), green anole (*Anolis carolinensis carolinensis)*, bullfrog (*Rana catesbeiana*), and many other snakes, turtles, salamanders, lizards, and toads (Southern 2006c). Habitats located in the vicinity of the VEGP site are suitable for a variety of migratory songbirds, upland game birds, waterfowl, and raptors. One hundred-forty three bird species have been identified onsite (Southern 2006c). Common bird species at the VEGP site include the American crow (*Corvus brachyrhynchos*), Northern bobwhite quail (*Colinus virginianus*), blue jay (*Cyanocitta cristata*), Carolina chickadee (Poecile carolinensis), mourning dove (*Zenaida macroura*), black vulture (*Coragyps atratus*), turkey vulture (*Cathartes aura*), song sparrow (*Melospiza melodia*), white-throated sparrow (*Zonotrichia albicollis*), dark-eyed junco (*Junco hyemalis*), Northern cardinal (*Cardinalis cardinalis*), tufted titmouse (*Baeolophus bicolor*), red-bellied woodpecker (*Melanerpes carolinus*), and Northern flicker (*Colaptes auratus*) (Southern 2007a).

Southern started bluebird (*Sialia sialis*) and wood duck (*Aix sponsa*) nest monitoring programs in March 1993 by placing bluebird and wood duck nest boxes in suitable nesting habitats at the VEGP site. Wood duck boxes are located on Mallard Pond, Debris Basins #1 and #2, the run-off catch pond, and the river boat ramp. In the last 3 years, Southern has recorded up to 50 fledglings from these locations each year (Southern 2006c).

The primary game species at the VEGP site are Eastern cottontail, white-tailed deer, gray squirrel, Northern bobwhite quail, mourning dove, and American woodcock (*Scolopax minor*). Turkey (*Meleagris gallopavo*) are also commonly found on the VEGP site. Land management practices to benefit turkey and Northern bobwhite quail have been in place since 1983. Southern plants browntop millet, rye, and chufa to benefit the turkey, quail, and other birds on the VEGP site and food plots are provided for quail (Southern 2006c). The reestablishment of longleaf pine onsite also provides cover for quail and turkey (Southern 2006c). There are no significant "travel corridors" for game species on the VEGP site (Southern 2007a).

Southern has partnered with the non-game management branch of GDNR, the Southeast region of the National Fish and Wildlife Federation, National Wild Turkey Federation, and the Migratory Bird Division of the U.S. Fish and Wildlife Service (FWS) on wildlife enhancements programs and habitat management projects on the VEGP site (Southern 2006c).

Wildlife Species in the Vicinity of the Proposed 500-kV Transmission Line

Common Georgia wildlife species occurring along the transmission line right-of-way are expected to be similar to those found on the VEGP site.

State-Listed Species in the Vicinity of the VEGP site

This section describes Georgia and South Carolina State-listed and proposed threatened and endangered terrestrial species and designated and proposed critical habitat that may occur in the vicinity of the site. State-listed endangered, threatened, and other special-status species that may occur in the vicinity of the VEGP site are listed in Table 2-3. This list is composed of Georgia State-listed species with recorded occurrences in Burke County (GDNR 2007a), species listed on the FWS website as having the potential to occur in Burke County (FWS 2004), or species within 16 km (10 mi) of the site in Aiken and Barnwell Counties in South Carolina (SCDNR 2007a). A rare plant survey was conducted by GDNR biologists on April 13, 2007, along the river bluffs at the proposed new water intake structure and adjacent upland sandhill habitat. No State-listed species were observed during this survey (Patrick 2007). During the spring (April 12 to 21), summer (August 22 to 31), and fall (October 2 to November 2) of 2005, Third Rock Consultants, LLC (TRC) conducted three surveys at the VEGP site for State-listed species classified as threatened and endangered (TRC 2006).

Bay star-vine (*Schisandra glabra*), State-listed as threatened in Georgia, was the only State-listed species found at the site. Bay star-vine is found twining over understory trees in rich forested areas, especially bottomlands and slopes. Older vines may occur on overstory tree trunks or rooted while sprawling along the ground, especially near mountain laurel (*Kalmia latifolia*) thickets (Patrick et al. 1995). The bay star-vine was found at several locations along the wooded bluff bordering the Savannah River, including in the area of the proposed cooling water intake, and in a wooded wetland in the southern portion of the VEGP site (Southern 2007b).

Table 2-3. South Carolina and Georgia State-Listed Terrestrial Species with Known Occurrence within 16 km (10 mi) of the VEGP Site. [a][b][c]

Scientific Name	Common Name	Georgia State Status	South Carolina State Status	County of Occurrence
Plants				
Agalinis linifolia	flaxleaf false-foxglove		SC	Aiken
Allium cuthbertii	striped garlic		SC	Barnwell/Aiken
Astragalus michauxii	sandhills milkvetch		SC	Barnwell
Astragalus villosus	bearded milkvetch		SC	Barnwell
Baptisia lanceolata	lance-leaf wild-indigo		SC	Barnwell
Carex cherokeensis	Cherokee sedge		SC	Barnwell
Carex decomposita	cypress-knee sedge		SC	Barnwell
Carex socialis	social sedge		SC	Barnwell
Coreopsis rosea	rose coreopsis		RC	Barnwell/Aiken
Croton elliottii	Elliott's croton		SC	Barnwell/Aiken
Echinacea laevigata	smooth coneflower	SE	SE	Barnwell/Aiken
Echinodorus parvulus	dwarf burhead		SC	Barnwell/Aiken
Elliottia racemosa	Georgia plume	ST		Burke
Epidendrum conopseum	green-fly orchid		SC	Barnwell
Gaura biennis	biennial gaura		SC	Barnwell/Aiken
Ilex amelanchier	sarvis holly		SC	Barnwell/Aiken
Lindera subcoriacea	bog spicebush		RC	Barnwell/Aiken
Ludwigia spathulata	spatulate seedbox		SC	Barnwell/Aiken
Macbridea caroliniana	Carolina bird-in-a-nest		SC	Barnwell
Monarda didyma	Oswego tea		SC	Barnwell
Nestronia umbellula	Indian olive	SR	SC	Barnwell/Aiken, Burke
Nolina georgiana	Georgia beargrass		SC	Barnwell/Aiken
Paronychia americana	American nailwort		SC	Barnwell
Platanthera lacera	green-fringed orchid		SC	Barnwell/Aiken
Quercus sinuata	Durand's white oak		SC	Barnwell
Rhododendron flammeum	Piedmont azalea		SC	Barnwell/Aiken
Rhynchospora inundata	drowned hornedrush		SC	Barnwell/Aiken
Rorippa sessiliflora	stalkless yellowcress		SC	Barnwell
Sagittaria isoetiformis	slender arrow-head		SC	Barnwell
Sarracenia rubra	sweet pitcherplant	ST		Burke

Table 2-3. (contd)

Scientific Name	Common Name	Georgia State Status	South Carolina State Status	County of Occurrence
Schisandra glabra	Bay star-vine	ST		Burke, found on the VEGP site
Scutellaria ocmulgee	Ocmulgee skullcap	ST		Burke
Trepocarpus aethusae	Aethusa-like trepocarpus		SC	Barnwell
Utricularia floridana	Florida bladderwort		SC	Barnwell
Mammals				
Condylura cristata	star-nosed mole		SC	Barnwell/Aiken
Corynorhinus rafinesquii	Rafinesque's big-eared bat	SR	SE	Barnwell/Aiken
Geomys pinetis	southeastern pocket gopher	ST		mounds in Burke County[c]
Neotoma floridana	eastern woodrat		SC	Barnwell, Aiken
Spilogale putorius	eastern spotted skunk		SC	Aiken
Birds[d]				
Haliaeetus leucocephalus	bald eagle	ST	SE	Barnwell
Mycteria americana	wood stork	SE	E	Barnwell
Picoides borealis	red-cockaded woodpecker	SE	SE	Barnwell/Aiken
Amphibians and Reptiles				
Ambystoma tigrinum tigrinum	eastern tiger salamander		SC	Barnwell
Heterodon simus	southern hognose snake	ST	SC	Barnwell/Aiken
Hyla avivoca	bird-voiced treefrog		SC	Barnwell/Aiken
Micrurus fulvius	eastern coral snake		SC	Barnwell/Aiken
Pituophis melanoleucus	pine snake		SC	Barnwell/Aiken
Rana capito	gopher frog	SR	SE	Barnwell/Aiken
Seminatrix pygaea	black swamp snake		SC	Barnwell

(a) State status determined by the GDNR and SCDNR : SE = State endangered, ST = State threatened, SR = State Rare, SU = State Unusual, RC= Of concern regionally, SC = species of concern (GDNR 2007a; SCDNR 2007a).

(b) All State occurrence data and distances are provided by GDNR (2007a) and SCDNR (2007a).

(c) All species listed have known occurrences between 2 and 10 mi from the VEGP site. The only State-listed species known to occur within 3.2 km (2 mi) of the site is the bay star-vine. Mounds indicative of the southeastern pocket gopher have been found on the property just north of the VEGP site (Southern 2007a).

(d) The bald eagle, wood stork and red-cockaded woodpecker are listed as potentially occurring in Burke County (FWS 2004). However, there are no records of these species in Burke Country within 16 km (10 mi) of the VEGP site.

With the exception of bay star-vine described above, there are no known State-listed plant species occurrences within 3.2 km (2 mi) of the VEGP site (GDNR 2007a; SCDNR 2007a).

Four Georgia State-listed plant species have been recorded in Burke County within 16 km (10 mi) of the VEGP site: Ocmulgee skullcap (*Scutellaria ocmulgee*), Georgia plume (*Elliottia racemosa*), sweet pitcherplant (*Sarracenia rubra*), and Indian olive (*Nestronia umbellula*). All are listed as State threatened except for the Indian olive, which is listed as rare in Georgia. The smooth coneflower (*Echinacea laevigata*) is listed in both Georgia and South Carolina as State-endangered; rose coreopsis (*Coreopsis rosea*) and bog spicebush (*Lindera subcoriacea*) are of concern regionally; and 29 additional plant species are of concern both locally and regionally in South Carolina within 16 km (10 mi) of the VEGP site.

Three Georgia State-listed bird species, the bald eagle (*Haliaeetus leucocephalus*), wood stork (*Mycteria americana*), and red-cockaded woodpecker (*Picoides borealis*), have the potential to occur in suitable habitats within Burke County (FWS 2004). The wood stork and red-cockaded woodpecker are also Federally endangered. These species are discussed in Section 2.7.1.2. Red-cockaded woodpeckers and wood storks have been observed on the Savannah River Site, which is in South Carolina adjacent to the VEGP site (Wike et al. 2006).

The bald eagle is currently listed as State-threatened in Georgia and South Carolina. It was federally delisted on July 9, 2007 (72 FR 37346). Bald eagles are found throughout the United States, are permanent Georgia residents, and are most abundant in the coastal region (GDNR 2007b). In 2005, there were 82 known occupied nests in Georgia. Although the coastal region has the greatest density of nesting eagles, territories are found throughout much of the state where there is sufficient open water habitat and large trees for nesting (GDNR 2007b). Records of bald eagle sightings in the Savannah River area date back to 1904 (Wike et al. 2006).

Bald eagle nests are large, measuring up to 1.8 m (6 ft) across. Nest sites typically include at least one perch with a clear view of the water where the eagles usually forage (FWS 2006). Nests in the region around the VEGP site are typically found in large pine trees (Wike et al. 2006). However, eagles are also known to occasionally nest in cypress trees. Fish are the major component of the diet, which results in the majority of nest sites being built near a body of water such as coastal shorelines, bays, rivers, lakes, farm ponds, and reservoirs. Winter foraging areas are usually located near open water on rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant. Bald eagles also feed on other prey species such as waterfowl, gulls, rabbits, rodents, deer, and carrion (FWS 2003a, 2006).

The bald eagle is listed as having the potential to occur in the vicinity of the VEGP site, in Burke County, Georgia (FWS 2004) as well as Aiken and Barnwell Counties in South Carolina (FWS 1999). There are no known historical occurrences of bald eagles on the site, and bald eagles were not identified in the 2005 threatened and endangered species survey (Southern 2006d; TRC 2006). Bald eagles have been recorded within 3.2 km (2 mi) of the VEGP site in the Savannah River Swamp on the DOE Savannah River Site, but known nest locations on the Savannah River Site are more than 8 km (5 mi) away (Wike et al. 2006). The majority of bald eagles seen on Savannah River Site have been reported in the Par Pond system more than 16 km (10 mi) from the VEGP site. The last successful nesting attempt on the Savannah River Site was in 1998 (Wike et al. 2006). Bald eagles are observed during all months of the year on the Savannah River Site, but most eagles are seen during the fall and winter when this species is nesting and wintering in the region. Birds seen during the summer are most likely migratory transients (Wike et al. 2006).

It is unlikely that bald eagles would be nesting onsite. However, bald eagles may occasionally use large trees along the Savannah River or in wetland areas for roosting or perching.

Although no State-listed herpetofauna have been reported in Georgia within 16 km (10 mi) of the VEGP site, seven species have been observed within this distance in South Carolina (SCDNR 2007a), including the gopher frog (*Rana capito*), which is South Carolina endangered and Georgia rare, and six species of various levels of concern in one or both states: (1) eastern tiger salamander (*Ambystoma tigrinum tigrinum*), (2) southern hognose snake (*Heterodon simus*), (3) bird-voiced treefrog (*Hyla avivoca*), (4) eastern coral snake (*Micrurus fulvius*), (5) pine or gopher snake (*Pituophis melanoleucus*), and (6) black swamp snake (*Seminatrix pygaea*).

Listed mammals within 16 km (10 mi) of the VEGP site have only been recorded in South Carolina (SCDNR 2007a). Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), a South Carolina endangered species, has been observed in Barnwell and Aiken Counties. The star-nosed mole (*Condylura cristata*), eastern woodrat (*Neotoma floridana*), and eastern spotted skunk (*Spilogale putorius*), are State species of concern in Aiken and/or Barnwell Counties in South Carolina.

In October 2006, the GDNR updated its list of protected species, including the addition of the threatened southeastern pocket gopher (*Geomys pinetis*). This species was not targeted in the 2005 threatened and endangered species surveys of the site (NRC 2007c). There are no known records of the pocket gopher in Burke County (GDNR 2007a). However, surface mounds indicative of the pocket gopher have been observed in property bordering the northern part of the VEGP site (Southern 2007a). The southeastern pocket gopher is found in upland areas of dry, sandy soil or well-drained, fine-grained gravely soil (GDNR 2000).

State-Listed Species in the Vicinity of the Proposed 500-kV Transmission Line

Fourteen State-listed plant species have been recorded within the counties the proposed 500-kV transmission line may cross (Burke, Jefferson, McDuffie, Warren) (Table 2-4). Canby's dropwort is Federally endangered and is discussed in Section 2.7.1.2. In addition to the State-threatened sandhill rosemary (*Ceratiola ericoides*), Ocmulgee skullcap, Georgia plume, and sweet pitcherplant already discussed in the VEGP site vicinity, Georgia aster (*Symphyotrichum georgianum*), Oglethorpe oak (*Quercus oglethorpensis*), and granite stonecrop (*Sedum pusillum*) also occur in the right-of-way counties. Georgia aster is a Federal candidate and is discussed in Section 2.7.1.2. Indian olive, silky camellia (*Stewartia malacodendron)*, cutleaf beardtongue (*Penstemon dissectus*), and Carolina bogmint (*Macbridea caroliniana*) are State-listed rare species within the corridor counties. State-listed species classified as unusual in these counties include the hooded pitcherplant (*Sarracenia minor*) and pink ladyslipper (*Cypripedium acaule*).

The State-listed animal species with potential to reside in these counties are the same species that have the potential to occur in the vicinity of the VEGP site: bald eagle, wood stork, red-cockaded woodpecker, gopher frog, southern hognose snake, spotted turtle, and flatwoods salamander.

Three State-listed species have been documented by the GDNR as occurring within the RDC: the silky camellia, sandhill rosemary, and bald eagle. The silky camellia (Georgia rare) typically occurs within the rich understory along streams and open edges of lower slopes with beech (*Fagus* sp.), magnolia (*Magnolia sp.)*, and Florida maple (*A. barbatum*) (Patrick et al. 1995). Sandhill rosemary is an evergreen shrub, and consistent with its namesake, it is found in deep sand ridges typical of the Ohoopee Dunes of Georgia (Patrick et al. 1995).

The bald eagle is listed as potentially occurring within Burke, Jefferson, McDuffie, and Warren Counties (FWS 2004). There is one known location of an active nest in the McDuffie County portion of the RDC. GPC stated that they would ensure the right-of-way would not come within 180 m (600 ft) of this known bald eagle nesting site (GPC 2007). In addition, there are several bald eagle nests within 16 km (10 mi) of the RDC in Jefferson County (GDNR 2007b). In the absence of a ground or aerial survey for bald eagles in suitable foraging, roosting, and nesting habitat in areas that would be affected by construction of the proposed 500-kV transmission line, it is unknown if this species occurs at additional locations within the RDC.

2.7.1.2 Threatened and Endangered Terrestrial Species

This section describes Federally listed and proposed threatened and endangered terrestrial species and designated and proposed critical habitat that may occur in the vicinity of the site and in the vicinity of the proposed 500-kV transmission line. Endangered, threatened, and other special-status species that may occur in the vicinity of the VEGP site are listed in Table 2-5. This list is composed of Federally listed species with recorded occurrences in Burke County (GDNR 2007c) , species listed on the FWS website as having the potential to occur in Burke County (FWS 2004), or species within 16 km (10 mi) of the site in Aiken and Barnwell Counties in South Carolina (SCDNR 2007a).

Table 2-4. State-Listed Terrestrial Species in Georgia Counties Crossed by the Proposed Thomson-Vogtle Transmission Line Right-of-Way (Warren, McDuffie, Burke, Jefferson Counties)

Scientific Name	Common Name	Georgia State Status[a]	Counties of Occurrence
Plants			
Ceratiola ericoides	sandhill rosemary	ST	Burke
Cypripedium acaule	pink ladyslipper	SU	McDuffie
Elliottia racemosa	Georgia plume	ST	Burke
Macbridea caroliniana	Carolina bogmint	SR	McDuffie
Nestronia umbellula	Indian olive	SR	Burke, Jefferson
Oxypolis canbyi	Canby's dropwort	SE	Burke
Penstemon dissectus	cutleaf beardtongue	SR	Jefferson
Quercus oglethorpensis	Oglethorpe oak	ST	McDuffie
Sarracenia minor	hooded pitcherplant	SU	Burke
Sarracenia rubra	sweet pitcherplant	ST	Burke, Jefferson
Scutellaria ocmulgee	Ocmulgee skullcap	ST	Burke
Sedum pusillum	granite stonecrop	ST	Warren
Stewartia malacodendron	silky camellia	SR	Burke
Symphyotrichum georgianum	Georgia aster	ST	McDuffie
Birds[b]			
Haliaeetus leucocephalus	bald eagle	ST	Burke, Jefferson, McDuffie, Warren
Mycteria americana	wood stork	SE	Burke, Jefferson
Picoides borealis	red-cockaded woodpecker	SE	Burke, Jefferson
Amphibians and Reptiles			
Ambystoma cingulatum	flatwoods salamander	ST	Burke, Jefferson
Clemmys guttata	spotted turtle	SU	Burke, Jefferson, Warren
Heterodon simus	southern hognose snake	ST	Burke, Jefferson, McDuffie
Rana capito	gopher frog	SR	Burke

(a) State status determined by the GDNR: SE = State Endangered, ST = State Threatened, SR = State Rare, SU = State Unusual (GDNR 2007c).

(b) Counties for the listed bird species based on GDNR (2007c) and FWS (2004).

Table 2-5. Federally Listed Terrestrial Species Occurring in the Vicinity of the VEGP Site

Scientific Name	Common Name	Federal Status[a]	County of Occurrence	Distance from the VEGP Site[b]
Plants				
Echinacea laevigata	smooth coneflower	E	Aiken, Barnwell	< 16 km (10 mi)
Oxypolis canbyi	Canby's dropwort	E	Burke	>16 km (10 mi)
Trillium reliquum	relict trillium	E	Aiken	> 16 km (10 mi)[c]
Birds				
Mycteria americana	wood stork	E	Barnwell, Aiken, Burke	< 3.2 km (2 mi)
Picoides borealis	red-cockaded woodpecker	E	Barnwell, Aiken, Burke	16 km (10 mi)
Amphibians and Reptiles				
Alligator mississippiensis	American alligator	T(S/A)	Barnwell, Aiken, Burke	Occurs onsite [d]
Ambystoma cingulatum	flatwoods salamander	T	Burke	>16 km (10 mi)

(a) Federal status rankings determined by the FWS under the Endangered Species Act, E = Federal Endangered, T = Threatened, T(S/A) = Threatened by similarity of appearance (FWS 2004).
(b) (GDNR 2007c; SCDNR 2007a; Wike et al. 2006)
(c) Suitable habitat exists for the relict trillium onsite (PNNL 2006)
(d) TRC (2006)
Species included in this table meet at least one of the following criteria:
- species have been recorded to occur on the VEGP site
- species have been recorded to occur within 16 km (10 mi) of the VEGP site in Aiken and Barnwell Counties, South Carolina
-species are listed by FWS (2004) as occurring or having the potential to occur in Burke County, Georgia
-species were known to have suitable habitat on the VEGP site

A list of Federally listed species occurring in counties may be crossed by the proposed new 500-kV transmission line (Burke, Jefferson, McDuffie, Warren) was obtained from FWS county listings for the State of Georgia, and location information was obtained from the GDNR element occurrence database (Table 2-6) (FWS 2004; GDNR 2007c).

Table 2-6. Federally Listed Terrestrial Species in Counties that are Proposed to Contain the Proposed Thomson-Vogtle Transmission Line Right-of-Way (Burke, McDuffie, Jefferson and Warren Counties in Georgia)

Scientific Name	Common Name	Federal Status[a]	Counties of Occurrence
Plants			
Oxypolis canbyi	Canby's dropwort	E	Burke
Symphyotrichum georgianum	Georgia aster	C	McDuffie
Birds			
Mycteria americana	wood stork	E	Burke, Jefferson
Picoides borealis	red-cockaded woodpecker	E	Burke, Jefferson
Herpts			
Alligator mississippiensis	American alligator	T(S/A)	Burke
Ambystoma cingulatum	flatwoods salamander	T	Burke

(a) Federal status rankings determined by the FWS under the Endangered Species Act, C = Candidate E = Endangered, T = Threatened, T(S/A) = Threatened by similarity of appearance (FWS 2004).

Surveys conducted by TRC in the spring, summer, and fall of 2005 took place on 675.4 ha (1669 ac) of the 1282.5 ha (3169 ac) that comprise the VEGP site (Figure 2-14). These surveys were conducted on all known areas that would be disturbed by preconstruction and construction activities for the proposed VEGP Units 3 and 4 (Southern 2007b). A majority of the areas surveyed on the site were areas that had not been previously disturbed during original construction (TRC 2006). No Federally listed plant species were found on the VEGP site during the 2005 surveys. The American alligator was the only Federally listed animal species observed on the VEGP site during the 2005 surveys. One adult alligator was observed in Mallard Pond during the summer survey. It is listed as "threatened due to similarity of appearance" to the endangered American crocodile (*Crocodylus acutus*) (TRC 2006).

Three Federally listed terrestrial plant and four animal species have the potential to occur in the vicinity of the VEGP site. One Federally listed terrestrial plant and four animal species and one Federal candidate species have the potential to occur in the vicinity of the proposed transmission line right-of-way. There is no designated or proposed critical habitat for terrestrial species known to occur on or in the general area of the site or in the general vicinity of the proposed transmission line right-of-way.

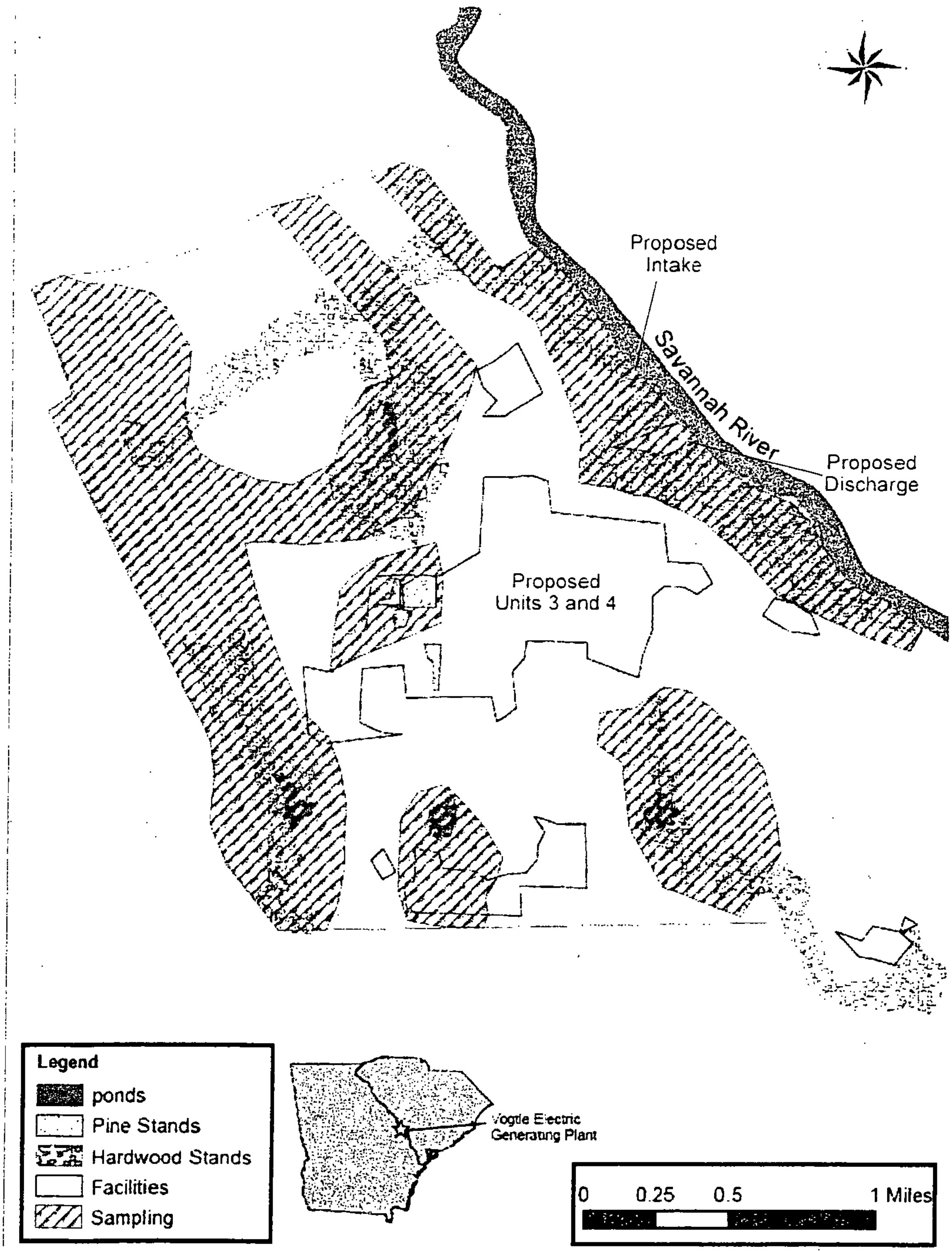


Figure 2-14. 2005 Threatened and Endangered Species Survey Locations at the VEGP Site (Southern 2007b).

Red-Cockaded Woodpecker – Endangered

The red-cockaded woodpecker (*Picoides borealis*) was listed by the FWS as endangered in 1970 (35 FR 16047). Historically, the red-cockaded woodpecker's range extended from north Florida to New Jersey and Maryland, as far west as Texas and Oklahoma, and inland to Missouri, Kentucky, and Tennessee. This species has been extirpated in New Jersey, Maryland, Tennessee, Missouri, and Kentucky (FWS 2007a), and today it is estimated that about 6000 family groups of red-cockaded woodpeckers, or 15,000 birds, from Florida to Virginia and west to southeast Oklahoma and eastern Texas represent about 1 percent of the woodpecker's original range (FWS 2007a). Critical habitat has not been established for red-cockaded woodpeckers (FWS 2007b). In 1998, there were 665 family groups of red-cockaded woodpeckers in Georgia (GDNR 1999).

The red-cockaded woodpecker is endemic to open, mature, and old growth pine ecosystems in the southeastern United States. Red-cockaded woodpeckers require open pine woodlands and savannahs with large old pines for nesting and roosting habitat for family groups (clusters). Large old pines are required as cavity trees because the cavities are excavated completely within inactive heartwood and the higher incidence of heartwood decay in older trees greatly facilitates excavation. Cavity trees must be in open stands with little or no hardwood midstory and few or no overstory hardwoods. Suitable foraging habitat consists of mature pines with an open canopy, low densities of small pines, little or no hardwood or pine midstory, few or no overstory hardwoods, and abundant native bunchgrass and forb groundcovers (FWS 2003b).

Red-cockaded woodpeckers are a cooperatively breeding species, living in family groups that typically consist of a breeding pair with or without one or two male helpers. In red-cockaded woodpeckers (and other cooperative breeders), a large pool of helpers is available to replace breeders when they die. Helpers do not disperse very far and typically occupy vacancies on their natal territory or a neighboring one (FWS 2003b). A typical territory for an active group ranges from approximately 51 to 80 ha (125 to 200 ac), but can be as large as 240 ha (600 ac). The size of the particular territory is related to both habitat and population density (FWS 2007a). Dispersal is undertaken primarily by young birds. Mate loss and an apparent avoidance of inbreeding sometimes causes adults to disperse, and adults may also occasionally move to neighboring territories for unknown reasons (Walters et al. 1988). In a North Carolina study, females dispersed a maximum of 31.4 km (19.5 mi) and males a maximum of 21.1 km (13.1 mi) (Walters et al. 1988).

Southern is currently working on enrolling the VEGP site in the GDNR Safe Harbor Program. Safe Harbor Agreements are arrangements that encourage voluntary management for red-cockaded woodpeckers while protecting the participating landowners and their rights for development in the event these woodpeckers become established on the private property. Landowners entering into safe harbor agreements must establish a baseline number of individuals that would be maintained in the event that they are observed. Surveys at the VEGP site conducted in February 2006 found no occurrence of red-cockaded woodpeckers onsite. Southern expects to have the Safe Harbor Agreement in place by the end of 2007 (Southern 2006c).

There are no recorded occurrences of the red-cockaded woodpecker in Burke County, Georgia (GDNR 2007a) or 16 km (10 mi) of the site in South Carolina (SCDNR 2007a); however, red-cockaded woodpeckers are listed as having the potential to occur in Burke County in Georgia (FWS 2004) and Aiken and Barnwell Counties in South Carolina (FWS 1999). There are no known historical occurrences of the red-cockaded woodpecker on the VEGP site and they were not identified in the 2005 threatened and endangered species survey or the 2006 Safe Harbor baseline survey (Southern 2006c, 2006d, 2007a; TRC 2006). In 2003, a total of 177 red-cockaded woodpeckers in 45 family groups were recorded on the Savannah River Site, with the closest active colony being approximately 16 km (10 mi) from the VEGP site (Wike et al. 2006). Suitable habitat for the red-cockaded woodpecker exists on the VEGP site, but this habitat is not in the vicinity of the construction area footprint.

Proposed 500-kV Transmission Line

The red-cockaded woodpecker has the potential to occur in Burke and Jefferson Counties (FWS 2004). In addition, the red-cockaded woodpecker has been recorded on Fort Gordon, which is adjacent to the RDC (GDNR 1999). In 1998, there were two active groups on Fort Gordon, representing less than 1 percent of the total number of groups in Georgia. There are no known occurrences of the red-cockaded woodpecker in the general vicinity of the proposed RDC (GDNR 2007a). At this time, it is not known if suitable nesting or foraging habitat exists in the vicinity of the proposed 500-kV transmission line right-of-way.

Wood Stork – Endangered

Breeding populations of the wood stork (*Mycteria americana*) are Federally listed as endangered and currently occur or have recently occurred only in Alabama, Florida, Georgia, and South Carolina (49 FR 7332; FWS 1997). There were 13 active colonies of wood storks in Georgia during the 2002 breeding season with an estimated 1227 nesting pairs (FWS 2003c). No critical habitat has been designated for this species (FWS 2007c).

The wood stork is a highly colonial species, usually nesting and feeding in flocks. The wood stork inhabits freshwater and brackish wetlands, and normally nests in cypress or mangrove swamps. At freshwater sites, nests are often constructed in cypress and blackgum. Wood storks in Georgia and South Carolina lay eggs from March to late May, with fledging occurring in July and August (FWS 1997).

Wood storks have a unique feeding technique (tacto-location) and typically require higher prey concentrations than other birds. They tend to rely on depressions in marshes or swamps where prey can become concentrated during low-water periods (FWS 1997). A study from a wood stork colony in east-central Georgia found the diet was mostly composed of fish, including sunfish (*Lepomis* sp.), bowfin (*Amia calva*), redfin pickerel (*Esox americanus americanus*), and lake chubsuckers (*Erimyzon* sp.) (FWS 1997).

Wood storks in east-central Georgia forage in a wide variety of habitats including hardwood and cypress swamps, ponds, marshes, drainage ditches, and flooded logging roads. Typical wood stork foraging sites have reduced quantities of both submerged and emergent macrophytes. The water in the foraging areas is either still or very slowly moving, and the depth is normally between 5 and 41 cm (2 and 16 in.). It has been suggested storks may have difficultly feeding in water more than 50 cm (20 in.) deep (Coulter and Bryan 1993).

Differences among season, rainfall, and surface-water patterns often cause storks to change where and when certain habitats are used for nesting, feeding, or roosting. These hydrological changes may cause storks to shift the timing or intensity of feeding at a local wetland, or cause entire regional populations of birds to make large geographic shifts between one year and the next. Because nesting storks generally use foraging sites that are located within about 50 km (31 mi) of the colony, successful colonies are those that are in regions where birds have options to feed under a variety of rainfall and surface-water conditions. Maintaining a wide range of feeding site options requires that many different types of wetlands, both large and small and with relatively long and short annual hydroperiods, be available for foraging (FWS 1997).

The closest known wood stork colonies to the VEGP site are located in Jenkins and Screvin Counties, Georgia. The Birdsville colony is located at Big Dukes Pond, a 570-ha (1400-ac) cypress swamp, 12.6 km (7.8 mi) northwest of Millen, in Jenkins County, Georgia. The site is approximately 45 km (28 mi) from the Birdsville colony. The Chew Mill Pond colony in Jenkins County is approximately 6 km (3.7 mi) southwest of the Birdsville colony. Chew Mill Pond has a history of being a wood stork foraging site and a wading bird rookery. Researchers consider it to be an overflow or satellite colony of the Birdsville colony (Wike et al. 2006). The Jacobsons Landing colony, in Screven County is approximately 43 km (27 mi) southeast of the VEGP site. In 1996, it contained an estimated 40 wood stork nests. These colonies are all within 60 to 70 km (37 to 43 mi) of the VEGP site, the maximum radius that wood storks can travel during daily feeding flights (Coulter and Bryan 1993). Wood storks have been recorded foraging throughout Burke County (Coulter and Bryan 1993; Wike et al. 2006), and within 3.2 km (2 mi) of the site in the Savannah River Swamp on the Savannah River Site in South Carolina (Wike et al. 2006).

Wood storks were reported in the vicinity of the DOE Savannah River Site before the site was established in 1952, and before the discovery of the Birdsville colony. Storks have been followed from the Birdsville colony to the Savannah River Site. Data from the aerial wood stork surveys of the Savannah River Swamp and the studies at the Birdsville colony suggest that the Savannah River Swamp probably is not used extensively during the breeding or prefledging phases of the Birdsville colony. Most of the observations of storks on the DOE Savannah River

Site occur during the late-nestling or the post-fledging period, which occurs between June and September. Some of the birds observed foraging in the Savannah River Swamp may be storks from farther south, either non-breeders or birds that have already finished breeding for the year (Wike et al. 2006).

No wood storks were identified in the threatened and endangered species surveys completed onsite in 2005, and there are no known historical records of wood storks occurring on the VEGP site (Southern 2006d; TRC 2006). The closest known colony is more than 40 km (25 mi) from the VEGP site. Although forage areas may be 60 to 70 km (37 to 43 mi) from the colony, 85 percent are within 19 km (12 mi) (Coulter and Bryan 1993). Suitable foraging habitat includes wetlands and open waters with low flows, depths less that 50 cm (20 in.), and reduced quantities of both submerged and emergent macrophytes. These habitats exist on the VEGP site, and wood storks have been seen within 3.2 km (2 mi) of the site in the Savannah River Swamp. Foraging on the VEGP site appears possible from June to September in wetland areas along stream drainages, man-made ponds, drainage ditches, and the cypress wetlands along the Savannah River.

Proposed 500-kV Transmission Line

Wood storks have the potential to occur in Burke and Jefferson Counties (FWS 2004). There are no known nesting colonies in these counties and there are no documented occurrences of wood storks in the vicinity of the proposed RDC (GDNR 2007a). Wood storks have been seen foraging on Fort Gordon, adjacent to the RDC, in Richmond County (Mitchell 1999), and have the potential to forage within the RDC.

Flatwoods Salamander – Threatened

The flatwoods salamander (*Ambystoma cingulatum*) was listed by FWS as threatened in 1999 (64 FR 15691). The historical range of the flatwoods salamander included parts of the states of Alabama, Florida, Georgia, and South Carolina that are in the lower Coastal Plain of the southeastern United States. Survey work completed since 1990 indicates that 51 populations of flatwoods salamanders are known from across the historical range. Most of these occur in Florida (36 populations or 71 percent). Eleven populations have been found in Georgia, four in South Carolina, and none have been found in Alabama. The last breeding record for Burke County was in the 1940s (FWS 2004). Critical habitat was proposed in February 2007 in Miller and Baker Counties, Georgia (72 FR 5856). These counties are over 290 km (180 mi) southeast of the VEGP site.

Adults and sub-adults are fossorial, occur in open mesic pine forests, and are closely associated with pine/wiregrass habitats dominated by longleaf or slash pine maintained by frequent fire (Petranka 1998). During the breeding period, which coincides with heavy rains from October to December, these salamanders move to isolated, shallow, small, acidic, tannin-stained depressions (forested with emergent vegetation) that dry completely on a cyclic basis (ephemeral ponds) (72 FR 5856).

There are no recorded occurrences within 16 km (10 mi) of the VEGP site, no known historical occurrences on the site, and they were not identified in the 2005 threatened and endangered species survey (Southern 2006d, 2007a; TRC 2006; GDNR 2007a). Suitable habitat for the flatwoods salamander may occur onsite, but suitable habitat is not found within the construction area footprint for the proposed VEGP Units 3 and 4.

Proposed 500-kV Transmission Line

Flatwoods salamanders have the potential to occur in Burke County (FWS 2004). There are no documented occurrences of flatwoods salamander in the vicinity of the RDC (GDNR 2007a).

American Alligator – Threatened Based on Similarity of Appearance

In 1967, the American alligator (*Alligator mississippiensis*) was classified by FWS as endangered throughout its range, including Georgia. By 1987, following several reclassification actions in other states, it was reclassified to "threatened based on similarity of appearance" to the American crocodile in the remainder of its range, including Georgia (52 FR 21059). The alligator is no longer biologically imperiled in Georgia. Its populations are considered disjunct, limited to suitable habitat, and stable. The reclassification helps prevent excessive take of the alligator and protects the American crocodile (52 FR 21059).

During surveys of the VEGP site made by TRC in the summer of 2005, an alligator was observed in Mallard Pond (TRC 2006). Alligator habitat consists of swamps, marshes, ponds, lakes, and slow-moving streams and rivers. Alligators appear to be relatively common in the general vicinity of the site (Wike et al. 2006).

Proposed 500-kV Transmission Line

The American alligator has the potential to occur in suitable habitat within RDC.

Canby's Dropwort – Endangered

Canby's dropwort (*Oxypolis canbyi*), listed as endangered by FWS in 1986 (51 FR 6690). This species is native to the Coastal Plain from Delaware (historical only), Maryland, North Carolina, South Carolina, and Georgia. Historically, this plant was found in Burke, Dooly, Lee, and Sumter Counties in Georgia. There is no critical habitat designated for this species (FWS 1990a).

Canby's dropwort has been found in a variety of habitats, including ponds dominated by pond cypress, grass-sedge-dominated Carolina bays, wet pine savannahs, shallow pineland ponds, and cypress-pine swamps or sloughs. The largest and most vigorous populations occur in open bays or ponds, which are wet throughout most of the year and have little or no canopy cover.

Sites occupied by this species generally have infrequent and shallow inundations (5 to 30 cm [2 to 12 in.]). The species' water requirements are narrow, with too little or too much water being detrimental (FWS 1990a). Suitable habitat is normally a sandy loam or loam soil underlain by a clay layer which along with the slight gradient of the areas, results in the retention of water. Known soil types that support populations of Canby's dropwort are Rembert loam, Portsmouth loam, McColl loam, Grady loam, Coxville fine sandy loam, and Rains sandy loam. These soil types are similar in that they have a medium-to-high organic content, high water table, and are deep, poorly drained, and acidic (FWS 1990a). These soil types do not occur on the VEGP site. Soil types found on the VEGP site include soils in the Chastain-Tawcaw association; Lucy, Osier, and Bibb soils; Tawcaw-Shellbluff association; and Fuquay, Bonifay, and Troup series soils (NRCS 2003a). The soil types that would be impacted during construction include Lucy, Troup, and Tawcaw-Shellbluff (Figure 2-13). Lucy and Troup soils are deep, well-drained soils occurring in the upland (NRCS 1997, 2003b). The Tawcaw-Shellbluff soils occur in the Savannah River floodplain and are acidic, poorly drained, and deep (NRCS 2002, 2003c). Though the Savannah River Tawcaw-Shellbluff soils found on the VEGP site have characteristics similar to the soil types associated with Canby's dropwort, these areas are likely not suitable habitat because of the frequency and depth of inundations along the Savannah River.

Canby's dropwort has not been recorded within 16 km (10 mi) of the site. There are no known historical occurrences on the site, and it was not identified in the 2005 threatened and endangered species survey (Southern 2006d, 2007a; TRC 2006; GDNR 2007a). There are two historical records in Burke County around Waynesboro (51 FR 6690); and these populations are currently thought to be extirpated (FWS 1990a). It is unlikely that suitable habitat for the Canby's dropwort is found in areas that would be disturbed by the construction of VEGP Units 3 and 4.

Proposed 500-kV Transmission Line

Canby's dropwort is listed as potentially occurring in Burke County (FWS 2004). However, there are no known populations within the RDC. The closest known population is approximately 5.6 km (3.5 mi) from the RDC in Burke County (GDNR 2007a).

Smooth Coneflower – Endangered

The smooth coneflower (*Echinacea laevigata*) was listed by FWS as endangered in 1992 (57 FR 46340). There are no known occurrences of smooth coneflower in Burke County (FWS 2004), no historical occurrences on the VEGP site, and it was not recorded in the 2005 threatened and endangered species survey (TRC 2006; Southern 2006d). It is known to occur in Stephens County, Georgia (Patrick et al. 1995), and is also found in Aiken and Barnwell Counties, South Carolina, more than 8 km (5 mi) from the VEGP site (SCDNR 2007a).

The smooth coneflower occurs in meadows and open woodlands on basic or near neutral soils. These types of soils do not occur on the VEGP site. It is often found with eastern redcedar (*Juniperus virginiana*) or button snakeroot (*Eryngium yuccifolium*) (Patrick et al. 1995). Neither species is known to occur on the VEGP site (Southern 2006c), and it is unlikely that suitable habitat occurs onsite.

Proposed 500-kV Transmission Line

Smooth coneflower is not known to occur in any of the counties that may be crossed by the proposed 500-kV transmission line.

Relict Trillium – Endangered

The relict trillium (*Trillium reliquum*) was listed as endangered by FWS in 1988 (53 FR 10879). Populations of relict trillium are limited to portions of Georgia, South Carolina, and Alabama (FWS 1990b). In 1990, 14 known populations of this species occurred in Clay, Lee, Early, Talbot, Columbia, and Macon Counties, Georgia. Relict trillium is also known to occur in Aiken County, South Carolina, more than 16 km (10 mi) from the VEGP site (SCDNR 2007a).

There are no known occurrences of relict trillium in Burke County (FWS 2004), no historical occurrences on the VEGP site, and the relict trillium was not recorded in the 2005 threatened and endangered species survey (TRC 2006; Southern 2006d). Relict trillium is found primarily in moist hardwood forests that have had little or no disturbance in the recent past. The soils on which it grows vary from rocky clays to alluvial sands, but all exhibit a high organic matter content in the upper soil layer. Most sites appear to be free from the influence of fire, both in the recent and distant past. Timber harvesting at the known sites has been limited to selective cutting. Relict trillium does occur on less than optimum sites, such as power and sewer line rights-of-way, and can apparently become reestablished after intense disturbance to the habitat, such as agricultural activity (FWS 1990b).

The staff met with biologists from the GDNR in October 2006. During this meeting GDNR staff told NRC staff that relict trillium had the potential to occur on the VEGP site in suitable habitat along the Savannah River (PNNL 2006). The forested bluff at the VEGP site provides suitable habitat for this Federally endangered species. This bluff was surveyed during the seasonal field surveys conducted in 2005 and in 2007 (TRC 2006; Patrick 2007). The spring 2005 and 2007 surveys were conducted during the flowering period for the relict trillium, which is best for positive identification of this species (Patrick et al. 1995), and this was a targeted species that received special attention during the surveys (Southern 2007b, Patrick 2007). Although suitable habitat for the relict trillium appears to exist within the construction footprint, this species was not been identified through surveys and it is unlikely that it would occur in the future.

Proposed 500-kV Transmission Line

Relict trillium is not known to occur in any of the counties that may be crossed by the proposed 500-kV transmission line.

Georgia Aster – Candidate

Georgia aster is a candidate for Federal listing (70 FR 24924). It is not known to occur in Burke County in the vicinity of the VEGP site.

Proposed 500-kV Transmission Line

Georgia aster is known to occur about 9.0 km (5.5 mi) from the RDC in McDuffie County, Georgia (GDNR 2007a). There are no known populations within the RDC (FWS 2004; GDNR 2007a). Historically, 97 populations of Georgia aster were known to exist; 34 of these have apparently been destroyed. The species appears to have been eliminated from Florida, one of the five states in which it originally occurred. It remains in 31 counties in North Carolina, South Carolina, Alabama, and Georgia (70 FR 24924).

Georgia aster is a relict species of post oak savannah/prairie communities that existed in the southeast before widespread fire suppression and the extirpation of large native grazing animals. Most populations are small, and since the species' main mode of reproduction is vegetative, each isolated population probably represents just a few genotypes (70 FR 24924).

Most remaining populations of this species survive adjacent to roads, railroads, utility rights-of-way, and other openings where land management mimics natural disturbance regimes. However, at these sites the species is inherently vulnerable to accidental destruction from herbicide application, road shoulder grading, and other maintenance activities. Many populations are threatened also by development (several are within planned residential subdivisions), highway expansion/improvement, and woody succession resulting from fire suppression. (70 FR 24924).

2.7.1.3 Terrestrial Ecology Monitoring

The VEGP Units 1 and 2 Environmental Protection Plan, Appendix B to VEGP operating license nuclear power facility (NPF) 68 and NPF 81, Section 4.1 entitles "Unusual or Important Environmental Events" requires NRC notification of any unusual environmental events, including excessive bird mortality, on site plant or animal disease outbreaks and the mortality or unusual occurrence of any species protected by the Endangered Species Act (ESA) (Southern 1989). To date no reports to the NRC have been made.

Formal terrestrial ecological monitoring for threatened and endangered species was conducted on 675.4 ha (1669 ac) of the VEGP site in the fall, winter, and spring of 2005 by TRC (TRC 2006). These surveys were conducted to document the presence of Federal and State species of concern. Red-cockaded woodpeckers surveys were also conducted by GPC biologists in February of 2006 (Southern 2006c).

Threatened and endangered species surveys are conducted prior to timber harvests or thinning. These surveys are conducted by GPC biologists using available county records maintained by the FWS and the GDNR, with field surveys used for verification. No threatened and endangered species were identified in any of these surveys from 2002 to 2005 (Southern 2007b).

Eco-Sciences made visits to the site in December 2006. The purpose of these visits was to delineate and describe the jurisdictional wetlands on the VEGP site (Eco-Sciences 2007). Descriptions of the various types of wetlands found on the VEGP site based on these visits are provided in Section 2.7.1.

Wetlands are considered an important habitat (NRC 2000). Besides wetlands, no other important habitats are known to occur on the VEGP site. Approximately 9.3 ha (22.5 ac) of wetlands would be disturbed by the construction of the proposed VEGP Units 3 and 4 and the associated facilities (Southern 2007b). If necessary, Southern would mitigate the disturbance or loss of wetlands based on USACE recommendations through the Clean Water Act 404 permitting process (Southern 2007a).

The wood stork is known to occur within 3.2 km (2 mi) of the VEGP site in the Savannah River Swamp on the DOE Savannah River Site. Surveys were conducted for the wood stork throughout the period from 2002 to 2005 in areas harvested for timber and on 675 ha (1669 ac) of the site (TRC 2006; Southern 2007e). However, this species has not been documented onsite (Southern 2006d). The wood stork may also occasionally use wetlands associated with stream drainages, man-made ponds, and areas along the Savannah River for foraging.

The VEGP site is approximately 16 km (10 mi) from the closest known active group of red-cockaded woodpeckers on the Savannah River Site (Wike et al. 2006). Surveys were conducted on the site for red-cockaded woodpeckers in February 2006 in support of a Safe Harbor Agreement, from 2002 to 2005 in areas harvested for timber, and on 675.4 ha (1669 ac) of the site in support of this ESP application. However, the red-cockaded woodpecker has never been documented onsite (TRC 2006; Southern 2006c, d). The types of habitat that would be disturbed during construction mainly consist of previously disturbed areas, planted pines, hardwoods, wetlands along the Savannah River, and open fields. Red-cockaded woodpeckers are found mainly in large stands of old longleaf pine. These habitats would not be impacted during construction, and the red-cockaded woodpecker is not likely be to found in the areas impacted by construction.

Relict trillium, smooth coneflower, Canby's dropwort, and the flatwoods salamander are not known to occur in the vicinity of the VEGP site. Surveys were conducted for these species from 2002 to 2005 in areas harvested for timber and on 675.4 ha (1669 ac) of the site in support of this ESP application. However, they have not been documented onsite (TRC 2006; Southern 2006d). It is unlikely these species occur in the vicinity of the proposed construction footprint.

2.7.2 Aquatic Ecology

This section describes the aquatic environment and biota in the vicinity of the VEGP site and other areas likely to be impacted by the construction, operation, or maintenance of the proposed VEGP Units 3 and 4. It describes the spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages on which the proposed action could have an impact, and it identifies "important" or irreplaceable aquatic natural resources and the location of sanctuaries and preserves that might be impacted by the proposed action.

The aquatic communities associated with the VEGP site include those of the Savannah River, as well as small streams and ponds located onsite. The VEGP site is bordered on the northeast by the Savannah River (Southern 2007a), which is the largest and most important aquatic resource in the vicinity of the plant. Other aquatic communities in the vicinity of the VEGP site include Beaverdam Creek, which drains Telfair Pond and is characterized as an impounded blackwater creek (Southern 2007a). Beaverdam Creek is located just south of the plant site. Two stormwater retention basins were built in the early stages of construction of VEGP Units 1 and 2 (Southern 2007b). Debris Basin #1, on the southeast side of the plant drains to Beaverdam Creek halfway between Telfair Pond and the Savannah River. Debris Basin #2 is located in the southwest corner of the site and drains via a small creek into Daniels Branch and then into Telfair Pond (Southern 2007a).

Mallard Pond, a man-made pond that was on the site before construction, is also characterized as an impounded blackwater creek; it is located just north of the new plant footprint. Mallard Pond is drained by a small, unnamed stream that flows into the Savannah River floodplain upstream of the proposed river intake structure. At least two beaver ponds are located on the stream below Mallard Pond (Southern 2007b). Another stream flowing out of the northwest corner of the site joins the unnamed stream flowing from Mallard Pond approximately one-third of the way to the Savannah River.

There are no sanctuaries or preserves that could be affected by the proposed action. The nearest managed area is the 3160-ha (7800-ac) Yuchi WMA, which is managed by GDNR for public hunting. The Yuchi WMA is located adjacent to the VEGP site (Southern 2007a). The northern edge of the Yuchi WMA lies on the southern shore of Beaverdam Creek (Figure 2-3) (Southern 2007a).

2.7.2.1 Aquatic Communities of the VEGP Site

Onsite Ponds and Streams

The stormwater retention ponds were created in the early stages of the construction of VEGP Units 1 and 2. The ponds were built to provide sediment retention for stormwater before discharge to Beaverdam Creek. Over the years both ponds have developed distinct wetland characteristics. No analyses have been performed of the aquatic biota of these ponds or various small drainages on the property (Southern 2007b)

No analyses of the aquatic communities of Mallard Pond or of its drainage have been performed (Southern 2007a).

Three studies were conducted on the aquatic ecology of Beaverdam Creek to look at the effects of construction of the site. From March 1977 to May 1978, a study was conducted to determine the extent of use of Beaverdam Creek by anadromous fishes for spawning and the effects of construction on spawning (Wiltz 1982a). Eggs and adults were collected in gill net, hoop net, and larval drift surveys. A total of 674 individual fish (including eggs and larvae) from 29 species were collected. The study concluded that Beaverdam Creek was a minor contributor with respect to spawning of blueback herring (*Alosa aestivalis*). Although the habitat was suitable for hickory shad (*Alosa mediocris*), only 17 individuals were found, and none were observed spawning (Wiltz 1982a).

A second study by Wiltz on Beaver Creek conducted from 1977 to 1978 evaluated the potential effects of siltation and sedimentation on resident fish populations during construction of VEGP Units 1 and 2. A total of 2435 fish representing 39 species were collected in 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. Collectively these four species made up 68 percent of all fish collected during the study. The Savannah darter (*Etheostoma fricksium*) was also observed in smaller numbers (31 individuals, collected over a 2-year period). This species has since been listed as a "species of concern" by the State of Georgia. The study concluded that siltation was not a factor influencing the resident fish population in Beaverdam Creek. Turbidity and runoff decreased quickly after heavy rainfall. The only increase in turbidity was caused by transmission line right-of-way construction and logging operations adjacent to the VEGP site property (Wiltz 1982b).

A third study (Staats 1983) looked at the macroinvertebrate populations of Beaverdam Creek between 1973 and 1978. The purpose of the study was to determine the possible environmental effects of plant construction (erosion and siltation) on the aquatic macroinvertebrate community inhabiting Beaverdam Creek. It was concluded that species composition at the altered stations (those affected by access road construction) were similar to the control stations throughout the study indicating that plant construction had little or no effect on the macroinvertebrate fauna of Beaverdam Creek. Species compositions at the altered stations recovered from the construction and were not affected by plant construction.

No further analyses have been conducted on Beaverdam Creek since the late 1970s.

Savannah River

The VEGP site is located on the Savannah River from rkm 241 to 244 (RM 150 to 152). This area is within the middle Savannah River (defined as occurring from the Fall Line just above Kiokee Creek in Columbia County to the mouth of the Brier Creek (rkm 156 to 355) (Marcy et al. 2005). The middle reach of the Savannah River is typical of southeastern river basins. It is home to a diverse fish fauna, and like other southeastern rivers, its watershed is increasingly affected by the region's growing human population. The Savannah River has several habitat types that are used by the fish populations. The main river channel, cutoff bends or "dead rivers," swampy habitats (such as habitats located in Phinezy Swamp, adjacent to Augusta, or on the DOE Savannah River Site), floodplains (such as in the area of the proposed intake structure), and streams or tributaries that empty into the river (Marcy et al. 2005).

The potential for impacts from operation of the proposed VEGP Units 3 and 4 to aquatic biota would be primarily to organisms inhabiting the Savannah River. The aquatic species include attached algae and aquatic macrophytes, diatoms, benthic macroinvertebrates (including mussels, clams, aquatic insects), molluscs, and fish. The area of the Savannah River adjacent to the VEGP site has been well studied because of the location of the DOE Savannah River Site immediately across the river. The Academy of Natural Sciences of Philadelphia (ANSP) has conducted biological and water-quality studies of this area of the Savannah River since 1951 for the purpose of assessing potential effects of the DOE Savannah River Site on the aquatic communities in the Savannah River. Within this study area, the ANSP has also conducted studies starting in 1985 in the vicinity of the VEGP site at rkm 243.3 (RM 151.2) the approximate location of the proposed intake structure for the proposed VEGP Units 3 and 4, and rkm 241.1 (RM 149.8) approximately 1.6 km (1 mi) downstream from the VEGP site) (ANSP 2003). The surveys at the VEGP site sampling stations were conducted to assess potential impacts of the VEGP site so that these impacts could be separated from potential impacts from the DOE Savannah River Site (ANSP 2003). Since 1985, studies occurred approximately every 2 years through 1996. Starting in 1997, sampling at the stations for the VEGP site was limited to diatom surveys only (ANSP 2003).

<u>Attached Algae and Aquatic Macrophytes</u>

The ANSP qualitatively sampled attached algae and aquatic macrophytes. The algal flora was found to be similar at all four stations (the reference station upstream of the Savannah River

Site and three stations downstream of the VEGP site and potentially impacted by the DOE Savannah River Site). There was evidence of nutrient enrichment at all stations, apparently attributable to sources upstream from the study site. No significant beds of submerged aquatic vegetation were observed (ANSP 2001).

Diatoms

Studies by the ANSP since 1951 included an investigation of diatom diversity, richness and evenness as a measure of water quality in the river. The studies involved comparing diatom assemblages grown on artificial substrates at a reference station with those found at the DOE Savannah River Site stations below the VEGP site and farther down river below the DOE Savannah River Site. The most abundant species of diatoms, *Gomphonema parvulum* and *Melosira varians*, have wide ecological tolerances and adjust to a range of conditions. However, these species are not usually indicative of poor water quality. The composition and tolerances of diatom species in the Savannah River above and below the DOE Savannah River Site were similar during the 2001 study (ANSP 2003). Most of the dominant species observed in the 2001 study were similar to those found in previous studies and are characteristic of alkaline, nutrient-enriched waters. The differences in distribution patterns that were observed for the relative abundance of dominant species were seasonal rather than spatial and, thus, were not related to the operation of the DOE Savannah River Site or the existing VEGP Units 1 and 2. However, the reference station showed higher species-richness rank, lower dominance rank and higher diversity rank than the other stations, although there was no corresponding pattern in ecological or pollution tolerances of the dominant species, which made the evidence unclear regarding a potential DOE Savannah River Site impact on water-quality components to which the diatoms would be most sensitive (ANSP 2003).

Aquatic Insects

The ANSP studied the species composition of insect fauna. The most species-rich group was the dipterans (47 taxa, mainly from the family Chironomidae), beetles (28 taxa), dragonflies and damselflies (15 taxa), mayflies (17 taxa) and caddisflies (14 taxa). Species richness in 2001 was similar to that from the studies of previous years. Overall, the results of the 2001 aquatic insect study (ANSP 2003) suggest that the differences detected among sites reflects the natural spatial variation found in all rivers and streams. The results of the statistical analysis between stations indicate that the condition of the aquatic insect assemblages at the stations exposed to the DOE Savannah River Site tend to be as good as, or superior to, the condition at the reference sites (located upstream of the DOE Savannah River Site and VEGP site). The same conclusion was demonstrated by the results of the 1999 study and the 2000 study (ANSP 2003).

Molluscs

Molluscs found in the vicinity of the VEGP site include snails and bivalves such as Asiatic clams, fingernail clams, pea clams, and mussels (ANSP 2003). Sixteen species of mussels have been identified from the surveys conducted by the ANSP between 1951 and 2001. The introduced Asiatic clam (*Corbicula fluminea*) was abundant in a variety of substrates at all collection stations (silts and mud to fine- through coarse-grained sands) and numerically dominated the benthic habitat of the Savannah River, composing between 96 to 98 percent of the bivalves taken in sieve studies (ANSP 2001). ANSP 2001 reported that the mussel fauna has changed since the early 1951 to 1968 studies when the yellow lamp mussel (*Lampsilis cariosa*), eastern elliptio (*Elliptio complanata*), Carolina slabshell (*E. congarea*), Atlantic spike (*E. producta*), variable spike (*E. icterina*), and rayed pink fatmucket (*L. splendida*) were all listed as the most abundant species. In 1961, an "almost uniform distribution" of mussels "...from juveniles through old adults (over 8 years of age)" was reported. Reduced numbers of juvenile mussels have commonly been reported since 1960. Slightly lower numbers of species were identified in the 2001 studies (ANSP 2003), which appears to be a continuation of the trend that began in 1999 and is thought to reflect drought conditions in the basin and lower flows in the Savannah River during the years since June 1998. Although the results produced fewer taxa than other recent studies (1993 to 1999), the numbers fell within the long-term trends of 1972 to 2000. The 2001 study results did not indicate an impact from the DOE Savannah River Site (ANSP 2003).

Fish

Numerous studies have been performed on the fish located in the middle Savannah River. The most comprehensive studies include Bennett and McFarlane (1983) (written to provide background information for biologists initiating ichthyofaunal studies on the Savannah River Site), Specht (1987) (the Comprehensive Cooling Water Study initiated in 1983 to evaluate the environmental effects of the intake and release of cooling water on the structure and function of aquatic ecosystems at the Savannah River Plant); Marcy et al. (2005); and the series of studies performed by the ANSP, including the two most recent studies (ANSP 2001, 2003).

Marcy et al. (2005) indicates that 98 species of fish are found in the middle Savannah River, including 84 native species and 15 introduced species. The fishes of the middle Savannah River can be grouped into three groups: (1) resident freshwater fish (found in the area year-around), (2) diadromous species (present during seasonal migrations), and (3) marine/estuarine species (sometimes found in the river upstream of the saltwater-freshwater interface). A listing of the native resident, diadromous, and marine fish species of the middle Savannah River (as taken from Marcy et al. 2005) is given in Table 2-7. Table 2-8 contains a list of the introduced species in the middle Savannah River.

The ANSP conducted assessments of the fish assemblages in the vicinity of the DOE Savannah River Site since 1951, between rkm 259 and rkm 196 (RM 161 and RM 122). Until

Table 2-7. Native, Resident, Diadromous, Marine, and Upland Fish Species of the Middle Savannah River (as taken from Marcy et al. 2005 and presented in phylogenetic order)

Scientific Family	Common Name	Scientific Name
Resident Species		
Lepisosteidae (gars)	longnose gar	*Lepisosteus osseus*
	Florida gar	*Lepisosteus platyrhincus*
Amiidae (bowfins)	bowfin	*Amia calva*
Clupeidae (herring & shad)	gizzard shad	*Dorosoma cepedianum*
Cyprinidae (minnows)	bannerfin shiner	*Cyprinella leedsi*
	whitefin shiner	*Cyprinella nivea*
	eastern silvery minnow	*Hybognathus regius*
	rosyface chub	*Hybopsis rubrifrons*
	blueheaded chub	*Nocomis leptocephalus*
	golden shiner	*Notemigonus crysoleucas*
	ironcolor shiner	*Notropis chalybaeus*
	dusky shiner	*Notropis cummingsae*
	spottail shiner	*Notropis hudsonius*
	yellowfin shiner	*Notropis lutipinnis*
	taillight shiner	*Notropis maculatus*
	coastal shiner	*Notropis petersoni*
	pugnose shiner	*Opsopoeodus emiliae*
	lowland shiner	*Pteronotropis stonei*
	creek chub	*Semotilus atromaculatus*
Catostomidae (suckers)	quillback	*Carpiodes cyprinus*
	highfin carpsucker	*Carpiodes velifer*
	creek chubsucker	*Erimyzon oblongus*
	lake chubsucker	*Erimyzon sucetta*
	northern hogsucker	*Hypentelium nigricans*
	spotted sucker	*Minytrema melanops*
	notchlip redhorse	*Moxostoma collapsum*
	robust redhorse	*Moxostoma robustum*
	brassy jumprock	*Scartomyzon* sp. cf. *lachneri*
Ictaluridae (bullheads & catfish)	snail bullhead	*Ameiurus brunneus*
	white catfish	*Ameiurus catus*
	yellow bullhead	*Ameiurus natalis*
	brown bullhead	*Ameiurus nebulosus*
	flat bullhead	*Ameiurus platycephalus*

Table 2-7. (contd)

Scientific Family	Common Name	Scientific Name
	tadpole madtom	*Noturus gyrinus*
	margined madtom	*Noturus insignis*
	speckled madtom	*Natures leptacanthus*
Esocidae (pikes & pickerels)	redfin pickerel	*Esox americanus*
	chain pickerel	*Esox niger*
Umbridae (mudminnows)	eastern mudminnow	*Umbra pygmaea*
Aphredoderidae (pirate perch)	pirate perch	*Aphredoderus sayanus*
Amblyopsidae (cave fish)	swampfish	*Chologaster cornuta*
Fundulidae (top minnows)	golden topminnow	*Fundulus chrysotus*
	lined topminnow	*Fundulus lineolatus*
Poeciliidae (live bearers)	eastern mosquitofish	*Gambusia holbrooki*
Atherinopsidae (new world silversides)	brook silverside	*Labidesthes sicculus*
Centrarchidae (sunfish)	mud sunfish	*Acantharchus pomotis*
	flier	*Centrarchus macropterus*
	blackbanded sunfish	*Enneacanthus chaetodon*
	bluespotted sunfish	*Enneacanthus gloriosus*
	banded sunfish	*Enneacanthus obesus*
	redbreast sunfish	*Lepomis auritus*
	pumpkinseed	*Lepomis gibbosus*
	warmouth	*Lepomis gulosus*
	bluegill	*Lepomis macrochirus*
	dollar sunfish	*Lepomis marginatus*
	redear sunfish	*Lepomis microlophus*
	spotted sunfish	*Lepomis punctatus*
	largemouth bass	*Micropterus salmoides*
	black crappie	*Pomoxis nigromaculatus*
Elassomatidae (pygmy sunfish)	everglades pygmy sunfish	*Elassoma evergladei*
	bluebarred pygmy sunfish	*Elassoma okatie*
	banded pigmy sunfish	*Elassoma zonatum*
Percidae (darters & perch)	Savannah darter	*Etheostoma fricksium*
	swamp darter	*Etheostoma fusiforme*
	christmas darter	*Etheostoma hopkinsi*
	turquoise darter	*Etheostoma inscriptum*
	tessellated darter	*Etheostoma olmstedi*
	sawcheek darter	*Etheostoma serrifer*
	blackbanded darter	*Percina nigrofasciata*
Diadromous species		
Acipenseridae (sturgeon)	shortnose sturgeon	*Acipenser brevirostrum*
	Atlantic sturgeon	*Acipenser oxyrinchus*
Anguillidae (eels)	American eel	*Anguilla rostrata*
Clupeidae (herrings & shads)	blueback herring	*Alosa aestivalis*

Table 2-7. (contd)

Scientific Family	Common Name	Scientific Name
	hickory shad	*Alosa mediocris*
	American shad	*Alosa sapidissima*
Moronidae (temperate bass)	striped bass	*Morone saxatilis*
Marine Species		
Megalopidae (tarpons)	tarpon	*Megalops atlanticus*
Belonidae (needle fish)	Atlantic needlefish	*Strongylura marina*
Mugilidae (mullets)	mountain mullet	*Agonostomus monticola*
	striped mullet	*Mugil cephalus*
Achiridae (new world soles)	hogchoker	*Trinectes maculatus*
Upland Species		
	redeye bass[(a)]	*Micropterus coosae*

(a) The Savannah River is the only area of the redeye bass's range where it occurs below the Fall Line

Table 2-8. Introduced Fish Species in the Middle Savannah River Basin and their Status (as taken from Marcy et al. 2005)

Scientific Family	Common Name	Scientific Name
Clearly established		
Clupeidae (herrings & shads)	threadfin shad	*Dorosoma petenense*
Cyprinidae (carps & minnows)	common carp	*Cyprinus carpio*
Ictaluridae (bullhead & catfish)	channel catfish	*Ictalurus punctatus*
Percidae (perch and darters)	yellow perch	*Perca flavescens*
Rare and possibly not established		
Cyprinidae (carps & minnows)	goldfish	*Carassius auratus*
Moronidae (temperate bass)	white perch	*Morone americana*
	white bass	*Morone chrysops*
Centrarchidae (sunfish)	green sunfish	*Lepomis cyanellus*
	white crappie	*Pomoxis annularis*
Clearly not established		
Cyprinidae (carps & minnows)	grass carp	*Ctenopharyngodon idella*
Salmonidae (salmon)	rainbow trout	*Oncorhynchus mykiss*
Too little information		
Ictaluridae (bullhead & catfish)	blue catfish	*Ictalurus furcatus*
	flathead catfish	*Pylodictis olivaris*

1997, these assessments also included comprehensive studies at sites in the Savannah River between along the DOE Savannah River Site, cursory studies in the Savannah River in the vicinity of the DOE Savannah River Site, and independent monitoring of locations near the VEGP site. Comprehensive studies included a twice-per-year assessment every 4 years. The cursory studies were annual assessments with four sampling periods per year. Studies in the vicinity of the VEGP site, which included the same components as the comprehensive surveys but different sampling locations, were initiated in 1985. The last studies of fish in the vicinity of the VEGP site were conducted in 1996 (ANSP 2003).

The latest fish survey performed by ANSP (which included sites other than the two VEGP sampling sites) was in the fall of 2001. In total, 3951 specimens of 48 species of fish were collected in 2001 (ANSP 2003). The most common species were the spottail shiner (*Notropis hudsonius*) (24.4 percent of the total fish), followed by the tail light shiner (*N. maculatus*) (19.5 percent of the total number of fish). The bluegill (*Lepomis macrochirus*), bannerfin shiner (*Cyprinella leedsi*), and whitefin shiner (*C. nivea*) were also common. Together 75 percent of the total catch was composed of these five species (assuming that the unidentified minnows were from the genus *Cyprinella*) (ANSP 2003). The 2000 ANSP Savannah River survey captured a total of 4599 individuals of 50 species of fish. Again the spottail shiner was the most abundant (36.5 percent of the total number of fish), followed by the bannerfin shiner (11.7 percent of the total number of fish). The bluegill, whitefin shiner, and brook silverside (*Labidesthes sicculus*) were also common. Together 74 percent of the total catch was composed of the these five species (ANSP 2001).

Results from the 2001 ANSP study indicated that species richness was significantly higher at the sampling location farther downstream than at the sampling location upstream. However, neither species diversity nor the densities of common species differed significantly between stations (ANSP 2003). In general, the studies performed by the ANSP showed greater temporal variation in fish assemblages than spatial variation within the study sites (ANSP 2003).

Important Species

A number of important species of fish occur within the Savannah River. These include commercially and recreationally important species and species listed by the States of South Carolina and Georgia as threatened and endangered, or species of concern.

Commercially Important Fisheries

Commercial fisheries allowed on the middle Savannah River include American shad (*Alosa sapidissima*), channel catfish (*Ictalurus punctatus*) (Halverson et al. 1997), white catfish (*Ameiurus catus*) (Marcy et al. 2005), and American eels (*Anguilla rostrata*) (GDNR 2007d). These species are fished commercially primarily by non-professional, local fishermen. Previously, a fishery existed for Atlantic sturgeon (*Acipenser oxyrinchus*); however, all Atlantic coastal states have enacted a closure or moratorium on the harvest of Atlantic sturgeon. There is a commercial blueback herring (*Alosa aestivalis*) fishery on the South Carolina portions of the Savannah River (SCDNR 2007b), but no herring are taken in Georgia because of netting restrictions (Marcy et al. 2005; Halverson et al. 1997). Historically, the commercial landing data indicated that the commercial fishery for catfish was significantly smaller than the fishery for American shad. For this reason, only American shad is discussed here.

<u>American Shad (*Alosa sapidissima*)</u>

American shad are anadromous; the adults are marine fish and come into the Savannah River to spawn. They rarely appear in brackish estuaries and freshwater outside of the spawning season. Spawning usually occurs at night and may occur anywhere in a river, but the most frequented sites have flats or shallow water. Eggs hatch in 71 to 86 hours and are demersal (they sink) or pelagic (they stay in the water column). Eggs may travel 1.6 to 6.4 km (1 to 4 mi) from the point where they are broadcast. Larvae are carried downstream to the estuary (Meyer et al. 2003) and juveniles remain in the freshwater until temperatures decline in late fall (Marcy et al. 2005). Bailey et al. (2004) estimated the population size of American shad that reached the New Savannah Bluff Lock and Dam (located approximately 56 km [35 mi] upstream of the VEGP site) at 158,000 in 2001 and 217,000 in 2002. These numbers suggest a substantial numbers of American shad pass by the VEGP site during their annual spawning runs.

Although the American shad harvest specifically from the Savannah River is not readily available, the overall landings for American shad in the entire State of Georgia has dropped significantly from the 1980s when between 60.7 metric tons (66.9 tons) (1989) and 132 metric tons (146 tons) (1987) were landed by the commercial fishery (with a corresponding value of $134,000 to $291,000). Between 2000 and 2003 (the latest year with data available), the commercial landings ranged from 11.5 metric tons (12.7 tons) (2002) to 25.3 metric tons (27.9 tons) (2000). The total monetary value ranged from $21,000 to $32,000 (NMFS 2007). The decline in the harvest likely reflects a decline in the population of American shad.

Recreationally Important Fish

Sports fishermen are the principal consumers of river fishes in the middle Savannah River. The harvest includes mostly sunfish (*Lepomis* spp.) and crappie (*Pomoxis* spp.) (Halverson et al. 1997). Striped bass (*Morone saxatilis*), which is classified as a game fish in South Carolina and Georgia, is considered a favorite of fishermen in the region around Augusta. The staff recognized that there are other species that are popular game fish (Halverson et al. 1997).

<u>Striped Bass (*Morone saxatilis*)</u>

The striped bass is considered anadromous (Meyer et al. 2003) and ascends rivers to spawn in fresh or brackish water in February through June and then seeks out cooler water for the summer months. However, some reproducing landlocked and largely riverine populations exist (Marcy et al. 2005). Striped bass migrate upriver and into tributaries for spring spawning in March, April, and May (Marcy et al. 2005). Spawning occurs in strong currents of large rivers when the temperature is above 14.4°C (57.9°F) and in areas above the salt wedge of the estuary (Marcy et al. 2005). The eggs are semipelagic, and sufficient current is required to keep the eggs in the water column to allow them to hatch before sinking to the bottom (Marcy et al. 2005). Specific areas of the estuary near the mouth of the Savannah River (specifically the Back and Middle Rivers of the estuary and possibly the Front River) are considered the nursery areas (Meyer et al. 2003).

Before 1982, the major known spawning area for striped bass in the Savannah River was in the tidally influenced area 30 to 40 km (19 to 25 mi) upstream from the river mouth (Dudley et al. 1977). However, striped bass eggs or larvae were collected between 1983 and 1985 as part of an icthyoplankton study for the DOE Savannah River Site (Paller et al. 1986).

The population of striped bass drastically declined in the 1980s throughout the species' range on the Atlantic coast. It is also thought that the Savannah River harbor modifications resulted in habitat alterations in the estuarine spawning grounds and contributed to the decline of the fishery in the Savannah River (GDNR 2007e; Reinert et al. 2005). The alterations changed the flow patterns of the river and increased the salinity levels in parts of the river that were vital for striped bass (GDNR 2007e). Because of the dramatic decreases in striped bass numbers in the river, a moratorium was placed on the harvest of striped bass in the Savannah River by the State of Georgia in 1988 and, subsequently, by the State of South Carolina in 1991. The moratorium affected the entire free-flowing portion of the river up to the New Savannah Bluff Lock and Dam near Augusta, Georgia (approximately rkm 312 [RM 194]) (Reinert et al. 2005). Restoration activities that began in the 1990s included environmental remediation that attempted to restore salinity and flow patterns, including cessation of the tide gate operation and closure of the diversion canal. Stock enhancement programs were also evaluated and optimized in the early 1990s (Reinert et al. 2005). The dramatic increase in the catch-per-unit effort of adult striped bass since 1990 is primarily the result of fish stocking, which made up at least 70 percent of the catch annually (Reinert et al. 2005). The increased numbers of striped bass were the result, in part, of a management program in the 1990s that included a mix of monitoring and intensive stocking efforts. The number of naturally reproducing striped bass remains low (GDNR 2007e). On October 1, 2005, the regulations were changed in both Georgia and South Carolina to allow limited harvest of striped bass and striped white bass hybrids (GDNR 2007e).

Testing of striped bass in the Savannah River has shown significant amounts of mercury in the fish. As a result, the GDNR has issued advice regarding the amount of fish that should be eaten by the general public (no more than one meal per month of striped bass that are 69 cm [27 in.] or greater in length) (GDNR 2007e).

Other species of interest

Several other species of interest, including the American eel (*Anguilla rostrata*), and the robust redhorse (*Moxostoma robustum*) potentially occur near the VEGP site.

American Eel *Anguilla rostrata*

In 2004 a petition was filed with FWS and the National Oceanic and Atmospheric Administration (NOAA) to list the American eel as an endangered species (McCord 2004). The FWS initiated a status review in 2005, and in 2007, determined that listing the American eel as threatened and endangered is not warranted (72 FR 4967). Although the American eel has not been listed at either the State or Federal level, there is concern about declines in its numbers across the eastern seaboard. The Atlantic States Marine Fisheries Commission (ASMFC) instigated the development of an American Eel Interstate Fishery Management Plan, which was published in 2000. Eels have been captured upstream and downstream of the VEGP site in the Savannah River and its tributaries (Marcy et al. 2005). It is legal to fish commercially for eels in Georgia and in South Carolina. However, in 2006, the ASMFC approved a mandatory catch and effort monitoring program for the American eel, which would help determine whether the population is declining (ASMFC 2006).

American eels are catadromous, living for several years in freshwater until it is time to spawn. All American eels from North America form a single spawning population, with all sexually mature eels moving to the Sargasso Sea in the Atlantic Ocean during the fall and winter to spawn before they die. Newly hatched eels (leptocephali) drift in ocean currents toward the Atlantic coast where they begin to metamorphose into glass eels (McCord 2004). Glass eels actively move toward freshwater sources and may actually move into rivers (ASMFC 2000) during winter and spring while they are still age 0. After they reach freshwater, the glass eels become pigmented and metamorphose into elvers. At this point in their lives, they are generally about 10 cm (4 in.) long. Some elvers continue to migrate upstream, burrowing in soft river bottoms or deep water during the day and moving about at night (ASMFC 2000). Elvers mature into yellow eels around age 2. Female yellow eels may continue to migrate upstream or establish home ranges for several years, while males generally remain in brackish water and estuaries (McCord 2004). They are bottom dwellers and opportunistic feeders of both live and dead organisms, and inhabit a variety of habitats (ASMFC 2000). In the middle Savannah River, yellow eels prefer relatively shallow reaches with riffles, pools, and rocks (McCord 2004) but can survive drought and low-oxygen conditions for short periods of time.

Historically, the American eel constituted up to 25 percent of the fish biomass in eastern rivers (ASMFC 2000). Data on the number of eels caught per unit of effort indicate large localized declines in rivers across the Atlantic coast. Decline in population numbers may be occurring if the stock are overfished at various life stages anywhere in their range of occurrence, because eels are commercially caught as juveniles for fish farming and bait and as adults for human consumption or bait (ASMFC 2000; Haro et al. 2000). Other factors in their decline may be loss of spawning habitat or eggs because of seaweed harvesting in the Sargasso Sea, or loss of adult habitat in rivers and estuaries from dams, dredging, and wetland destruction (McCord 2004). Another possible factor in their decline is impingement and entrainment as they migrate past dams and water intakes (Haro et al. 2000). However, McFarlane et al. (1978) found only one eel impinged on water intake screens at the Savannah River Site in biweekly samples over a 10-month period in 1977.

Robust Redhorse *Moxostoma robustum*

The robust redhorse is State-listed as endangered in Georgia, although it is known to occur in the Savannah River, it is not listed as occurring in Burke County. The size of the population in the Savannah River is unknown (Nichols 2003). The robust redhorse is a large riverine catostomid (sucker) that was once presumed to be extinct. It was rediscovered in 1991 in the Oconee River. The first documentation of a robust redhorse from the Savannah River occurred in 1997 when an adult specimen was collected near the VEGP site. Portions of the Savannah River were later surveyed for the robust redhorse. A population was found near Augusta and other surveys have discovered the robust redhorse from numerous locations between Augusta and U.S. Hwy 301 (Hendricks 2002). A radio-tagging study involving 17 wild adult robust redhorses from below the Lower Savannah Lock and Dam demonstrated that some individuals moved as much as 195 km (121 mi) in the river away from their release sites. Overwintering fish dispersed along the length of the river down to rkm 90 (RM 56). Fish returned in the spring to spawn either in the gravel bar at rkm 283.7 (RM 176.3) or to staging and holding areas immediately upstream or downstream of it. The eggs developed within the gravel and the larval fish remained there for approximately 7 days after hatching. Adult fish spent the remainder of the spring and early summer in the vicinity of their spawning grounds before dispersing downstream in late June and early July to their overwintering areas (Grabowski and Isely 2006). For the most part, the robust redhorse appeared to stay within the main channel. High-water events were the only times that radio-tagged fish were located outside the main river channel. In most cases they relocated to the floodplain immediately adjacent to the river channel (Grabowski and Isely 2006).

Larval fish (13 to 20 mm in length) are capable of swimming speeds that range from 7 to 12 cm/s (3 to 5 in./s). They exhibit avoidance behavior of high flow rates in laboratory systems (Nichols 2003).

Non-Native and Nuisance Species

According to the 1985 Final Environmental Impact Statement for VEGP Units 1 and 2, populations of the Asiatic clam were first discovered at or near the VEGP site in 1972 (NRC 1985). The Asiatic clam is an introduced species that was found in surveys by the ANSP to be abundant in a variety of substrates at all sampling stations both above and below the VEGP site, during sampling in the years 1997 to 2001 (ANSP 2003). The ANSP reported that the substrates where the Asiatic clam occurred ranged from silts and muds to fine- through coarse-grained sands, often containing leaf litter, leaf fragments, and sticks (ANSP 2003). According to the ANSP, the Asiatic clam first appeared in collections in 1972, and by 1976 it was present at all stations and apparent that through competition it was damaging the native mussel fauna. The survey at four stations in 2001 (40 quadrants) produced 1877 molluscs, 85.1 percent of which were Asiatic clams. Based on this data, the ANSP states that it is apparent that the introduced Asiatic clam numerically dominates the macrobenthic habitat of the Savannah River and because of its great numbers competes with the mussels for space and food resources (ANSP 2003).

Other introduced or non-native species occurring in the Savannah River include the following species that are clearly established: threadfin shad (*Dorosoma petenense*), common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), and yellow perch (*Perca flavescens*). Table 2-8 lists nine other introduced species that are not established or that are rare. None of the fish species are considered nuisance species (Marcy et al. 2005).

No invasive aquatic plant species have been noted in the aquatic environments at the VEGP site (Southern 2007a).

Critical Habitats

No critical habitat has been designated by the FWS or NMFS in the vicinity of the VEGP site (Southern 2007a).

State-Listed Species

This section describes Georgia and South Carolina State-listed and proposed threatened and endangered aquatic species in the vicinity of the site. Federally and State-listed aquatic species that may occur near the VEGP site are listed in Table 2-9. Federally and State-listed species that may occur along the proposed Thomson-Vogtle transmission line right-of-way are listed in Table 2-10. Although no identified threatened and endangered aquatic species are located along the proposed Thomson-Vogtle 500-kV transmission line right-of-way, one specie of concern, the Savannah darter (*Etheostoma fricksium*), was identified as being reported from counties crossed by the right-of-way.

The State of Georgia also lists the shortnose sturgeon (*Acipenser brevirostrum*) as State-endangered. The shortnose sturgeon is also Federally listed and is discussed in Section 2.7.2.2. The only other Georgia State-endangered species listed as occurring within Burke County in the vicinity of the VEGP site is the Atlantic pigtoe mussel (*Fusconaia masoni*). The Savannah lilliput (*Toxolasma pullus*) is considered threatened in Georgia but is not listed as occurring in Burke County. Six mussels in South Carolina are considered to be species of concern for the two counties closest to the VEGP site.

Table 2-9. Federally and State-Listed (Georgia and South Carolina) Aquatic Species that are Endangered, Threatened, and Species of Concern

Scientific Name	Common Name	Federal Status[a]	Georgia State Status[b]	S. Carolina State Status[c]	County
Fish					
Acipenser brevirostrum	shortnose sturgeon	FE	SE		Burke
Etheostoma fricksium	Savannah darter		SC		Burke
Moxostoma robustum	robust redhorse		SE		No county given
Mussels					
Fusconaia masoni	Atlantic pigtoe		SE		Burke, Jefferson, Warren
Anodonta couperiana	barrel floater			SC	Barnwell
Elliptio congaraea	Carolina slabshell			SC	Barnwell
Lampsilis cariosa	yellow lampmussel			SC	Barnwell
Lampsilis splendida	rayed pink fatmucket			SC	Barnwell
Pyganodon cataracta	eastern floater			SC	Barnwell
Toxolasma pullus[(d)]	Savannah lilliput		ST	SC	No county given
Utterbackia imbecillis	paper pondshell			SC	Barnwell

(a) Federal status rankings determined by the FWS under the Endangered Species Act, FE = Federally Endangered.
(b) State status determined by the GDNR: SE = State Endangered, SC = Species of Concern (GDNR 2007c).
(c) Species information provided by the SCDNR Natural Heritage Program.
(d) Price 2007

Table 2-10. Listed Terrestrial and Aquatic Species in Georgia Counties Crossed by the Proposed New 500-kV Transmission Line Right-of-Way

Scientific Name	Common Name	Federal Status[a]	Georgia State Status[b]	Counties of Occurrence
Fish				
Acipenser brevirostrum	shortnose sturgeon	FE	SE	Burke
Etheostoma fricksium	Savannah darter		SC	Burke
Notropis chalybaeus	ironcolor shiner		SC	Jefferson
Notropis scepticus	sandbar shiner		SR	McDuffie
Pteronotropis stonei	lowland shiner		SC	Jefferson
Invertebrates				
Fusconaia masoni	Atlantic pigtoe		SE	Burke, Jefferson, Warren
Lampsilis cariosa	yellow lampmussel		SC	Jefferson

(a) Federal status rankings determined by the FWS under the Endangered Species Act, FE = Federally Endangered, (FWS 2004).
(b) State status determined by the GDNR: SE = State Endangered, SR = State Rare, SC = State Species of Concern (GDNR 2007c).

One State species of concern, the Savannah darter, has been reported from Beaverdam Creek (Wiltz 1982b). The shortnose sturgeon and the Atlantic pignose mussel are also reported from counties crossed by the proposed transmission line.

Mussels Family Unionidae

The Atlantic pigtoe is State-listed as endangered for Burke County. It is found in unpolluted, fast-flowing water in coarse sand-gravel substrate (USACE 2006b). As indicated previously, the ANSP monitored freshwater mussels in the vicinity of the VEGP site from 1951 to 2001. A total of 16 species of mussels were identified during comprehensive surveys (ANSP 2003). However, this mussel has not been identified during any of the ANSP studies as being found in the Savannah River.

South Carolina lists six species of mussels as being species of concern in Barnwell County, South Carolina, which is directly across the river from the VEGP site. All six species have been collected in the comprehensive surveys of the Savannah River from 1951 to 2001 at multiple sampling locations. The barrel floater (*Anodonta couperiana*), the yellow lampmussel (*Lampsilis cariosa*), and the Eastern floater (*Pyganodon cataracta*) were found as recently as the 1999 sampling season. The Carolina slabshell (*Elliptio congaraea*) and the rayed pink fatmucket (*L. splendida*) were found as recently as the 2001 sampling season. The paper pondshell (*Utterbackia imbecillis*) was found as recently as the 2000 sampling season. The ANSP reported in their 2001 study that the Carolina slabshell constituted 28.7 percent (35 animals) of the mussels collected in 2001 (ANSP 2003). Yearly ranking of abundance from 1993 to 1999 in hand collections showed the Carolina slabshell to be one of the five most abundant mussel species. The Eastern floater, yellow lamp mussel, and barrel floater were the least abundant. The paper pondshell and rayed pink fatmucket were considered to be moderately abundant (ANSP 2003). Communications with the State of South Carolina identified a seventh mussel species of concern, the Savannah lilliput (Price 2007). The Savannah lilliput was found as recently as 2001 sampling season (ANSP 2003).

Savannah Darter *Etheostoma fricksium*

The Savannah darter is listed as a species of concern for Burke County, Georgia. The habitat for this darter is shallow creeks with moderate current over sand or gravel substrate (GDNR 2007c). Marcy et al. (2005) indicates that the preferred sediment is sand and gravel where logs, sticks, and leafy detritus are present. The Savannah darter has not been found in the Savannah River. It is known from Beaverdam Creek where a total of 31 individuals were collected over a 2-year period (Wiltz 1982b).

2.7.2.2 Threatened and Endangered Aquatic Species

This section describes Federally listed threatened, endangered, and proposed aquatic species and designated and proposed critical habitats known to occur on or in the vicinity of the VEGP site. The only Federally listed aquatic species known to occur in the Savannah River in the vicinity of the VEGP site is the shortnose sturgeon (*Acipenser brevirostrum*) (NOAA 2006). There are no candidate species present or designated critical habitat. However, the Atlantic sturgeon (*A. oxyrinchus*) is considered a species of concern by NOAA. Species of concern are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Both the Atlantic sturgeon and the shortnose sturgeon are anadromous; that is, they ascend coastal rivers to spawn. More is known about the life history of the shortnose sturgeon than that of the Atlantic sturgeon in the southeastern United States (Collins and Smith 1997).

<u>Shortnose Sturgeon</u> <u>*Acipenser brevirostrum*</u>

The shortnose sturgeon is a member of the Family Acipenseridae, a long-lived group of ancient anadromous and freshwater fishes. The species is currently known by at least 19 distinct populations inhabiting 25 river systems ranging from New Brunswick, Canada, to northern Florida (NMFS 1998). The shortnose sturgeon was originally listed as an endangered species by the FWS on March 11, 1967, under the Endangered Species Preservation Act (32 FR 4001). The National Marine Fisheries Service (NMFS) assumed jurisdiction for the shortnose sturgeon in 1974.

Dadswell et al. (1984) provided a synopsis of biological data for the shortnose sturgeon. They reported that temperature is probably the major factor governing spawning. All sources referenced by Dadswell et al. (1984) reported shortnose sturgeon spawning to occur between 9° and 12°C (50°F and 54°F). Other factors influencing spawning are the occurrence of freshets (i.e., increased freshwater flow resulting from sudden rain or melting snow) and substrate character. Spawning grounds were described as being in regions of fast flow (40 to 60 cm/s [1.3 to 2.0 ft/sec]) with gravel or rubble bottoms. The locations are generally well upriver of the summer foraging and nursery grounds (rkm 100-200 [RM 62-124]). In South Carolina, spawning was reported to occur in flooded, hardwood swamps along inland portions of the rivers (including the Savannah River).

Shortnose sturgeon eggs are demersal and adhesive after fertilization, sinking quickly and adhering to sticks, stones, gravel and rubble on the stream bottom. Hatchlings (less than a day old) were rheotactic, photonegative, benthic, and vigorously sought cover. If they were denied cover, they exhibited vertical swim-up and drift behavior until cover was found. Older embryos (1 to 8 days old) exhibited the same behaviors as hatchlings, and when denied cover would search along the bottom until cover was found. Between 9 and 16 days old, the larvae left cover and were positively rheotactic and photopositive. Three-quarters of the larvae left the bottom cover and swam in the water column (Richmond and Kynard 1995).

A recent investigation was conducted to determine any differences in larval behavior resulting from latitudinal variation from shortnose sturgeon populations in the Connecticut River in Massachusetts and the populations in the Savannah River. Specific parameters investigated included habitat preference and dispersal and diel activity and timing for early life stages of shortnose sturgeon. Yolk sac larvae from both rivers preferred dark habitat and used rock cover. The use of cover decreased with age until Day 13, when all fish were foraging in the open, although they generally stayed near the bottom. Upon becoming larvae, the shortnose sturgeon showed an ontogenic behavioral shift to preferring bright, open habitat. Both groups showed some downstream movement as yolk-sac larvae. The Savannah River shortnose sturgeon used rock cover less in the first few days after hatching. Fish continued a low-level of downstream movement for the whole larval period and as early juveniles. During the first 30 days, larvae swam to a mean height of 67 to 117 cm (26.4 to 46.0 in.) on all days (Parker 2007).

Shortnose sturgeon were discovered in the lower Savannah River in the late 1970s (Dadswell et al. 1984). From 1984 to 1992 more than 100,000 sturgeon (18 percent of which were tagged) were stocked in the Savannah River (Smith et al. 2001) by the Marine Resources Research Institute of South Carolina's Department of Natural Resources. Information collected during the stocking efforts in the Savannah River and shortly thereafter indicated that stocked juveniles comprised a minimum of 35.4 percent of the juvenile population in the lower river nursery area. Based on records of marked fish and results from double tagging studies, it was estimated that at least 37.7 percent of the adult population in the Savannah River during the 1997 to 2000 time frame was comprised of stocked fish. Population estimates indicate that the adult population is increasing, but juveniles are still rare. Smith et al. (2001) attributed this to a recruitment bottleneck in the early life stages and in part because of water-quality degradation in the nursery habitat in the lower Savannah River (Smith et al. 2001). Collins et al. (2002) indicates the nursery habitat for juvenile shortnose sturgeon in the Savannah River is in the lower river approximately from rkm 31.5 (RM 19.6) to rkm 47.5 (RM 29.5), which is well distant from the VEGP site.

Shortnose sturgeon larvae were collected in the vicinity of the DOE Savannah River Site during ichthyoplankton surveys conducted from 1982 to 1985. Differentiating shortnose sturgeon larvae from Atlantic sturgeon larvae can be difficult based on their similar appearance. However, a total of 12 of the 43 sturgeon larvae collected were identified as shortnose sturgeon. Four of the shortnose sturgeon larvae were taken from the river downstream from the VEGP site between rkm 128 and rkm 193 (RM 79.9 and RM 120). The remaining eight sturgeon larvae were taken above the VEGP site between rkm 250 and rkm 269 (RM 155.4 and RM 166.6). The shortnose sturgeon larvae were taken during March and the Atlantic sturgeon larvae during April (Paller et al. 1986). Wike (1998) investigated the potential effect of increased DOE Savannah River Site river water withdrawal (an additional 694 L/s [11,000 gpm] from the river) on the shortnose sturgeon population and concluded that the existing and proposed operations at DOE Savannah River Site would not jeopardize the continued existence of the shortnose sturgeon in the Savannah River.

Collins and Smith (1993) captured 626 adult shortnose sturgeon in the Savannah River from 1984 to 1992. They found significantly more fish in the lower river between rkm 42 and rkm 75 than in the upper river between rkm 160 to rkm 299. Twenty-four adults shortnose sturgeon were implanted with radio transmitters. Telemetry data indicated that only a portion of the population participated in the upriver spawning migration. Migrating sturgeon began moving upriver in late January to mid-March traveling at speeds of up to 50 km (31 mi) per day. Hall et al. (1991) also performed telemetry studies to determine seasonal movements and habitat areas of adult and juvenile shortnose sturgeon. They reported upriver spawning migrations from mid-February to mid-March when temperatures ranged from 9 to 12°C (50 to 54°F). Migration rates were as high as 33 km (21 mi) per day.

The area near the VEGP site located at rkm 241 to 244 (RM 150 to 152), has not been identified as a known or suspected spawning site. Probable spawning sites were identified by monitoring the movement of adult shortnose sturgeon in the Savannah River. Hall et al. (1991) reported two areas, one downstream of the VEGP site (rkm 179 to 190) and one upstream (rkm 275 to 278) had repeatedly served as the destinations of migrating adult fish and were occupied for several days during the spawning season. Thus they were identified as probable spawning sites. Collins and Smith (1993) reported a probable spawning location between rkm 179 and rkm 228. Figure 2-15 illustrates the location of the probable spawning sites for the shortnose sturgeon in relation to the VEGP site.

Hall et al. (1991) described the environment at these two locations. They indicated that the substrate in the river bend portions of these locations was distinctly different from the other sections of the river. The sharp river bends were characterized by "...submerged timber, with scoured sand, clay, and gravel as substrate." The outside banks were hardpacked clay, which was scoured by the swift currents, preventing any sediment accumulation. Fish located in the spawning areas were always situated in the main channel. Hall reported that the maximum depths in the river bends of these two areas were 6 to 9 m (20 to 30 feet) and current velocities ranged from 52 to 104 cm/s (1.7 -3.4 ft/s) at the surface. Bottom velocities during the spawning season averaged 82 cm/s (2.7 ft/s). Hall theorized that the sharp bends in certain sections of the Savannah River create the necessary velocity and turbulence for spawning. Substrate in the area provided suitable attachment for the highly adhesive eggs. Dadswell et al. (1984) and Buckley and Kynard (1985) had reported that spawning is usually associated with areas where the predominant substrate is composed of gravel, rubble, and cobble. Hall et al. (1991) indicated that their visual observations of the bend areas in the suspected spawning grounds in the Savannah River confirmed the presence of such materials. Collins and Smith (1993) also reported that the probable spawning areas contain sharp bends with strong currents, submerged timber, and a substrate of gravel, clay, and sand.

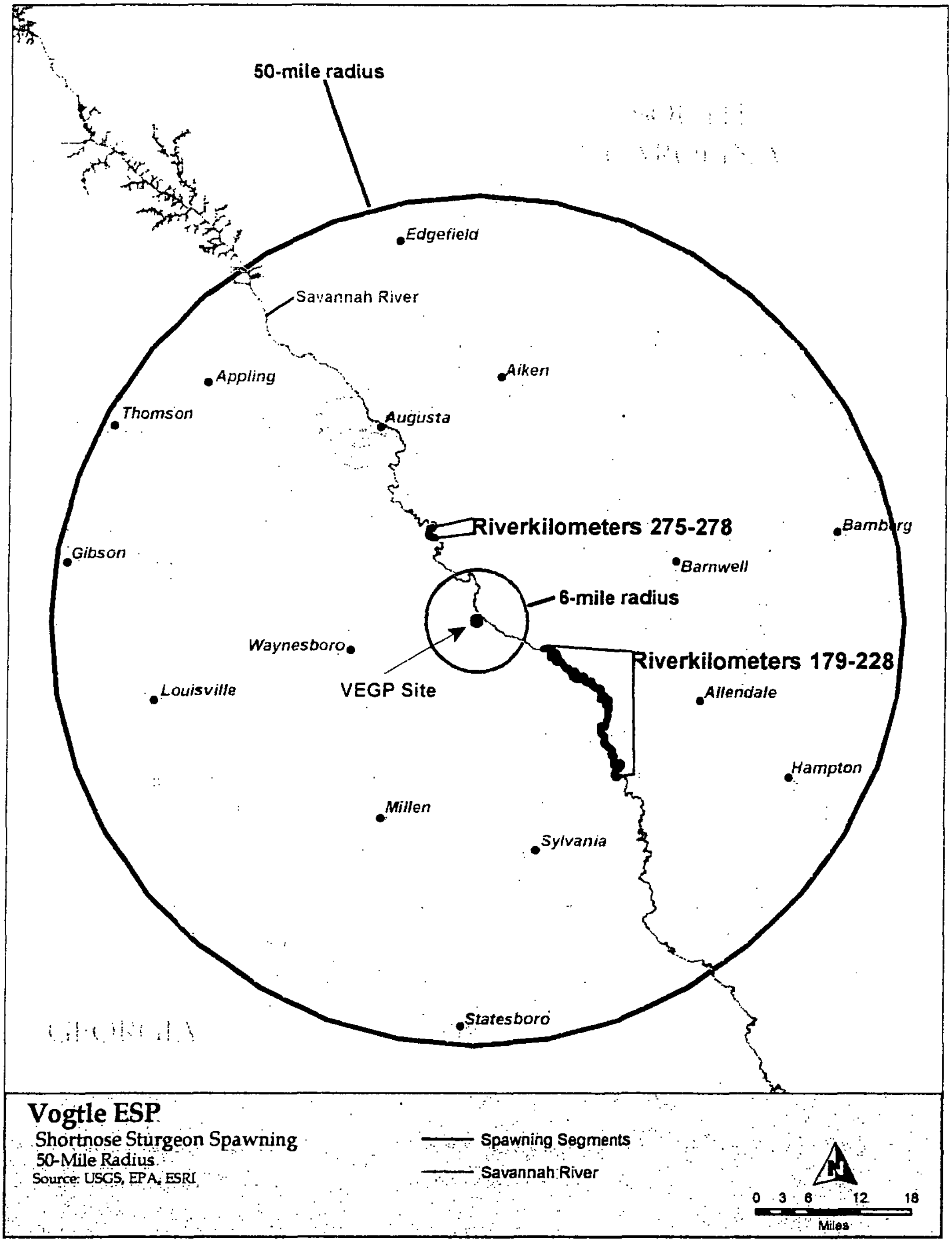


Figure 2-15. Shortnose Sturgeon Probable Spawning Within an 80 km (50 mi) Radius of the VEGP Site (based on data from Hall et al. 1991; Collins and Smith 1993)

It is unlikely that spawning activity occurs in the vicinity of the VEGP site. Aggregations indicative of spawning have been reported in stretches of the Savannah River upstream and downstream of the VEGP site over substrates unlike those found adjacent to the proposed site of the proposed VEGP Units 3 and 4.

2.7.2.3 Aquatic Ecology Monitoring

This section describes the analysis and evaluation of Southern's preapplication monitoring programs.

The NRC does not impose conditions of operation, including monitoring requirements, in the area of water quality. Regulation of water quality is implemented by an NPDES permit issued by the EPA or the states (in this case, Georgia). The NRC's role in water quality is limited to assessing aquatic impacts as part of its National Environmental Policy Act of 1969 (NEPA) evaluation.

The current NPDES permit does not require monitoring of aquatic ecological resources. There are no requirements in the license for the current VEGP Units 1 and 2 to do any monitoring of aquatic resources including specific aquatic ecological monitoring of the algal community, benthic invertebrates or fish. However, the VEGP Units 1 and 2 Environmental Protection Plan, Appendix B to VEGP operating licenses nuclear power facility (NPF) 68 and NPF 81, Section 4.1, entitled "Unusual or Important Environmental Events" requires NRC notification of any unusual environmental events, citing specific fish kills or impingement events at the plant. To date, no such report has been submitted for VEGP Units 1 and 2.

Monitoring of the aquatic ecology in the Savannah River near the VEGP site was part of preconstruction monitoring for VEGP Units 1 and 2. Preconstruction monitoring of the fish population occurred in May and September of 1972 (AEC 1974). Sampling of benthic invertebrates occurred on October 1971, January 1972, and February 1972. Aquatic macrophytes were also surveyed in October 1972 (AEC 1974). Preoperational monitoring was conducted from October 1971 to November 1981. During this time GPC conducted various studies in the Savannah River in the vicinity of the VEGP site to obtain information on the species composition, trophic relationships, relative abundance, and the reproductive cycle of the aquatic community (NRC 1985). GPC conducted larval fish studies from January through August 1974 (Wiltz 1983), studies of adult fish from September 1977 through December 1978, feeding habit studies from October 1980 through September 1981 (Wiltz and Miracle 1982), macroinvertebrate drift studies in the Savannah River from September 1980 through August 1981 (Nichols 1983), and surveys of plankton from January 1981 through September 1981 (NRC 1985).

In addition, the GPC conducted studies to assess the effect of plant construction activities on the resident aquatic fauna of Beaverdam Creek. These studies began in July 1973 and continued during construction at approximately 6-week intervals from July 1973 to February 1975 and from May 1976 to June 1978. The purpose of the study was to determine the environmental effects of plant construction (erosion and siltation) on the aquatic macro-invertebrate community in Beaverdam Creek. The effects of siltation from access road construction and other land grading activities were also examined. The results of the study showed that plant construction had little or no impact on the aquatic macroinvertebrate fauna of Beaverdam Creek (Staats 1983). Species composition at stations that were affected by access road construction became increasingly similar to those of control stations within approximately a year and a half after the construction.

Two other studies evaluated the fish located in Beaverdam Creek. The first study investigated the potential for anadromous fish to spawn in Beaverdam Creek (Wiltz 1982a). The only anadromous species they found was the blueback herring, although the creek is also suitable for hickory shad. The second study examined the potential effects of siltation and sedimentation on resident fish populations over a two-year period (1977 and 1978) (Wiltz 1982b).

Although Southern currently does not perform monitoring, they indicate that they track the status of species of interest including Federally aquatic and State-protected species, regularly interface with State and Federal resource agencies, and participate in recovery groups. GPC is a member of the Robust Redhorse Conservation Committee (RRCC) (Hendricks 2002).

Southern did not perform any pre-application monitoring for the proposed VEGP Units 3 and 4. Southern did not conduct surveys for Federally listed aquatic threatened and endangered or proposed species or of designated or proposed critical habitats, because other than the shortnose sturgeon, which has been well studied in the portion of the Savannah River in the vicinity of the site, there are no Federally listed species and no designated or proposed critical habitats.

2.8 Socioeconomics

This section describes the socioeconomic baseline of the proposed site. It describes the characteristics of the region surrounding the VEGP site, including population demographics, density, and use that form the basis for assessing the potential social and economic impacts from the construction and operation of the proposed two new nuclear units.

These impacts are for the region[a] surrounding the proposed site. This discussion focuses on the socioeconomic characteristics of Burke, Richmond, and Columbia Counties, although it considers the entire region within an 80-km (50-mi) radius of the proposed site. The scope of the review of community characteristics is guided by the magnitude and nature of the expected impacts of construction, maintenance, and operation of the proposed project and by those site-specific community characteristics that can be expected to be affected by these impacts.[b]

The population data for the analytical area are based on the 2000 U.S. Census data and estimated with SECPOP 2000, a computer program that calculates population by emergency planning zone sectors (Southern 2007a). In addition, the NRC staff analyzed the economic, employment, and population trends for the region using additional U.S. Census data sets and population projections from the Georgia Office of Planning and Budget Policy.

The analytical area is an 80-km (50-mi) circle centered on the proposed powerblock and includes all or a portion of 28 counties in Georgia and South Carolina. Table 2-11 identifies the counties and some summary geographic and demographic information for each county. Figure 2-2 shows a map of the analytical area.

2.8.1 Demographics

For the purposes of this analysis, the staff divided the total population within the analytical area into three major groups: residents who live permanently in the area; transients who may temporarily live in the area but have a permanent residence elsewhere, and migrant workers who travel into the area to work and then leave after their job is done. Transients and migrant workers are not fully characterized by the U.S. Census, which generally captures only resident populations.

2.8.1.1 Resident Population

Figure 2-16 shows the estimated population in 2000 within 80 km (50 mi) of the center of the proposed VEGP site. On this map, the powerblock for the center of the proposed site is the circle on this map is the proposed site, with concentric circles in 16-km (10-mi) increments up to 80 km (50 mi) from the proposed location. Population data for the area surrounding the VEGP site indicate low-population densities and a rural setting. Contributing to the population sparseness near the plant is the Savannah River Site, a secured U.S. Government facility with

(a) For the purposes of the EIS, the relevant region is limited to that area necessary to include social and economic base data for (1) the county in which the proposed plant would be located and (2) those specific portions of surrounding counties and urbanized areas (generally, up to 80 km [50 mi] from the station site) from which the construction/operations workforce would be principally drawn, or that would receive stresses to community services by a change in the residence of construction/operations workers.

(b) *Table G-3 in Appendix G provides summary statistics for all counties within an 80-km (50-mi) radius of the VEGP site that were used to assist in narrowing the scope to assess socioeconomic impacts.*

Table 2-11. Counties within 80 Km (50 Mi) of the Proposed VEGP Site

				Largest Town/City within County			
County	State	Number of Current VEGP Residents (2005)	Population Density per mi^2 (2000)	Name	Population	Driving Distance to VEGP	Median Income (1999)
Bulloch	GA	10	82.1	Statesboro	22,698	58.8	$29,499
Burke	GA	170	26.8	Waynesboro	5813	16.8	$27,877
Candler	GA	2	38.8	Metter	3879	64	$25,022
Columbia	GA	289	307.9	Martinez	27,749	37	$55,682
Effingham	GA	0	78.3	Rincon	4376	75.6	$46,505
Emanuel	GA	12	31.8	Swainsboro	6943	57.6	$24,383
Glascock	GA	2	17.7	Gibson	694	60.2	$29,743
Jefferson	GA	13	32.7	Louisville	2712	41.2	$26,120
Jenkins	GA	16	24.5	Millen	3492	32.9	$24,025
Johnson	GA	2	28.1	Wrightsville	2223	70.9	$23,848
Lincoln	GA	3	39.5	Lincolnton	1595	85	$31,952
McDuffie	GA	3	81.7	Thomson	6828	61.1	$31,920
Richmond	GA	224	616.5	Augusta-Richmond County	195,182	32.5	$33,086
Screven	GA	58	23.7	Sylvania	2675	35.3	$29,312
Warren	GA	0	22.2	Warrenton	2013	72.3	$27,366
Washington	GA	1	31.1	Sandersville	6144	66.9	$29,910
Aiken	SC	37	132.9	Aiken	25,337	47.9	$37,889
Allendale	SC	1	27.5	Allendale	4052	39.9	$20,898
Bamberg	SC	2	42.4	Bamberg	3733	66.6	$24,007
Barnwell	SC	4	42.8	Barnwell	5035	57.1	$28,591
Colleton	SC	0	36.2	Walterboro	5153	91.7	$29,733
Edgefield	SC	1	49	Edgefield	4449	64.1	$35,146
Hampton	SC	0	38.2	Hampton	2837	55.1	$28,771
Jasper	SC	0	31.5	Ridgeland	2518	85.6	$30,727
Lexington	SC	0	308.9	West Columbia	13,064	106.9	$44,659
McCormick	SC	4	27.7	McCormick	1489	71.1	$31,577
Orangeburg	SC	0	82.8	Orangeburg	12,765	84.6	$29,567
Saluda	SC	0	42.4	Saluda	3066	78.6	$35,774

Source: Southern 2007b

no permanent residents across the Savannah River and adjacent to the plant in neighboring South Carolina. The Savannah River Site occupies approximately 803 km^2 (310 mi^2), approximately 20 percent of which lies within a 32-km (20-mi) radius of the VEGP site, principally in Aiken and Barnwell Counties. The only population center within 16 km (10 mi) of the VEGP site is Girard, Georgia, approximately 13 km (8 mi) to the southeast with a population of 227 (USCB 2007a).

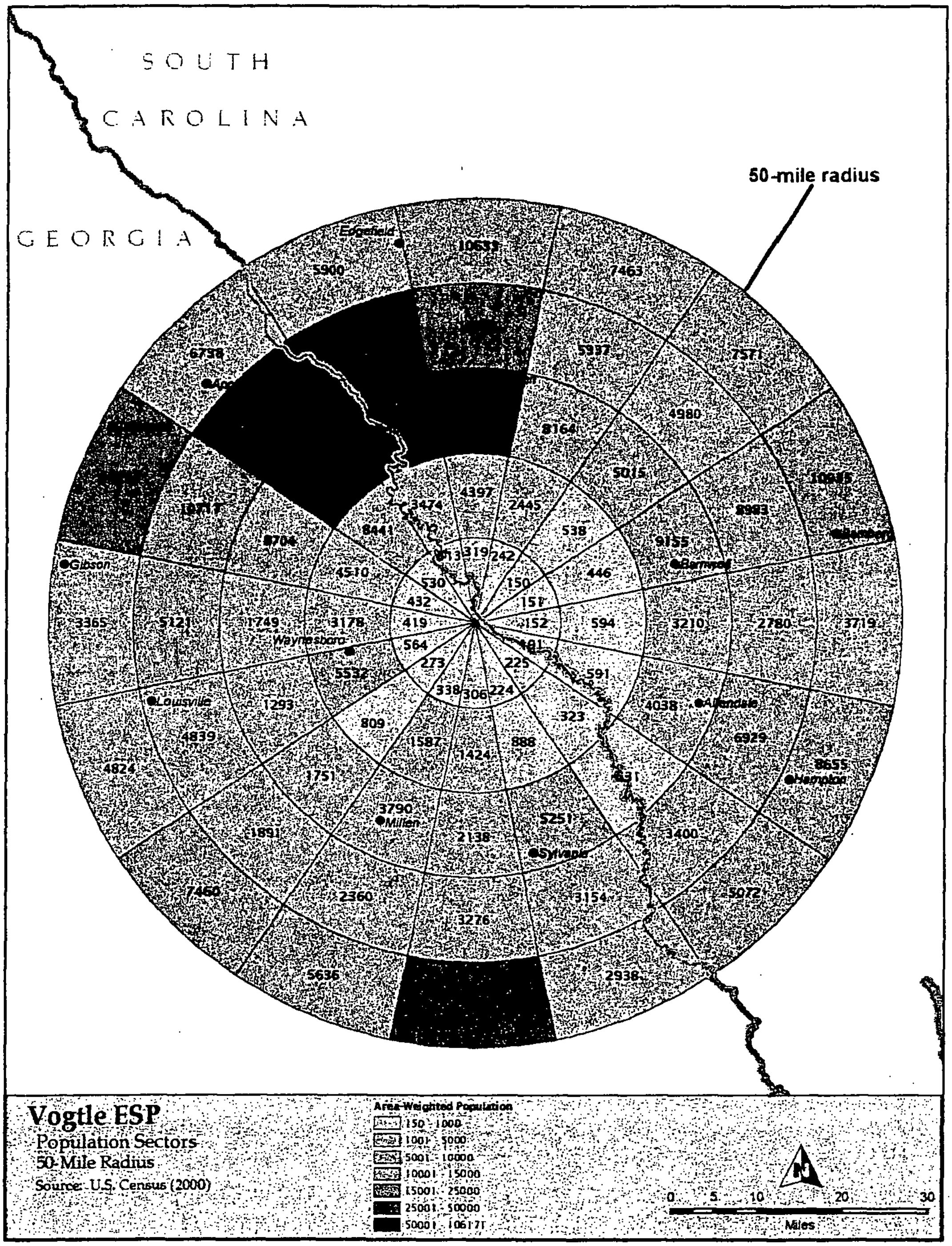


Figure 2-16. Estimated Population in 2000 within 80 km (50 mi) of the VEGP Site (USCB 2000)

Table 2-12. Population Growth in Burke, Columbia, and Richmond Counties (1970 to 2015)[(a)]

	Burke County		Richmond County		Columbia County		Georgia	
Year	Pop	Annual Percent Growth	Pop	Annual Percent Growth	Pop	Annual Percent Growth	Pop	Annual Percent Growth
1970	18,255	–	162,437	–	22,327	--	4,589,575	N/A
1980	19,349	0.6	181,629	1.1	40,118	6.0	5,463,105	1.8
1990	20,579	0.6	189,719	0.4	66,031	5.1	6,478,216	1.7
2000	22,243	0.8	199,775	0.5	89,288	3.1	8,186,453	2.4
2010 (est.)	24,561	1.0	193,914	-0.3	116,642	2.7	9,864,970	1.9
2015 (est.)	25,765	1.0	191,563	-0.2	132,303	2.6	10,813,573	1.9

Source: Southern 2007a

(a) Historic population numbers come from U.S. Census data and future population projections were developed by Georgia Office of Planning and Budget Policy (GOPBP 2005).

Three larger towns are within 32 km (20 mi) of the VEGP site, including Waynesboro (population 5813) and Sardis (population 1171) to the west and south of the plant in Georgia, and Jackson (population 1625) to the north of the plant in South Carolina. As shown in Figure 2-16, the more densely populated areas in the region are more than 32 km (20 mi) from the proposed site along the Interstate-20 (I-20) corridor. Augusta, located in Georgia to the northwest of the plant, and North Augusta and Aiken, both located to the north of the plant in South Carolina, have the largest populations with 195,102 people, 17,574 people, and 25,337 people, respectively.

Augusta, Georgia, is the largest metropolitan area within an 80-km (50-mi) radius of the VEGP site, and most of the current 862 VEGP employees live in Augusta, its suburban communities, or in unincorporated sections of Columbia and Richmond Counties. The towns neighboring Augusta, such as Evans (population 17,727), and Hephzibah (population 3880) in Georgia; and North Augusta (population 17,574) and Aiken (population 25,337) in South Carolina have also experienced a high rate of suburban growth in recent years. Outside the Augusta area, there are a few small towns, such as Waynesboro (population 5813), which have town centers, shopping, and several services. There are also several rural communities, similar to Girard (population 227), that provide limited services (Southern 2007a; USCB 2007a).

Table 2-12 provides population totals for Burke, Columbia, and Richmond Counties and the State of Georgia from 1970 through 2000 and estimated population projections for these areas through 2015, based on estimates developed by the State of Georgia's Office of Planning and Budget. Additional population estimates and projections for counties throughout the analytical area are found in Appendix G (includes projected populations by sector through 2090). The population projection methodology used for the sector population analysis is provided in Section 2.5 of Southern's ER (Southern 2007a).

2.8.1.2 Transient Population

Transients include people who work in or visit large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, and at recreational areas or special events where there may be seasonal and workday variations in population. With the exception of the Savannah River Site, no significant industrial or commercial facilities are located within a 16-km (10-mi) radius of the VEGP site. Transient population estimates up to a 16-km (10-mi) radius around the VEGP site are included in Table G-3, of Appendix G. The Savannah River Site employs approximately 11,000 people and maintains its own emergency plan; thus, Savannah River Site employees are excluded from VEGP's analysis of transient populations for emergency planning (Southern 2007a).

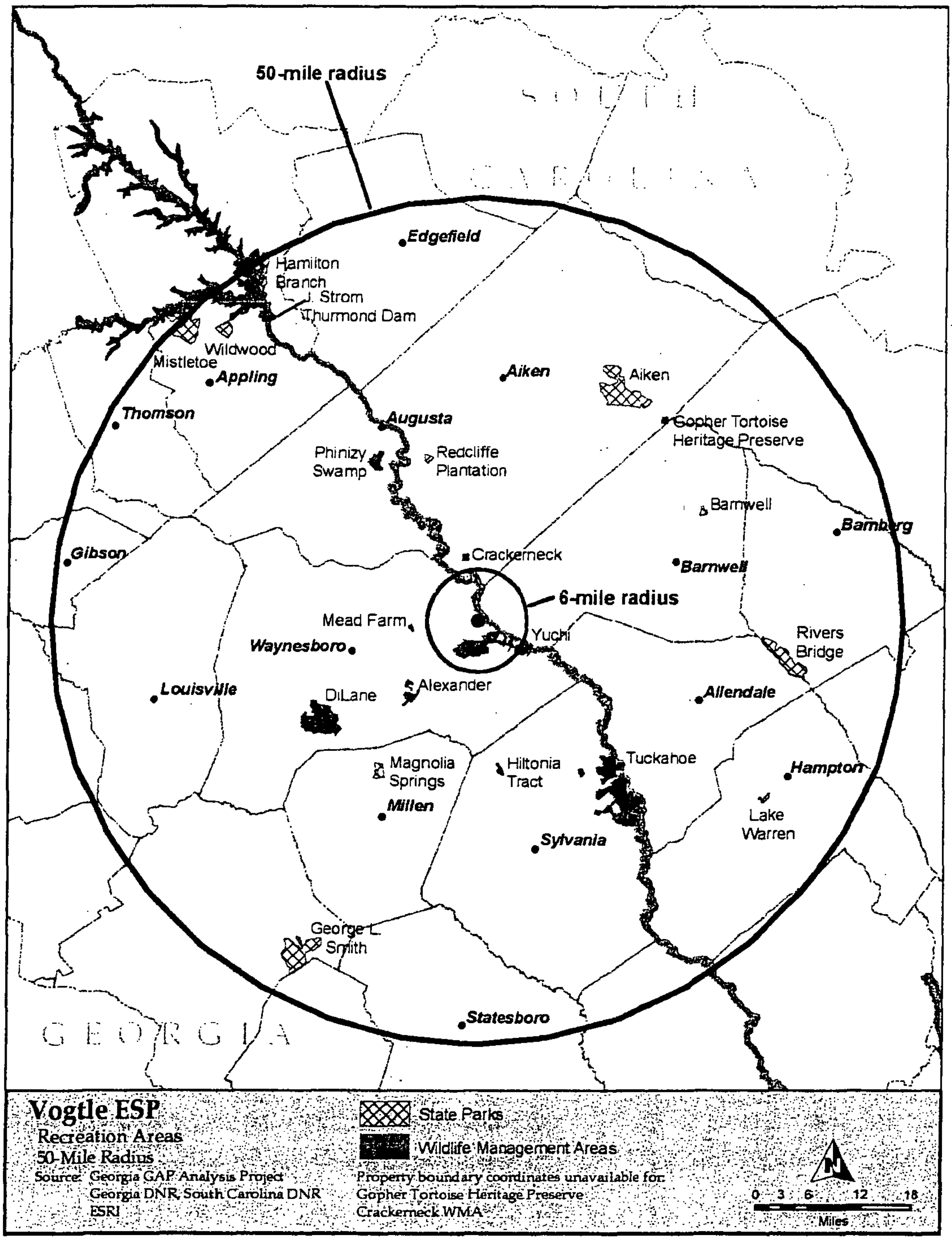
Workplace transients within the 80-km (50-mi) radius of the plant are found primarily in Fort Gordon, several industries along the Savannah River, hospitals and nursing homes in the region, schools and colleges, correctional facilities, and numerous hotels. In addition, recreational parks in the area attract thousands of visitors each year. Magnolia Springs, the state park nearest the VEGP site, had 120,500 visitors in 2004. Redcliffe Plantation, the next closest state park, had 2500 visitors in 2004. During the 2004 hunting season, 3100 hunters visited Crackerneck Wildlife Management Area on the Savannah River Site (see Figure 2-17, Recreational Areas within 80 km [50 mi] of the VEGP site) (Southern 2007a).

2.8.1.3 Migrant Labor

The 2002 Census of Agriculture indicates the migrant population is low within 80 km (50 mi) of the proposed site is low. The U.S. Census Bureau defines a migrant laborer as someone who is working seasonally or temporarily and moves one or more times from one place to another to perform seasonal or temporary employment. Migrants tend to work short-duration, labor-intensive jobs harvesting fruits and vegetables, which are not grown in significant commercial quantities in the immediate vicinity. Within the 80-km (50-mi) radius of the site, only McDuffie County has a substantial number of farms that raise relatively labor-intensive crops that employ migrant labor (Southern 2007a).

2.8.2 Community Characteristics

The VEGP site sits in a quiet, rural area with several small towns located within 32 km (20 mi) of the plant. With the exception of Aiken County, about half of the population in any county around the VEGP site is minority (primarily African American). Between one-fifth and one-third of the households in these counties have median incomes below the poverty level. Burke County and the five counties closest to the site are described in terms of racial characteristics and income level in Table 2-13.



1 **Figure 2-17**. Recreational Areas within 80 km (50 mi) of the VEGP Site (Southern 2007a)

Table 2-13. Minority and Low-Income Populations (2000 U.S. Census)

	Percentage Minority	Percentage Below Poverty
United States	30.9	12.4
Georgia	34.9	12.6
Burke	53.5	28.7
Richmond	55.6	19.6
Screven	46.8	20.1
South Carolina	32.8	14.1
Aiken	29.6	13.8
Allendale	73.0	34.5
Barnwell	45.2	20.9

Source: USCB 2007a

Further discussion of the demographic composition of the analytical area can be found under "Environmental Justice" in Section 2.10. The remainder of this section addresses community characteristics including the regional economy, transportation networks and infrastructure, taxes, aesthetics and recreation, housing, community infrastructure and public services, and education.

2.8.2.1 Economy

The principal economic centers in Burke, Columbia, and Richmond Counties include Augusta (Richmond County), Martinez (Columbia County), Evans (Columbia County), and Waynesboro (Burke County). The U.S. Bureau of Economic Analysis reports service industries in Augusta, Martinez, Evans, and Waynesboro (Burke County) employ the most workers (28.5 percent of employment) of any sector in the region. Other important sectors of employment include government (24.4 percent); retail trade (18 percent); manufacturing (10.3 percent), and construction (5.9 percent). In the last decade, the transportation and utilities sectors and service industries had the largest growth rates, while mining, wholesale trade, farming, and construction declined during these same years (Southern 2007a).

Although no single employer dominates the region, two of the largest employers in the area are the U.S. Army's Fort Gordon, employing 12,000 military and 5000 civilian workers, and DOE's Savannah River Site, which employs 11,000 workers. Augusta is home to a large medical school and medical complex that is a major source of employment and also fosters affiliated industries such as pharmaceuticals, diagnostic equipment, and medical supplies (Southern 2007a).

Approximately 860 full-time employees currently are employed on the VEGP site, with an additional 1000 contract workers onsite during maintenance outages. Southern is the largest employer in Burke County. Approximately 80 percent live in three counties: Burke (20 percent), Richmond (26 percent), and Columbia (34 percent). Because the remaining 20 percent of the

VEGP site's permanent employees are sparsely distributed among 15 other counties, the staff simplified its analysis by concentrating on Columbia, Richmond, and Burke Counties. The staff used the distribution of VEGP's employees as the basis for several demographic assumptions in its economic impact assessment discussed in Chapters 4 and 5 of this EIS. Table 2-14 shows where the VEGP site's employees lived in 2006.

Table 2-14. Residence Locations of the Workforce at the VEGP Site (June 2006)

County	Workforce Number	Percent of Workforce
Columbia	289	34
Richmond	224	26
Burke	170	20
Screven	58	7
Aiken	37	4
Jenkins	16	2
Jefferson	13	2
Emanuel	12	1
Bulloch	10	1
Other Counties	33	3
Total	**862**	**100.0**

Source: Southern 2007a

Burke, Columbia, and Richmond Counties have a diversified, expanding industry base. Manufacturing firms in the three counties produce a variety of products from disposable diapers to golf carts. The area has two natural resource assets: wood and kaolin. Forestry companies manufacture wood products including paper products, pulpwood, furniture, and flooring. There are several textile firms in the area that manufacture fabrics and apparel. Although manufacturing is a large employment sector, no single manufacturing firm ranks among the top 10 employers in the region (Southern 2007a).

Table 2-15 shows the number of workers employed and the unemployment rates for Burke, Columbia, and Richmond Counties and the State of Georgia for 1995 and 2005. These data show the number of employed workers in Burke County increased between 1995 and 2005 by more than 24 percent. The number of employed workers has also increased significantly in Columbia County, roughly in proportion with its population growth. During the same time period, the unemployment rate in Burke County decreased from 13.7 percent to 7.7 percent while the unemployment rate in Richmond and Columbia Counties remained relatively unchanged (USBLS 2007).

2.8.2.2 Taxes

Counties, municipalities, and boards of education may impose sales taxes in addition to the state sales tax. Burke County has its own 2 percent sales tax in addition to the Georgia state sales tax of 4 percent. Richmond and Columbia Counties assess an additional 3 percent sales

Table 2-15. Employment Changes in Burke, Columbia, and Richmond Counties (1995 to 2005)

Region	Workers Employed[a] 1995	Workers Employed[b] 2005	Percentage Change in Workers Employed 1995-2005	Percentage Unemployment Rate 1995	Percentage Unemployment Rate 2005
Burke County	7516	9374	24.7	13.7	7.7
Columbia County	38,567	53,098	37.7	4.1	4.4
Richmond County	75,814	84,793	5.0	7.1	7.1
County Totals	**121,897**	**147,265**	**20.8**		
Georgia	*3,522,905*	*4,384,030*	*24.4*	*4.8*	*5.2*

Source: USBLS 2007

(a) Employed workers includes both part-time and full-time employment

(b) Unemployed workers includes all workers without employment who are available for, and seeking employment

and use tax (Southern 2007a). Counties and municipalities are authorized by the state constitution to levy and collect a general ad valorem ("according to value") property tax.

Georgia law generally requires tangible real and personal property be assessed at 40 percent of its fair market value.[a] The tax rate is stated in terms of "mills," with 10 mills equal to 1 percent of a property's assessed value. County and city governing authorities set the property tax (millage) rate (Southern 2007a).

Southern and the VEGP site's co-owners pay annual property taxes to Burke County. Table 2-16 presents information on the total property taxes the VEGP site pays to Burke County, the total property taxes collected by the county, and the percentage of the total property taxes that are paid by the VEGP site, and the portion of Burke County's tax revenues that is disbursed to the Burke County School District. For the 5 years between 2000 and 2004, the

Table 2-16. Property Tax Information for Burke County (2000-2004)

Year	Total Burke County Property Tax Revenue	Burke County Tax Revenue Disbursed to the Burke County School District	Property Tax Paid by Southern ($)	Percent of Total Property Taxes
2000	30,329,024	19,119,331	24,930,927	82.2
2001	30,758,563	18,691,850	25,276,404	82.2
2002	29,713,972	18,022,492	23,699,476	79.8
2003	30,029,880	18,160,393	24,341,247	81.1
2004	29,805,738	17,838,847	24,358,042	81.7

Source: Southern 2007a

(a) Exceptions apply to special types of property such as historic property, conservation use property, some agricultural use property, and standing timber.

VEGP site paid about 80 percent of the property tax collected in Burke County (Southern 2007a).

Tax bases differ between counties in Georgia because of differences in taxable properties. Counties that have power plants or large manufacturing plants have much greater revenue-raising potential than purely agricultural counties. In terms of revenue-generating capacity per capita (including all forms of local tax revenues), Burke County has one of the highest revenues in the state. Columbia County revenues per capita are close to the state average, and Richmond County is somewhat below the average relative to all other counties in the state (Matthews 2005).

2.8.2.3 Transportation

The VEGP site's transportation network includes an interstate and state highway system, two primary freight rail carriers (CSX in South Carolina and Georgia and Norfolk Southern in Georgia), and 16 regional airports. Augusta Bush Field Airport is the only airport that supports commercial carrier service. Interstate 20 runs east-west through Augusta, connecting Columbia, South Carolina, with Atlanta, Georgia. I-520 serves as a beltway around Augusta, connecting I-20 with several north-south highways throughout the region, including U.S. Route 25, connecting Augusta with Waynesboro, and State Routes 56 and 23, which also connect Augusta with rural towns to the south (Southern 2007a).

Figure 2-18 presents the major road networks throughout the region, and highlights the most likely employee commuter routes to and from the VEGP site. Most of the roads in Columbia and Richmond Counties are designated "urban," and all of the roads in Burke County are "rural." The level of use and congestion on roadways is the highest in and around Augusta where annual average daily traffic counts exceed 25,000 in certain sections of I-20 and I-520. In Burke County annual average daily traffic counts are highest around Waynesboro where traffic can range from 5000 to 15,000. Outside of Waynesboro annual average traffic counts in Burke County are less than 5000 (GDOT 2007).

Rail

There is no passenger rail service in Burke, Columbia, or Richmond Counties. Two primary freight rail carriers service the three counties, CSX and Norfolk Southern. From Augusta, CSX has three lines leading to Atlanta, Georgia; Greenwood, South Carolina, and Savannah, Georgia (through South Carolina). From Augusta, Norfolk Southern has a rail line that goes through Waynesboro to points south and west. Both rail lines have the capacity to run additional trains. A 32-km (20-mi) rail spur line runs from the VEGP site to the Norfolk and Southern line, connecting north of Waynesboro. Southern recently upgraded the spur to support the transfer of heavy equipment to the VEGP site (Southern 2007a).

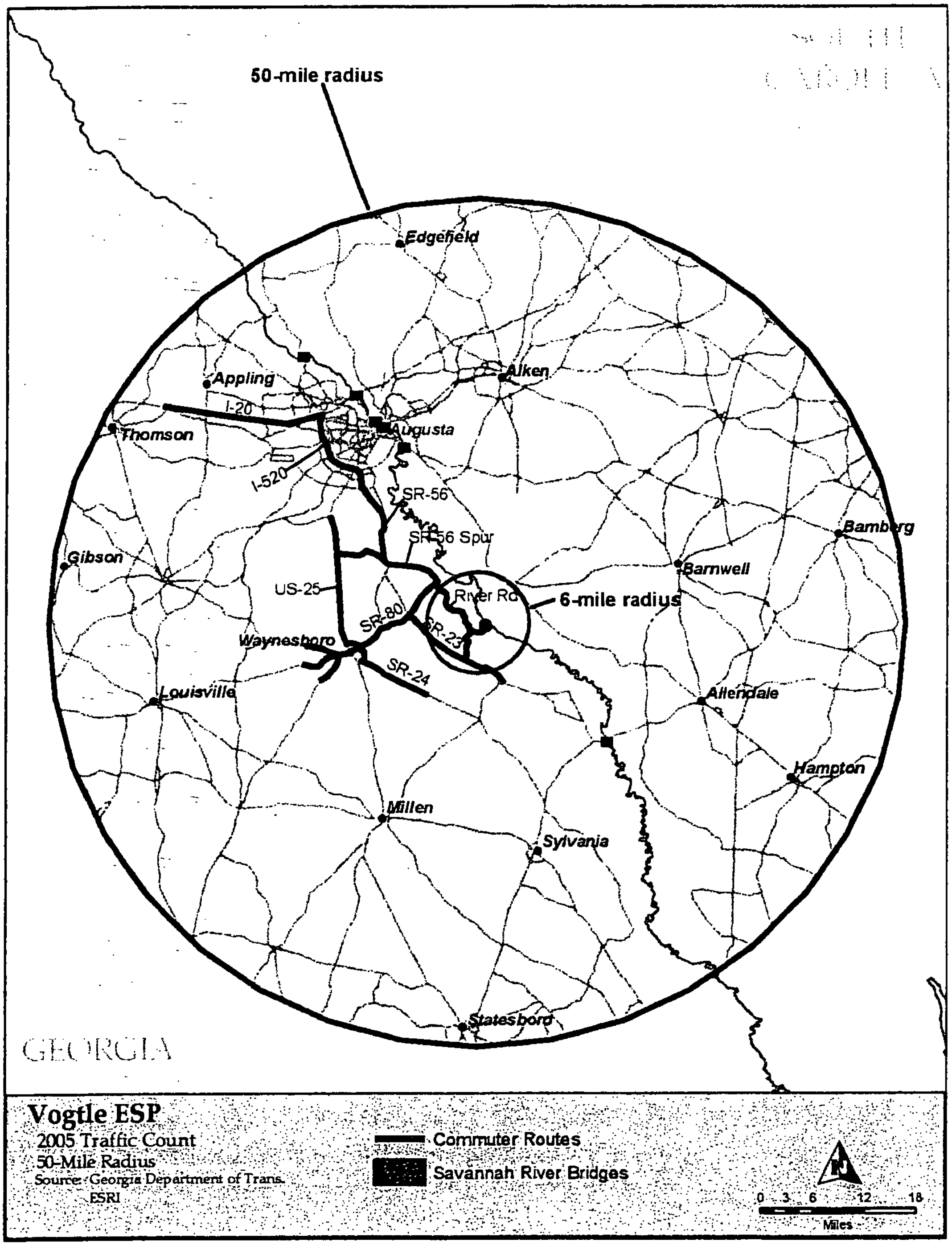


Figure 2-18. Major Commuter Routes in Burke, Columbia, and Richmond Counties (GDOT 2007)

Waterway

The VEGP site is located at rkm 243 (RM 151) of the Savannah River. The Savannah River is part of the U.S. Inland Waterway System and an authorized navigation channel exists from the mouth of the Savannah River in Savannah, Georgia, to Augusta, Georgia. All of the major components for VEGP Units 1 and 2 were delivered to the site by barge using the Savannah River navigation channel. The VEGP site is equipped with a barge slip downstream of the VEGP Units 1 and 2 intake structure, to support unloading major equipment.

2.8.2.4 Aesthetics and Recreation

State parks and wildlife management areas within 80 km (50 mi) of the VEGP site and are listed in Table 2-17 and are shown in Figure 2-17. The Yuchi WMA, a 3160-ha (7800-ac) site adjacent to the VEGP site, and the Crackerneck WMA, a 4237-ha (10,470-ac) site on the South Carolina side of the Savannah River adjacent to the west boundary of the Savannah River Site, are closest to the VEGP site. Both WMAs are within a 10-km (6-mi) radius of the VEGP site, although Crackerneck is approximately 80 km (50 mi) from the site by road. Mead Farm WMA is about 13 km (8 mi) from the VEGP site, and Alexander WMA is about 20 km (12 mi) from the VEGP site. The closest State parks are Magnolia Springs, in Jenkins County, Georgia (approximately 32 km (20 mi) from the VEGP site), and Redcliffe Plantation State Park in Aiken County, South Carolina (approximately 32 km (20 mi) by air from VEGP). J. Strom Thurmond Dam and reservoir, formerly named Clarks Hill Lake, are within 80 km (50 mi) of the VEGP site.

The lake is a major recreation area for the Central Savannah River Area (Southern 2007a). There are numerous locations and opportunities to hunt and fish in the area on public and private land.

Festivals and sporting events throughout the region bring in tourists for several days to a week. Major sporting events in the Augusta area are the Masters Golf Tournament, the Cutting Horse Futurity, the Invitational Rowing Regatta, the Southern National Boat Races, and the Aiken Triple Crown. Redcliffe Plantation hosts annual Heritage Days. Burke County hosts the Redbreast Festival and the Georgia Bird Dog Field Trials (Southern 2007a).

VEGP Units 1 and 2 have natural draft cooling towers, which stand approximately 168 m (550 ft) high and are the tallest structures at the site. On the Georgia side of the Savannah River, trees and terrain provide barriers to viewing the containment, turbine buildings, and support structures from the road or river, but the towers can be seen from Highways I-520 and 56, River Road, and parts of the Savannah River. The only structures fully visible from the river are the intake canal, intake structure, and pumphouse (Southern 2007a).

Table 2-17. Recreation Areas Within 80 km (50 mi) of the VEGP Site

Name	Acreage	Location	Annual Visitors	Overnight Facilities? (Yes/No)
Wildlife Management Areas (WMA)[a]				
Georgia				
Phinizy Swamp	1500	Richmond County	NA	No
Alexander	1300	Burke County	NA	No
DiLane	8100	Burke County	NA	No
Yuchi	7800	Burke County; less than 16 km from the VEGP site	NA	No
Mead Farm	200	Burke County; less than 16 km from the VEGP site	NA	No
Hiltonia Tract	500	Hiltonia, Screven County	NA	No
Tuckahoe	15,100	Sylvania, Screven County	NA	No
South Carolina				
Crackerneck	10,470	Aiken County; less than 10 air miles from the VEGP site	3100	No
Gopher Tortoise Heritage Preserve	1395	Aiken County	NA	No
State Parks				
Georgia				
Magnolia Springs	1071	Millen, Jenkins County	120,500	Yes
George L. Smith	1634	Twin City, Emanuel County	44,136	Yes
Mistletoe State Park	1920	Appling, Columbia County	132,314	Yes
Wildwood Park	975	Columbia County	132,314	Yes
South Carolina				
Hamilton Branch	731	Plum Branch, McCormick County	117,200	Yes
Aiken Natural Area	1067	Windsor, Aiken County	42,645	Yes
Redcliffe Plantation	369	Beech Island, Aiken County	2400	Yes
Barnwell	300	Blackville, Barnwell County	76,845	Yes
Rivers Bridge	390	Ehrhardt, Bamberg County	6027	Yes
Lake Warren	440	Hampton, Hampton County	49,962	Yes

Sources: Southern (2007a)
NA: Not Available
(a) Visitor records for WMAs not kept except for Crackerneck WMA, which is part of Savannah River site land area.

The terrain along the Savannah River allows the plumes and, in a few cases, the towers to be visible from the vicinity of Highway 125 in Allendale and Barnwell Counties, South Carolina; the southern outskirts of Aiken County, and parts of I-520 in South Carolina. Across the river from the VEGP site's intake are three intake canals and a barge facility for the Savannah River Site (Southern 2007a).

2.8.2.5 Housing

Approximately 80 percent of the current the VEGP site employees reside in three counties in Georgia: Burke (20 percent), Richmond (26 percent), and Columbia (34 percent). The remaining 20 percent are distributed across 24 other counties (see Table 2-18). Within 80 km(50 mi) of the proposed site there are residential areas in and near cities and towns, smaller communities, and farms. Rental property is scarce in the rural areas, but is available in the larger municipalities such as Waynesboro, Augusta, Martinez, and Evans. In the vicinity of the VEGP site, housing units are generally isolated, older single-family homes, manufactured homes, or mobile homes. New residential developments are primarily located in the cities and suburbs around Augusta (Southern 2007a). Several new residential areas are currently being developed in Waynesboro in anticipation of new full-time employees at the proposed site (PNNL 2006).

Table 2-18. Regional Housing Information by County for the Year 2000

County	Total Housing Unit	Occupied	Owner Occupied	Renter Occupied	Vacant Housing	Percent Vacancy
Burke	8842	7934	6030	1904	908	10.3
Columbia	33,321	31,120	25,557	5563	2201	6.6
Richmond	82,312	73,920	42,840	31,080	8392	10.2
Screven	6853	5797	4513	1284	1056	15.4
Aiken (SC)	61,987	55,587	42,036	13,551	6400	10.3
Total	**193,315**	**174,355**	**120,976**	**53,382**	**18,957**	**9.8**

Source: Southern 2007a; USCB 2007a

Table 2-18 provides the number of housing units and vacancies for the five counties where most the VEGP site employees reside: Columbia, Richmond, Burke, Screven, and Aiken. In 2000, there were a total of 193,315 housing units in the five-county region, with an average vacancy rate of 9.8 percent. The vacancy rate in Screven County is significantly higher than the average rate of this five-county region, while the vacancy rate in Columbia County is lower than the average (USCB 2000). Richmond County has more rental property than any other county. Of the 8392 vacant housing units in Richmond County, 3739 were for rent and 1160 were for sale. In Columbia County, of the 2201 vacant housing units, 560 units were available for rent and 760 were for sale.[a] Of 908 vacant housing units in Burke County in 2000, 167 were for rent and 77 were for sale (Southern 2007a).

(a) U.S. Census classifications of vacant homes includes the following: for rent, rented but not yet occupied, for sale only, sold but not yet occupied, vacation home, migrant housing, other.

2.8.2.6 Public Services

Water Supply and Waste Treatment

The VEGP site consumes approximately 3.8 million L/d (1 MGD) of water from three onsite groundwater wells. One well generally supplies all necessary water for normal plant operation, leaving two wells on standby. the VEGP site has permits to withdraw 20.8 million L/d (5.5 MGD) from the three wells (Southern 2007a).

In the Central Savannah River Area, municipal water sources can be surface water (such as rivers, lakes, and streams), or groundwater. Columbia County lies north of the Fall Line, a geomorphic boundary between the Piedmont and the Coastal Plain. It is characterized by a limited groundwater supply because of the dense, crystalline rock underlying the area. Like most of the large municipal systems above the Fall Line, Columbia County obtains its water from the Savannah River or one of its impoundments (Southern 2007a).

In the Coastal Plains of Georgia and South Carolina, two major regional aquifer systems supply about 11 million L/d (3 MGD) of water: the lower Cretaceous aquifer system and upper Tertiary aquifer system. The VEGP site withdraws groundwater primarily from the Cretaceous aquifer. Most counties in the Coastal Plain, including Burke and Richmond Counties, obtain their water from these aquifers, and some municipalities use the Savannah River to supplement their supply. Tables 2-19 and 2-20 detail water supplies in Burke, Columbia, and Richmond Counties, their permitted capacities, and their average daily production (Southern 2007a).

Table 2-19. Water Supply System Usage and Capacity for Groundwater Withdrawals

System Name	Permitted Annual Average Withdrawal, Million L/d (MGD)	Reported Annual Average Withdrawal, Million L/d (MGD)	Population Served
Burke County			
Waynesboro	13.25 (3.50)	2.99 (0.79)	5813
Sardis	1.51 (0.40)	0.26 (0.07)	1152
Columbia County			
Columbia County[a]	2.20 (0.58)	0.00 (0.00)	77280
Grovetown	3.41 (0.90)	0.49 (0.13)	5500
Harlem	0.95 (0.25)	0.08 (0.02)	4290
Richmond County			
Augusta-Richmond County Water System	65.87 (17.40)	31.80 (8.40)	200,000
Hephzibah	4.54 (1.20)	1.29 (0.34)	3011

Source: Southern 2007a
[a] Columbia County system is withdrawn primarily from surface-water systems.

Table 2-20. Water Supply System Usage and Capacity for Withdrawals from Surface Water

System Name	Permitted Monthly Average Withdrawal, Million L/d (MGD)	Reported Monthly Average Withdrawal, Million L/d (MGD)	Population Served
Burke County			
Waynesboro	3.8 (1.0)	0.38-0.72 (0.10-0.19)	5813
Sardis[a]	--	--	--
Columbia County			
Columbia County	147.6 (39.0)	25.40-67.30 (6.71-17.78)	77,280
Grovetown[a]	--	--	--
Harlem[a]	--	--	--
Richmond County			
Augusta-Richmond County Water System	227.12 (60.00)	92.36-167.85 (24.40-44.34)	200,000
Hephzibah[a]	--	--	--

Source: Southern 2007a
[a] Systems do not withdraw surface water.

According to local planning officials, water supply in the three counties is not a concern. Local communities are adequately served by the existing water supplies and planners estimate that the counties have adequate supply to support growth in the region.

Local governments provide wastewater treatment and each municipality decides which treatment method to use based on its needs and the technology and funds available. Currently, municipalities in the three counties can meet their current and projected wastewater treatment needs. Table 2-21 details public wastewater treatment systems, their permitted capacities, and their average daily processed wastewater volume. The rural areas of each county use individual septic systems (Southern 2007a).

Police, Fire, and Medical

Burke County's Sheriff's Department and Fire Department have jurisdiction over the immediate area around the VEGP site. According to a 2005 draft planning report produced by the Central Savannah River Area Regional Development Center, planning officials consider the current level of police and fire protection adequate in the region (Southern 2007a).

Richmond County serves as a regional medical hub for most of the region's hospitals and medical services, with four general hospitals, one military hospital, one mental and psychiatric hospital, one rehabilitation hospital, and two Federal hospitals. Burke County has one general

Table 2-21. Wastewater System Usage and Capacity

System Name	Average Daily Wastewater Processed million L/d (MGD)	Permitted Maximum Sewer Capacity million L/d (MGD)	Capacity as Percent of Current System Usage
Burke County			
Waynesboro	3.8 (1.0)	7.6 (2.0)	200
Sardis	0.0163 (0.0043)	0.76 (0.20)	4663
Columbia County			
Kiokee Creek	0.08 (0.02)	1.14 (0.30)	1425
Crawford Creek	3.8 (1.0)	5.68 (1.50)	149
Little River	9.46 (2.50)	11.4 (3.0)	120
Reed Creek	12.49 (3.30)	17.41 (4.60)	139
Richmond County			
Augusta-Richmond-J.B. Messerly Plant	117.3 (31.0)	174.89 (46.20)	149

Source: Southern 2007a

hospital and Columbia County has no hospitals. Table 2-22 presents hospital and medical practitioner data by county. All three counties have health departments, which provide several basic medical services and are available to residents regardless of their ability to pay. Social services in Georgia are overseen by the State Department of Human Resources through four

Table 2-22. Hospitals and Physicians in Burke, Columbia, and Richmond Counties

County	Hospital beds per 1000 population	Physicians per 1000 population
Burke	1.7	0.6
Columbia	0	0.5
Richmond	10.1	6.1

Source: Southern 2007a

main divisions: family and children services; public health; mental health, developmental disabilities, addictive diseases; and aging services (Southern 2007a).

2.8.2.7 Education

A total of 96 public primary and secondary schools are in Burke, Columbia, and Richmond Counties, supporting a 2004 to 2005 student enrollment of 57,704 (see Table 2-23) (GOSA 2007). In addition, there are 24 private primary and secondary schools with a 2006 enrollment of 5070 students. There are six four-year colleges and seven two-year colleges within an 80-km (50-mi) radius of the VEGP site (Southern 2007a).

Richmond County School District is the largest of the three school districts, with more than 30,000 students enrolled in the public school system. After struggling with over-crowding issues for several years, the district now meets the Georgia Department of Education-mandated student-teacher ratios. The Columbia County School District services some of the highest growth residential developments around Augusta. Of the three school districts, Columbia County has experienced the highest rate of student enrollment growth in recent years and has continually struggled to meet state student-teacher ratios for pre-K through fifth grade. During the 2005 to 2006 school year, enrollment increased by more than 1000 students and is expected to increase by approximately 800 students for the upcoming 2007 to 2008 school year. New school construction is a high priority for the Columbia County Board of Education.[a] Burke County School District is the smallest of the three and has excess capacity. The Burke County School District office estimates a current (2006 to 2007 school year) excess capacity of about 17 percent, meaning they could support an additional 700 to 800 students.[b]

Table 2-23. Number of Public Schools, Students, and Student Capacity in Burke, Columbia, and Richmond Counties.

County	Number of Schools	Student Population (2005)
Burke	6	4365
Columbia	30	20,181
Richmond	60	33,158
Total	**96**	**57,704**

Source: GOSA 2007

2.9 Historic and Cultural Resources

In accordance with 36 CFR 800.8(c), the NRC staff is using the NEPA process to comply with the obligations imposed under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA). The NRC has determined that the Area of Potential Effect (APE) for the ESP review is the area at the power plant site and the immediate environs that may be impacted by land-disturbing activities associated with the construction and operation of the new unit(s), and construction and operation of a new transmission line that may be constructed to connect the new VEGP units with the existing electrical grid.

(a) Data provided by Columbia County School District office in e-mail from Pam Zgutowicz, March 5, 2007. Accession No. ML072290140.

(b) Data provided by Burke County School District office in e-mail from Wilbert Roberts, Assistant District Superintendent, March 6, 2007. Accession No. ML072290177.

This section discusses the historic and cultural background in the VEGP site region. It also details the efforts that have been taken to identify cultural resources in the APE and the resources that were identified. A description of the consultation efforts accomplished to date is also provided. The assessments of effects from the proposed construction and operation are found in Sections 4.6 and 5.6, respectively.

2.9.1 Cultural Background

The area in and around the VEGP site has a rich cultural history and a substantial record of significant prehistoric and historic resources (NSA 2006a, b). The Savannah River Salt Creek River system flows through the area and influenced settlement in the area. The record indicates that prehistoric occupation of the area was as follows:

- Paleoindian (Pre to 7800 B.C.) – Minimal evidence from this time period has been found. Of particular interest is speculation that the Topper site, located approximately 40 km (25 mi) downstream in South Carolina, may document the presence of human settlement as far as 50,000 years ago.

- Archaic (7800 B.C. to 1050 B.C.) – During this period, people appear to have become more sedentary and particularly adept at exploiting resources found within their environment. The period is characterized by fine-tempered pottery and shell middens.

- Woodland (1050 B.C. to 800 A.D.) – Settlement size increased as the people developed agricultural methods. Evidence of food preservation and storage is found.

- Mississipian (800 A.D. to 1450 A.D.) – The period is characterized by ceremonial mounds, along with large agriculturally based settlements, generally considered to have been controlled by chiefdoms.

- Post-1450 A.D. – Chiefdoms dissolved and the settlement in the area dispersed. As Euro-Americans moved into the area, the area was further depopulated, while some intermarriage between the Euro- and Native Americans occurred.

When Euro-Americans arrived in the area in the 17th and 18th centuries, the area was occupied by American Indian groups descended from the earlier chiefdoms that populated the southeastern United States. New South Associates (2006a) identifies American Indians in the general VEGP area as ancestors of groups later called Creeks and Seminoles.

The European colonization of Georgia began in the early 1700s. Burke County was formed in 1777. A 1780 map shows two settlements in the VEGP site area: Telfare's Plantation and Mathew's Bluff. These and others settlements appear on maps into the 20th century. Limited activities associated with the Civil War occurred in Burke County. Following the war, plantations evolved into large farms, an economic strategy that continues today. Since the 1920s, farming acreage has shifted from cotton to corn and more recently to soybeans and wheat (NSA 2006a).

2.9.2 Historic and Cultural Resources at the VEGP Site

To identify the historic and cultural resources at the VEGP site and associated transmission lines, the following information was used:

- Original FES – An archaeological assessment was conducted in the early 1970s before the construction of the original unit (Honerkamp 1973). Seven sites were identified (9BK21, 9BK22, 9BK1/20, 9BK23, 9BK24, 9BK25, 9BK26). None of the resources were considered important enough to further investigate before construction of the first VEGP plant (AEC 1974, NRC 1985).

- VEGP ER – Southern's contractor, TetraTech, subcontracted with New South Associates (NSA), a cultural resource contractor to identify and evaluate cultural resource sites in the area (NSA 2006 a, b) (NSA 2007).

- Transmission Line Right-of-Way Study – A study of possible transmission line rights-of-way was conducted to address cultural resource issues (GPC 2007).

- NRC Audit – NRC staff conducted a records search at the Georgia Archaeological Site Files and also conducted an on-the-ground visit of the VEGP site.

To comply with NRC guidance, National Register-eligible archaeological sites, structures, buildings, and districts located within 16 km (10 mi) of the VEGP site and within set distances of the transmission lines were identified (NSA 2006a, b). Twenty-six sites and 14 buildings were identified. Most of the areas within 16 km (10 mi) of the VEGP site or transmission lines have not been systematically surveyed; therefore, this information does not reflect the general cultural sensitivity of the area.

To identify on-plant resources within the APE, NSA identified and evaluated cultural resources located within the proposed construction areas at the plant. NSA performed its surveys and shovel tests in 2006 in 16 areas (NSA 2006a). Ten new archaeological sites were located. Site forms were completed for the sites and submitted to the Georgia Office of Historic Preservation. New South Associates recommended that two of the sites (9BK416 and 9BK423) were eligible for listing in the National Register, six sites were not eligible (9BK414, 9BK415, 9BK417, 9BK418, 9BK419, 9BK420), and two sites require additional information before an evaluation could be completed (9BK421, 9BK422) (NSA 2006a,b) (Table 2-24). The Georgia State Historic Preservation Office (SHPO) concurred with this assessment on October 4, 2006 (GaSHPO 2006).

Table 2-24. Archaeological Sites Identified Within the VEGP Site

Site Number[a]	Eligibility[b]	Description
9BK414	Not Eligible	Historic homesite
9BK415	Not Eligible	Historic homesite
9BK416	Eligible	Large multicomponent prehistoric site
9BK417	Not Eligible	Liquor still
9BK418	Not Eligible	Undiagnostic lithic scatter
9BK419	Not Eligible	Woodland prehistoric site
9BK420	Not Eligible	Undiagnostic lithic scatter
9BK421	Not Determined	Undiagnostic lithic scatter
9BK422	Not Determined	Historic and prehistoric scatter
9BK423	Eligible	Multicomponent prehistoric site
9BK459	Not Eligible	Undiagnostic lithic scatter
9BK460	Not Eligible	Woodland prehistoric site
9BK461	Not Eligible	Undiagnostic lithic scatter
9BK462	Not Eligible	Undiagnostic lithic scatter
9BK463	Not Eligible	Undiagnostic lithic scatter
9BK464	Not Eligible	Undiagnostic lithic scatter
9BK465	Not Eligible	Undiagnostic lithic scatter

Sources: Southern 2007a; New South Associates 2006b
(a) The Smithsonian numbering system for archaeological sites.
(b) Eligibility for listing in the National Register of Historic Places maintained by the National Park Service, U.S. Department of Interior)

Subsequent to the initial work, NSA returned to complete surveys in one additional area (NSA 2006b). Seven new sites were identified (9BK459 through 9BK465), all of which NSA recommended as not eligible for listing in the National Register of Historic Places (NSA 2006b). No concurrence from Georgia SHPO has been received.

In June 2007, additional testing was conducted due to modifications of the water pipeline associated with proposed water intake structure. NSA conducted a phase 1 archaeological survey of approximately 2500 feet of proposed pipeline corridor, of which, site 9BK416 was included. No new sites were identified during this survey. The results of the Phase 1 survey support the original findings that site 9BK416 is a multi-component prehistoric site that is eligible to be listed in the NRHP (NSA 2007). NSA states that site 9BK416 has the potential to yield significant information on prehistory for the area (NSA 2007). NSA recommended that site 9BK416 be avoided; however, if avoidance is not possible, further excavations will be required to mitigate the project's adverse effects.

Previous investigations did not discover any human remains in the proposed project areas. Consultation efforts with American Indian tribes formerly from this area may result in requests that they be contacted if human remains are discovered during construction. To date, literature reviews and consultations with regional American Indian Tribes have not identified any traditional cultural properties in the vicinity of the proposed construction area of the ESP units.

No analysis of historic and cultural resources was conducted for the transmission line rights-of-way. The full extent of potential land-use impacts in the transmission line rights-of-way can be estimated only after a specific route is defined. However, a study produced by the GPC (2007) examined potential impacts that would result should certain transmission line rights-of-way be selected for the new transmission line. The report included information on the recorded archaeological sites and historic buildings located within each right-of-way.

During construction of VEGP Units 1 and 2, an important fossilized whale skeleton was unearthed. The fossil (*Georgiacetus vogtlensis*) was found at a depth of 30 feet below ground surface in a stratum known as the Blue Bluff marl. Excavations associated with the new plant are not expected to encounter the Blue Bluff marl stratum, and therefore, no fossil discoveries are anticipated (Southern 2007a).

2.9.3 Consultation

In October 2006, the NRC initiated consultation on the proposed action by writing the Georgia SHPO, the Alabama SHPO and the Advisory Council on Historic Preservation. Also in October 2006, the NRC initiated consultations with 25 tribes (See Appendix C for complete listing). In the letters, the NRC provided information about the proposed action, indicated that review under the National Historic Preservation Act of 1966 would be integrated with the NEPA process in accordance with 36 CFR 800.8, invited participation in the identification and possible decisions concerning historic properties, and invited participation in the scoping process.

On October 19, 2006, NRC conducted a public scoping meeting in Waynesboro, Georgia. No comments or concerns regarding historic and cultural resources were made at this meeting. The NRC did receive letters in response to its earlier communications (Appendix F). The Miccosukee Tribe indicated that it restricts itself to those matters within the State of Florida and would defer to other tribes with a more direct cultural affiliation with the VEGP site. The Alabama Historical Commission indicated that it would look forward to reviewing the project if any alternative located in Alabama is selected.

2.10 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.[a] The

(a) Minority categories are defined as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; or Hispanic ethnicity; "other" may be considered a separate minority category. Low income refers to individuals living in households meeting the official poverty measure.

Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040).

This section describes the existing demographic and geographic characteristics of the proposed site and its surrounding communities. It offers a general description of minority and low-income populations within the region surrounding the site. The characterization in this section forms the analytical baseline from which potential environmental justice effects would be made. The characterization of populations of interest includes an assessment of "populations of particular interest or unusual circumstances," such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements.

2.10.1 Analysis

The staff first examined the geographic distribution of minority and low-income populations within 80 km (50 mi) of the VEGP site, employing a geographic information system and the 2000 Census to identify minority and low-income populations. The staff verified its analysis by field inquiries to numerous agencies and groups (see Appendix B for listing of contacts).

The staff's environmental justice methodology examines each census block group that is fully or partially included within the analytical area to determine for each minority or low-income population group, whether:

1. the population of interest exceeds 50 percent of the total population for the block group
2. the percentage of the population of interest is 20 percent (or more) greater than the same population's percentage in the block group's state.

If no minority or low-income population in any Census block area meets either of the above criteria, then the staff may determine there is no potentially disproportionate effect that could adversely affect a population of interest. However, if any Census block area meets either of the above criteria, then the staff must investigate further in that Census block area before determining whether or not the potential for a disproportionate adverse effect exists.

Census data for Georgia (USCB 2007b) characterizes 28.7 percent of the state population as Black races; 0.3 percent American Indian or Alaskan Native; 2.1 percent Asian; 0.1 percent Native Hawaiian or other Pacific Islander; 2.4 percent all other single minorities; 1.4 percent multiracial; 34.9 percent aggregate of minority races; and 5.3 percent Hispanic ethnicity. For South Carolina, the USCB reports 29.5 percent of the state population as Black races;

0.3 percent American Indian or Alaskan Native; 0.9 percent Asian; 0.04 percent Native Hawaiian or other Pacific Islander; 1.0 percent all other single minorities; 1.0 percent multi-racial; 32.8 percent aggregate of minority races; and 2.4 percent Hispanic ethnicity.

Minority Populations: Of the 491 census block groups within 80 km (50 mi) of the VEGP site, 175 have Black races populations that exceed the state average by 20 percent or more and 171 of which have Black races populations of 50 percent or more. One census block group within the 80-km (50-mi) radius has Hispanic ethnicity populations exceeding the state average by 20 percent or more, but no block had a Hispanic population greater than 50 percent. No census block group within the 80-km (50-mi) radius had any other minority classification that met either of the two selection criteria. One hundred sixty-eight census block groups have aggregate minority population percentages that exceed the state average by 20 percentage points or more. One hundred and eighty-three census block groups have aggregate minority population percentages that exceed 50 percent.[a] The geographic location of block groups that meet any of the minority criteria are shown in Figure 2-19.

Low-Income Populations: The staff used Census data to identify low-income households within the analytical area. The data indicate 12.6 percent of Georgia and 14.1 percent of South Carolina households are low income (USCB 2000). Seventy-two census blocks within an 80-km (50-mi) radius of the proposed site exceed the state average for low-population households by 20 percent or more. Of those 72 block groups, 14 have 50 percent or more low-income households. Figure 2-20 displays the geographic location of disproportionately high populations of low-income families in census block groups.

2.10.2 Scoping and Outreach

During the development of its ER, Southern interviewed community leaders of the minority populations within the analytical area. The staff built upon this base and performed additional interviews within the analytical area that had the potential for the greatest socioeconomic effects. Advanced notice of public hearings for the EIS scoping purposes were performed by the staff in accordance with its guidance.[b] The staff was successful in its outreach effort to minority and low-income populations, as evidenced by public comments from Black community leaders at the October 19, 2006, public meeting in Waynesboro, Georgia. The activities did not identify any additional groups of minority or low-income persons not already identified in the geographic information system analysis of census data.

(a) Note that because Georgia and South Carolina have relatively large percentages of aggregate minority populations, 34.0 and 32.8 percent, respectively, adding 20 percentage points to these averages equates to 54.9 and 52.8, respectively. Therefore, there are more census block groups that meet the "50-percent" threshold criteria than the "20 percentage-points-greater" threshold.

(b) "Management Directive 3.5, Attendance at NRC Staff Sponsored Meetings," NRR Office Instruction COM-202 Rev1. Accession No. ML051880110.

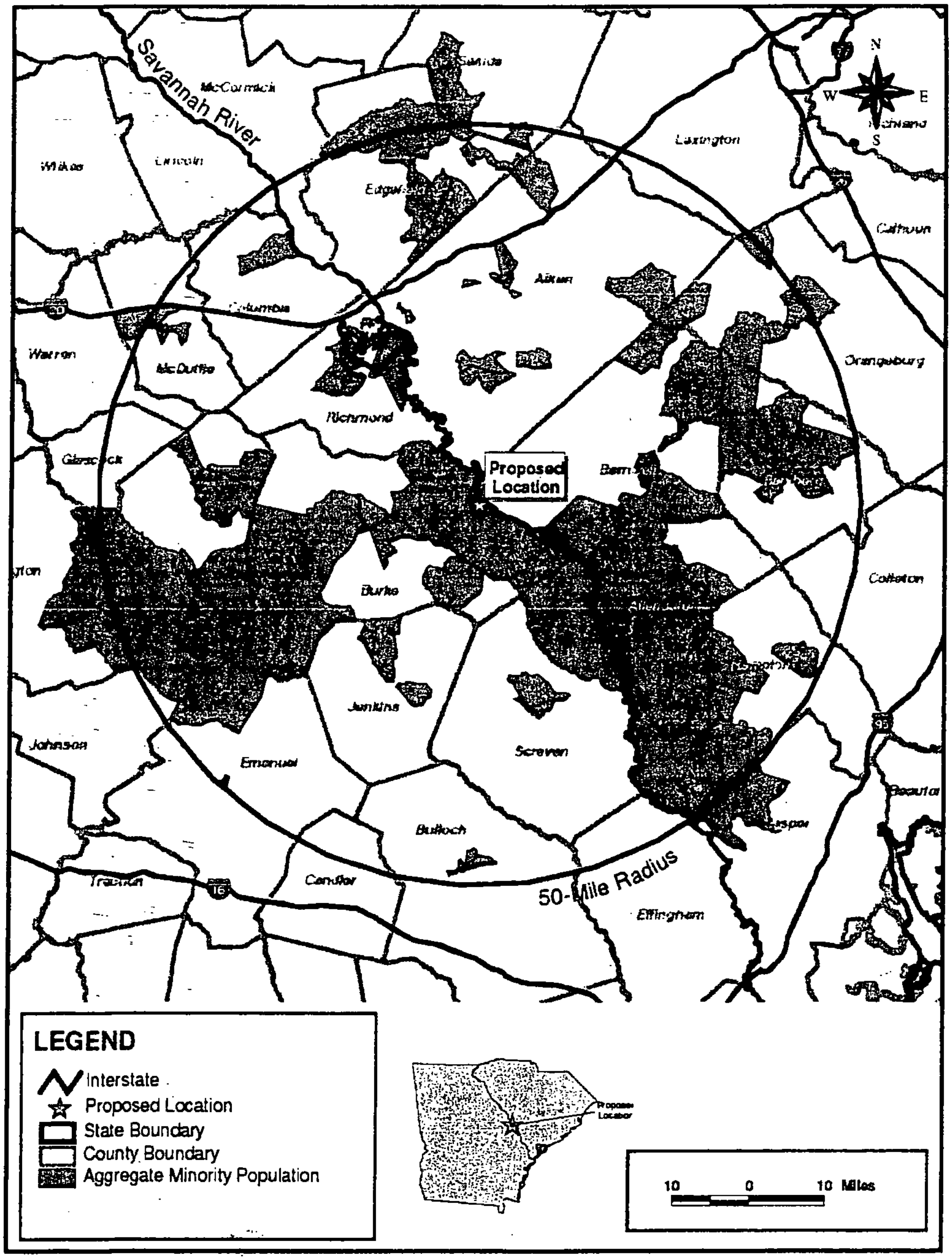


Figure 2-19. Aggregate Minority Populations in Block Groups Meeting Environmental Justice Selection Criteria (Southern 2007a)

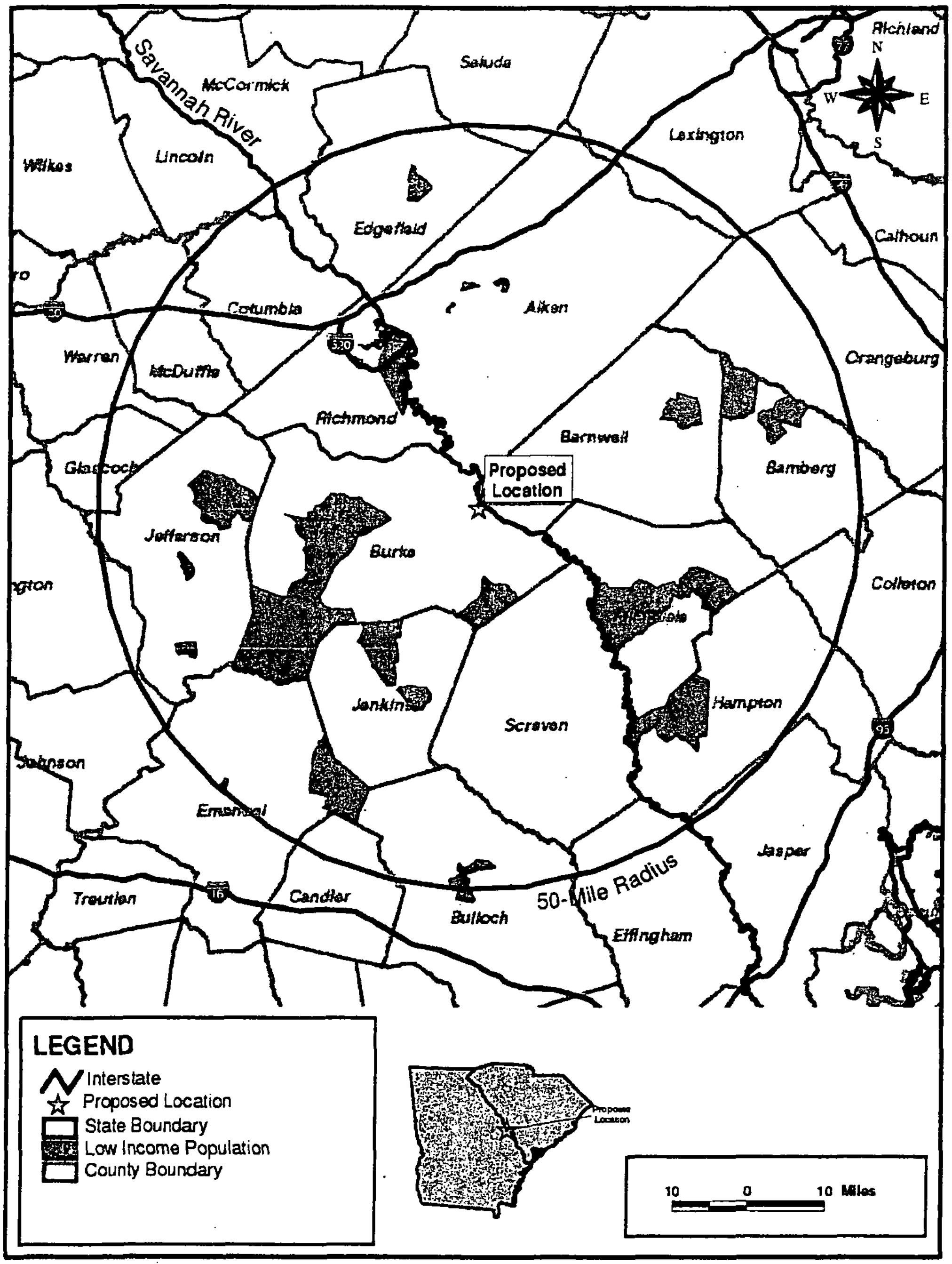


Figure 2-20. Aggregate Low Income Populations in Block Groups Meeting Environmental Justice Selection Criteria (Southern 2007a)

2.10.3 Health Preconditions and Special Circumstances of the Minority and Low-Income Populations

The staff's outreach and scoping activity identified several special socioeconomic and health circumstances and potential pathways for disproportionate health and environmental impacts, which are analyzed in Sections 4.8, 4.9, 5.8, and 5.9. The staff gathered data on mortality statistics of the total and Black/African American populations in Burke County and Georgia's East Central Health District (ECHD), which includes 11 counties within the 80-km (50-mi) radius of the VEGP site. Data are shown in Table 2-25. Local mortality rate data are not available by income level.

Table 2-25. Selected Health and Mortality Statistics for Minority and Total Population in Burke County, the ECHD, and the State of Georgia

	Burke County		East Central Health District[a]		Georgia	
	Total Population	Black/African-American Population	Total Population	Black/African-American Population	Total Population	Black/African-American Population
	Selected Causes of Death (age adjusted rates[b] per 100,000 population)					
All Causes	1190	1175	1034	1169	923	1072
Cancer	221	212	223	248	196	225
Respiratory Diseases	141	111	107	89	90	65
Major Cardiovascular Diseases	448	454	358	411	326	401

Source: Georgia Department of Human Resources 2007

(a) Includes the following Georgia counties: Burke, Columbia, Emanuel, Glascock, Jefferson, Jenkins, Lincoln, McDuffie, Richmond, Screven, Taliaferro, Warren, and Wilkes

(b) Age adjusted death rates are weighted averages of the age-specific mortality rates, where weights are the proportion of persons in the corresponding age groups of a standard population.

Mortality rates for all causes of death are slightly higher in Burke County than in the state for both total population and for Blacks/African Americans. The age-adjusted mortality rate for all cancer-related deaths for the total population in Burke County is slightly higher than the state average. When examining cancer deaths for African-Americans, however, the mortality rate in Burke County is slightly lower than mortality rates for the ECHD and for the State of Georgia. In Burke County, the Black/African American population has a lower cancer-related mortality rate than the total population in this county; however, in many other places in the ECHD and in the state, the cancer-related mortality rate for Blacks/African Americans is higher relative to total population averages. Burke County has slightly higher age-adjusted mortality rates for respiratory and cardiovascular diseases for the total population and for Black/African American populations when compared to the same rates for the ECHD and the state.

For each location (Burke County, LCHD, and the State of Georgia) examined, the respiratory disease-related mortality rates are lower for the Black/African-American populations than for total populations while the cardiovascular disease-related mortality rates were higher for African-American population than the total populations.

There is no evidence the Black/African-American population in Burke County is less healthy than other population subgroups, and would appear to be less likely to die of cancer than Black/African-American populations living in other parts of the state. There is no evidence in the health and mortality statistics of any environmental conditions that make the Black/African-American population exceptionally vulnerable in Burke County.

2.10.4 Migrant Populations

The U.S. Census Bureau defines a migrant worker as an individual employed in the agricultural industry in a seasonal or temporary nature and who is required to be absent overnight from their permanent place of residence. From an environmental justice perspective, there is a potential for such groups in some circumstances to be disproportionately affected by emissions in the environment. However, agricultural activities within the analytical area have traditionally been concentrated on tobacco, corn, soy beans, and cotton. None of these products require the intensive application of migrant labor. In addition, none of the interviews produced any mention of migrant workers. Consequently, the staff determined there were no significant concentrations of migrant workers within the analytical area.

2.10.5 Environmental Justice Conclusion

The staff found low-income, Black, Hispanic, and aggregated minority populations that exceed the percentage criteria established for environmental justice analyses. Consequently, the staff performed additional analyses before making a final environmental justice determination. These analyses can be found in Chapter 4 of this EIS for construction effects, and in Chapter 5 for operational effects.

2.11 Related Federal Projects and Consultation

The staff reviewed the possibility that activities (e.g., dam construction) of other Federal agencies might impact the issuance of an ESP to Southern. Any such activities could result in cumulative environmental impacts and the possible need for another Federal agency to become a cooperating agency for preparation of the EIS (10 CFR 51.10(b)(2)).

Federal lands within an 80-km (50-mi) radius of the VEGP site include the Savannah River Site, Sumter National Forest, and the U.S. Army Signal Center Fort Gordon. There are no wilderness areas or wild and scenic rivers within the region. Several Georgia and South Carolina State parks exist within the region. The closest Native American tribal reservations are more than 80 km (50 mi) from the VEGP site.

After reviewing the Federal activities in the vicinity of the VEGP site, the staff determined that there were no Federal project activities that would make it desirable for another Federal agency to become a cooperating agency for preparation of this EIS. By letter dated June 27, 2007, Southern submitted a license renewal application for VEGP Units 1 and 2 (Southern 2007f).

The NRC staff will be preparing a separate EIS for that licensing action. Future Federal actions related to this project include permits and licenses that may be required at the time of the construction permit (CP) or combined license (COL) application. Other Federal projects may be required at the CP or COL stage, such as transmission-related studies by FERC. However, these activities do not relate to the ESP and have not been started. In summary, no other Federal activities or projects are associated with the permitting of the VEGP site.

The NRC is required under Section 102(2)(C) of NEPA to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. During the course of preparing this EIS, NRC consulted with the FWS and NOAA Fisheries. Contact correspondence is included in Appendix F.

2.12 References

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10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

36 CFR Part 297. Code of Federal Regulations, Title 36, *Parks, Forests and Public Property*, Part 297, "Wild and Scenic Rivers."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800 "Protection of Historic Properties."

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3.0 Site Layout and Plant Description

The site for the proposed Southern Nuclear Operating Company, Inc. (Southern) early site permit (ESP) is located in Burke County in rural Georgia, within the current Vogtle Electric Generating Plant (VEGP) boundary. The site is situated approximately 42 km (26 mi) southeast of Augusta, Georgia. This chapter describes the approach Southern used to identify the key site characteristics that Southern and the U.S. Nuclear Regulatory Commission (NRC) staff used to assess the environmental impacts of the proposed action. The site layout and existing facilities are discussed in Section 3.1. The plant design and power transmission system are discussed in Sections 3.2 and 3.3, respectively, and the list of references cited is in Section 3.4.

3.1 External Appearance and Plant Layout

The existing VEGP site consists of two Westinghouse pressurized water reactors, a turbine building, a switchyard, water intake and discharge structures, and support buildings. The site is located on the Savannah River, about 241 river km (150 river mi) from the mouth of the Savannah River. Plant Wilson, a six-unit, oil-fueled combustion turbine facility built in 1974 and owned by the Georgia Power Company (GPC) is also located on the site. A radioactive waste disposal system, a fuel-handling system, the auxiliary structures, and other onsite facilities required for a complete nuclear power station are located on the VEGP site. The existing VEGP site development is shown in Figure 2-1. The existing VEGP Units 1 and 2 would not be changed. The ESP site is located in a previously disturbed area adjacent to the existing two units.

Southern states (Southern 2007a) that the two new Westinghouse AP1000 reactors would share a river intake structure and certain support structures such as office buildings and water, wastewater, and waste-handling facilities. Each proposed Westinghouse AP1000 reactor would have a rated thermal power level of 3400 megawatts thermal (MW(t)) (Southern 2007a). For the cooling system, Southern proposed natural draft cooling towers, in addition to mechanical draft service water system (SWS) cooling towers.

3.2 Plant Description

Southern has proposed adding two additional nuclear generating units at the VEGP site. The Westinghouse AP1000 NRC-certified plant design (Title 10 of the Code of Federal Regulations [CFR] Part 52, Appendix D) was selected by Southern for the VEGP ESP application (Westinghouse 2003, 2005). The planned location for the proposed Westinghouse AP1000 reactors, referred to as VEGP Units 3 and 4, would be west of and adjacent to the existing VEGP Units 1 and 2 (see Figure 3.1) (Southern 2007a).

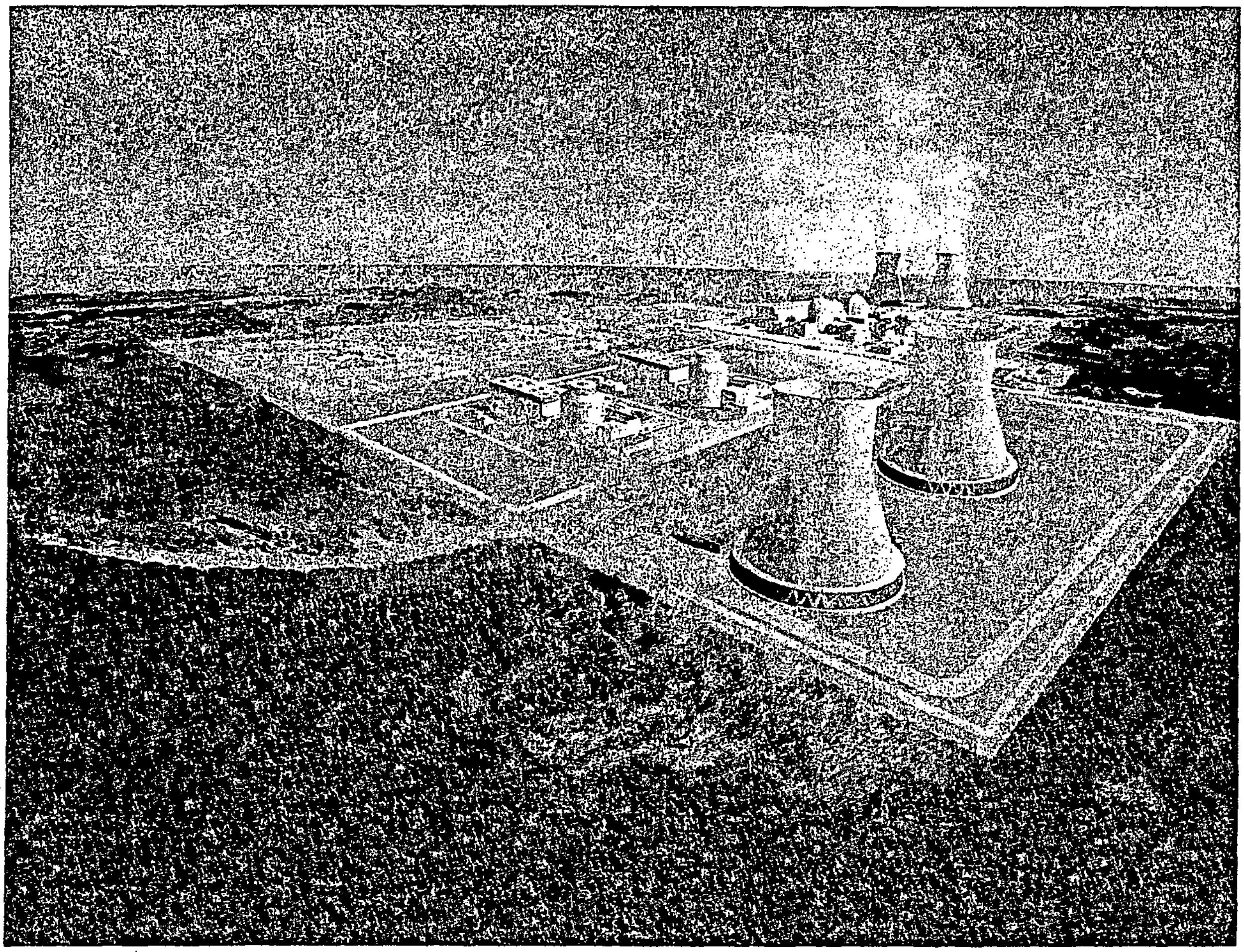

Figure 3-1. Artist's Conception of New Westinghouse AP1000 Units 3 and 4 (foreground) Located Adjacent to Existing VEGP Units 1 and 2 (background) (Southern 2007a)

The AP1000 reactor design, which is based on Westinghouse pressurized water reactor technology, includes a single reactor pressure vessel, two steam generators, and four reactor coolant pumps for converting reactor thermal energy into steam. One high-pressure turbine and three low-pressure turbines drive a single electric generator. Figure 3-2 shows a flow diagram of the reactor power conversion system (Southern 2007a). Each Westinghouse AP1000 unit is based on a "standalone" concept and consists of five principal generation structures: (1) the nuclear island, (2) the turbine building, (3) the annex building, (4) the diesel generator building, and (5) the radwaste building. Structures that make up the nuclear island include the containment building, the shield building, and the auxiliary building.

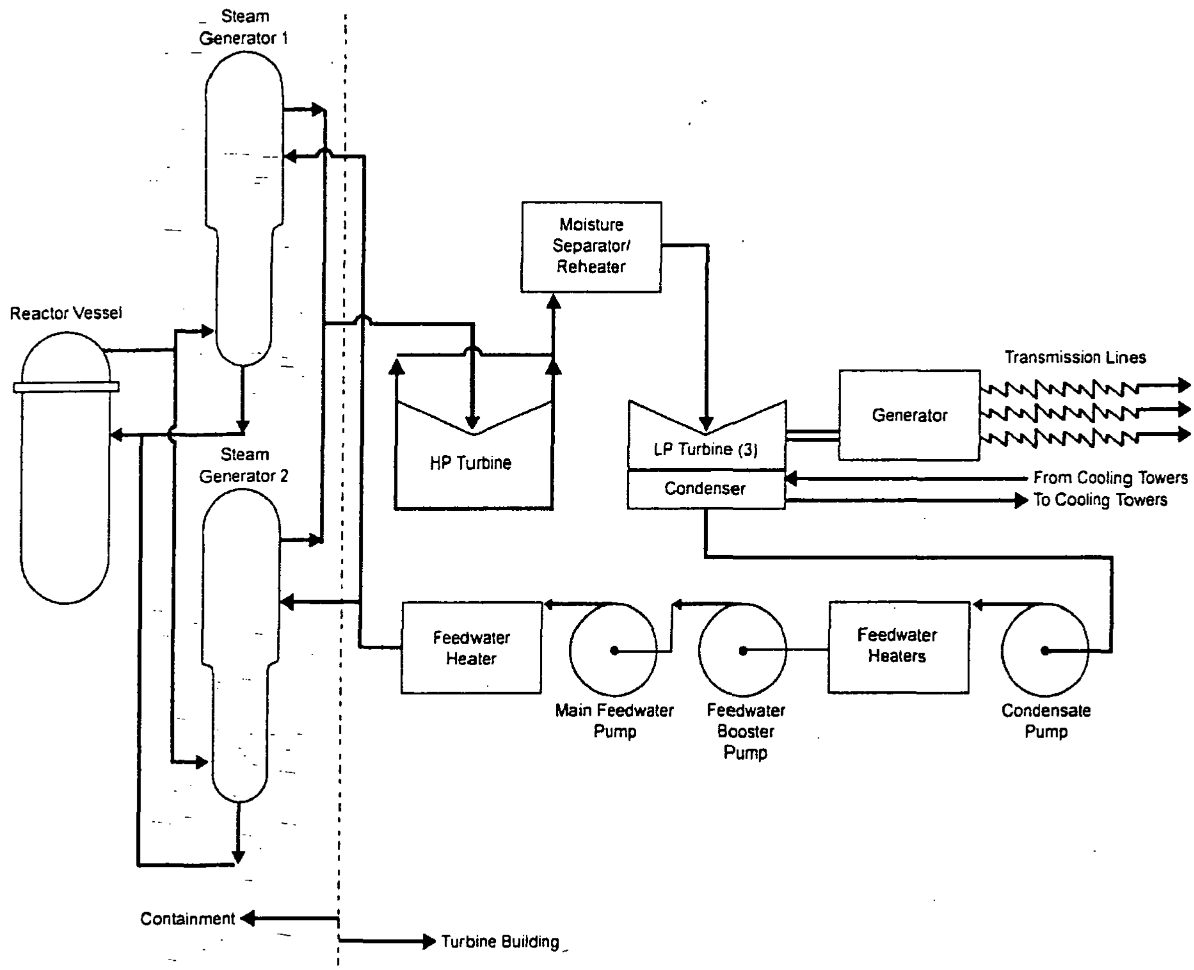

Figure 3-2. Simplified Flow Diagram of the Reactor Power Conversion System (Southern 2007a)

The Westinghouse AP1000 reactor has a thermal power rating of 3400 MW(t), with a net output of 1117 megawatts electrical (MW(e)). It uses uranium dioxide with an uranium enrichment of approximately 2.35 to 4.45 weight percent uranium-235 for the initial reactor core load and 4.51 weight percent uranium-235 for core reloads. The total fuel capacity is approximately 84.5 metric tons (93.1 tons) of uranium.

The proposed cooling system for the new units includes one concrete natural draft hyperbolic cooling tower for each unit (see Figure 3-1). Each tower, which would be approximately 183 m (600 ft) tall, would be able to reject about 7.55 x 10^9 BTU/hr (2208 MW(t)) of waste heat to the atmosphere. Together, the two towers and their supporting facilities would require an area of

28.04 ha (69.3 ac). In addition to the natural draft cooling towers, the new units also would have service water system (SWS) cooling towers. These mechanical draft cooling towers would be approximately 18 m (60 ft) high, would require an area of approximately 0.2 ha (0.5 ac) per unit, and would be located within the powerblock area. The unit thermal efficiency of the complete cycle would be approximately 35 percent. The new units would share common intake and discharge structures and certain support structures such as office buildings and water, wastewater, and waste-handling facilities.

3.2.1 Plant Water Use

This environmental impact statement (EIS) assesses the impacts of plant water use based on the design parameter values provided by Southern in its Environmental Report (ER) (Southern 2007a). At the ESP stage, the staff's review of the design parameters is limited to an evaluation of whether the parameter values are reasonable. At the construction permit (CP) or combined license (COL) stage, an applicant referencing the ESP is required to demonstrate that the specific plant design would fall within the design parameters in the ESP. The following sections describe both the consumptive and non-consumptive water uses of the proposed VEGP Units 3 and 4 and the associated plant water treatment systems.

3.2.1.1 Plant Water Consumption

This section describes power plant make-up water/water use consumption demands, and excludes those demands that are part of the normal cooling system (e.g., circulating water system [CWS]). Consumptive water demands associated with the normal cooling systems are discussed in Section 3.2.2 of this EIS.

The proposed VEGP Units 3 and 4 would have demands for demineralized, potable, and fire protection system water. Southern (2007a) states that the normal combined water demands for these systems are as follows: demineralized water demand of 9.5 L/s (150 gpm), potable water demand of 2.65 L/s (42 gpm), fire suppression water demand of 0.6 L/s (10 gpm), and miscellaneous water demands (e.g., rinse water for the demineralization system filters) of 0.82 L/s (13 gpm). Southern (2007a) also states that the maximum combined water demands for these systems are a demineralized water demand of 38 L/s (600 gpm), potable water demand of 8.8 L/s (140 gpm), fire-suppression water demand of 0.76 L/s (12 gpm), and miscellaneous water demands of 2.21 L/s (35 gpm). The fire suppression system would also provide a backup water supply for other systems, including the passive containment cooling system (Southern 2007a).

3.2.1.2 Plant Water Treatment

Southern discusses plant water treatment systems in its ER (Southern 2007a). The water quality of effluents from any water treatment system would be regulated by the Georgia Department of Natural Resources (GDNR) via a National Pollutant Discharge Elimination System (NPDES) permit.

The potable water system would be supplied from groundwater wells, and one system may supply both VEGP Units 3 and 4. A disinfection system would be used; however, it is not known at this time if additional treatment systems, such as filtration or corrosion control, would be needed (Southern 2007a).

Water for the demineralized water system would be drawn from groundwater wells. The groundwater would be treated via both reverse osmosis and an electro-deionization/mixed-bed system to remove solids, salts, organic compounds, dissolved gaseous carbon dioxide, and the majority of the ions in the water. These treatment processes would produce a stream of purified water that would then be distributed to a number of plant systems.

Groundwater supplying the fire protection system would be filtered via a system of strainers to prevent system fouling. Southern anticipates that the groundwater would be of sufficient quality to not require additional disinfection or other treatment; however, treatment needs would be evaluated and implemented as appropriate (Southern 2007a).

3.2.2 Cooling System

The following sections provide detailed descriptions of the operational modes and the components of the cooling water systems for the proposed VEGP Units 3 and 4. These descriptions were determined from the Westinghouse *AP1000 Design Control Document* (Westinghouse 2005), and included site-specific characteristics (Southern 2007a)

3.2.2.1 Description of Operational Modes

The following sections describe the cooling systems under normal operating conditions and emergency/shutdown conditions for the proposed VEGP Units 3 and 4. A general diagram of the cooling water flow is shown in Figure 3-3.

Circulating Water System

Waste heat is a by-product of normal power generation at a nuclear power plant. During normal plant operation, the CWS of each unit would dissipate up to 7.55 x 10^9 BTU/hr of waste heat (Southern 2007a). The CWS comprises a closed-cycle wet cooling system to transfer heat from

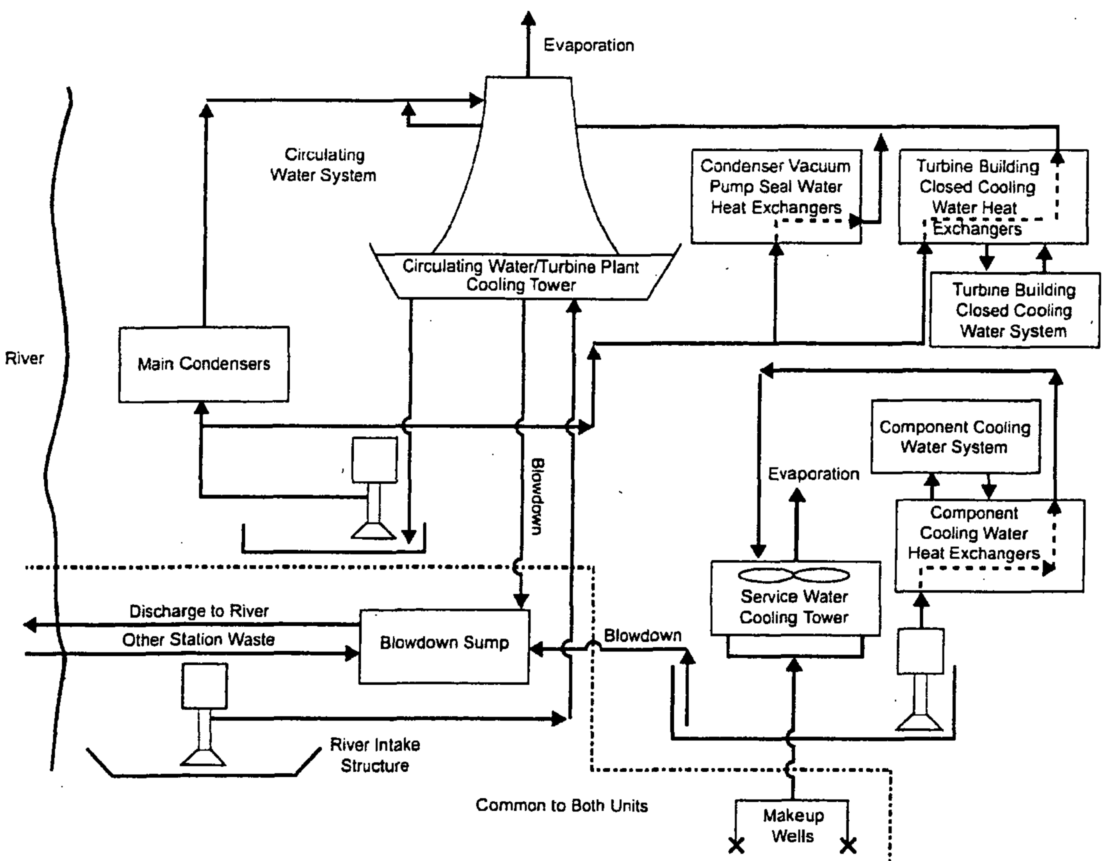

Figure 3-3. General Cooling System Flow Diagram (Southern 2007a)

the main condenser, the turbine building closed-cycle cooling water heat exchangers, and the condenser vacuum pump seal water heat exchangers to one natural draft cooling tower per unit. Excess heat in the cooling water is then transferred to the atmosphere by evaporative and conductive cooling in the cooling tower. During the heat dissipation process, evaporation of water increases the concentration of dissolved solids in the cooling water system. To limit the concentration of dissolved solids, a portion of the water is continuously discharged from the system as blowdown. In addition to blowdown and evaporative losses, a small percentage of water is also lost in the form of droplets (drift) from the cooling towers.

Southern (2007a) states that water pumped from the Savannah River would be used to make up water lost to the system by evaporation, blowdown, and drift. Blowdown water would be directed to a common CWS blowdown sump. Water from the blowdown sump would be retained for a period of time to allow suspended solids to settle before the water is discharged to the Savannah River (Southern 2007a). Southern (2007a) provided the following bounding water fluxes for the CWS (all values assume two reactor units):

- The maximum make-up water flow rate would be 3645.60 L/s (57,784 gpm).
- The maximum consumptive water use rate (evaporation and drift) would be 1823.56 L/s (28,904 gpm).
- The maximum blowdown rate would be 1822.04 L/s (28,880 gpm).

Service Water System

The non-safety-related SWS provides cooling water to the component cooling water heat exchangers located in the turbine building (Southern 2007a). The closed-cycle cooling system uses mechanical draft cooling towers to dissipate waste heat during normal operations, refueling, shutdown, and other operational events. Excess heat in the cooling water is then transferred to the atmosphere. During the heat dissipation process, evaporation of water increases the concentration of dissolved solids in the cooling water system. To limit the concentration of dissolved solids, a portion of the water is continuously discharged from the system as blowdown.

Southern (2007a) states that groundwater would be used to make up water lost by the SWS to evaporation, blowdown, and drift. Blowdown water would be directed to a common blowdown sump, and water from the sump ultimately would then be discharged to the Savannah River. An option also exists to discharge the SWS blowdown to the CWS basin (Southern 2007a). Southern provided the following bounding water fluxes for the SWS (all values assume two reactor units):

- The maximum make-up water flow rate from groundwater would be 148.5 L/s (2353 gpm).
- The maximum consumptive water-use rate (evaporation and drift) would be 76.26 L/s (1177 gpm).
- The maximum blowdown rate would be 74.19 L/s (1176 gpm).

Ultimate Heat Sink

The ultimate heat sink (UHS) cooling system is a tank filled with approximately 3.55 million L (780,000 gal) of demineralized water (Southern 2007a). The tank is situated on top of the containment structure, so the water can be released to form a water film over the containment dome and side walls should an accident occur. The water from the tank flows passively; therefore, an active external safety-related UHS system is not needed to achieve safe shutdown of the reactor. The tank has no other plant function and, once filled, requires only minimal additions of demineralized water to compensate for minor evaporative losses.

3.2.2.2 Component Descriptions

The following sections describe the intake, cooling water treatment, discharge, and heat dissipation systems for the proposed VEGP Units 3 and 4. Pursuant to Section 316(a) and 316(b) of the Clean Water Act (33 USC 1251), an applicant for a CP or COL who references an ESP for the site would be required to obtain approval from the GDNR by documenting the plant design and conducting a site-specific analysis regarding impacts of the thermal discharges and operation of the intake system on the aquatic environment of the Savannah River.

Intake System

The proposed VEGP Units 3 and 4 would use a common river intake structure to obtain make-up water for the CWS. The proposed location of the intake structure, which is shown in Figure 2-1, is upstream of the existing river intake. The intake canal would be approximately 73 m (240 ft) long and 52 m (170 ft) wide, and would have an earthen bottom at an elevation of 21 m (70 ft) above mean sea level (MSL) (Southern 2007a). The intake structure would be located at the upstream end of the intake canal and would contain three pump bays for each unit. The maximum total pump rate for all six pump bays would be 3645.60 L/s (57,784 gpm) (Southern 2007a). Each pump bay would contain one traveling screen and trash rack to prevent debris from entering the intake pumps. Diagrams of the proposed intake structure are shown in Figures 3-4 and 3-5.

Cooling Water Treatment System

Southern states in its ER that make-up water used in the CWS would be treated to control biofouling, corrosion, scaling, and deposition of solids (Southern 2007a). Biocides would be injected at the intake structure, and other chemicals may be added to the cooling water basins. Likewise, the SWS make-up water may also be treated; however, because this water originates from groundwater sources, significant water treatment may not be necessary (Southern 2007a, b). The water quality of the effluents from either the CWS or SWS would be regulated by the State of Georgia via an NPDES permit.

Discharge System

A common sump would collect wastewater from the CWS blowdown, the SWS blowdown, and the treated sanitary waste systems (Southern 2007a). The collected waste would then be discharged to the Savannah River approximately 120 m (400 ft) downstream of the existing discharge pipe terminus (Southern 2007a). Figure 2-1 shows the location of the discharge pipe; diagrams of the discharge pipes are shown in Figures 3-6 and 3-7.

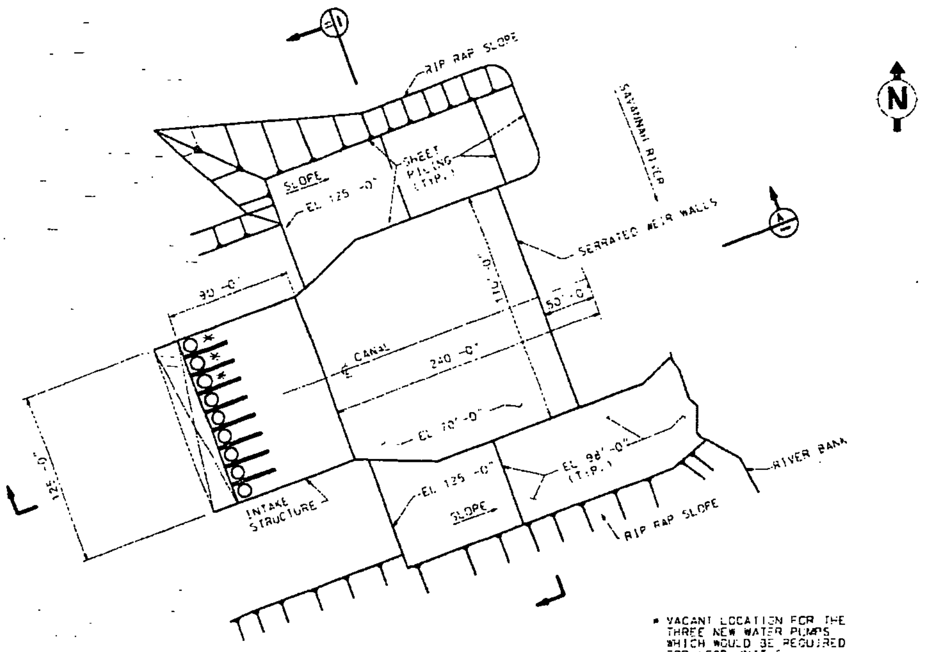

Figure 3-4. Plan View of River Intake System (Southern 2007a)

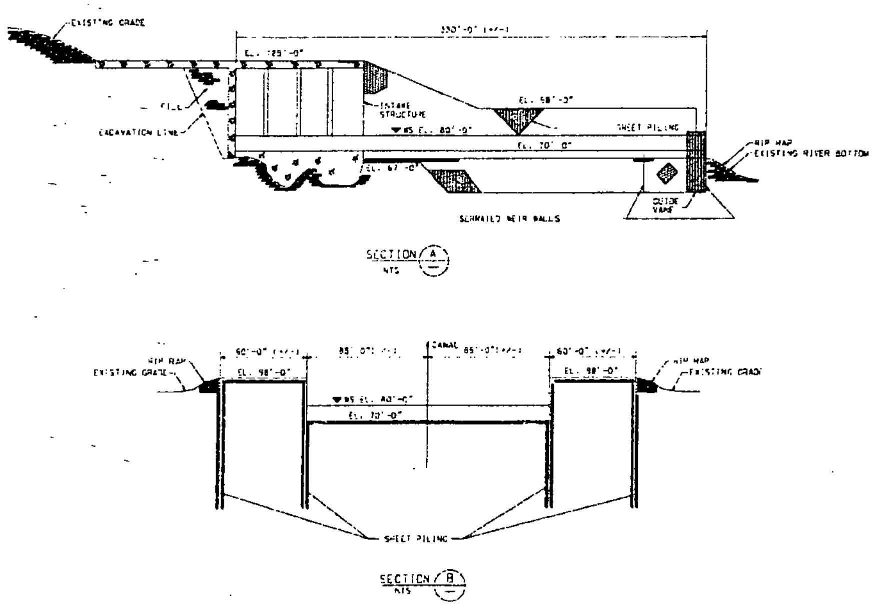

Figure 3-5. Section View of River Intake System (Southern 2007a)

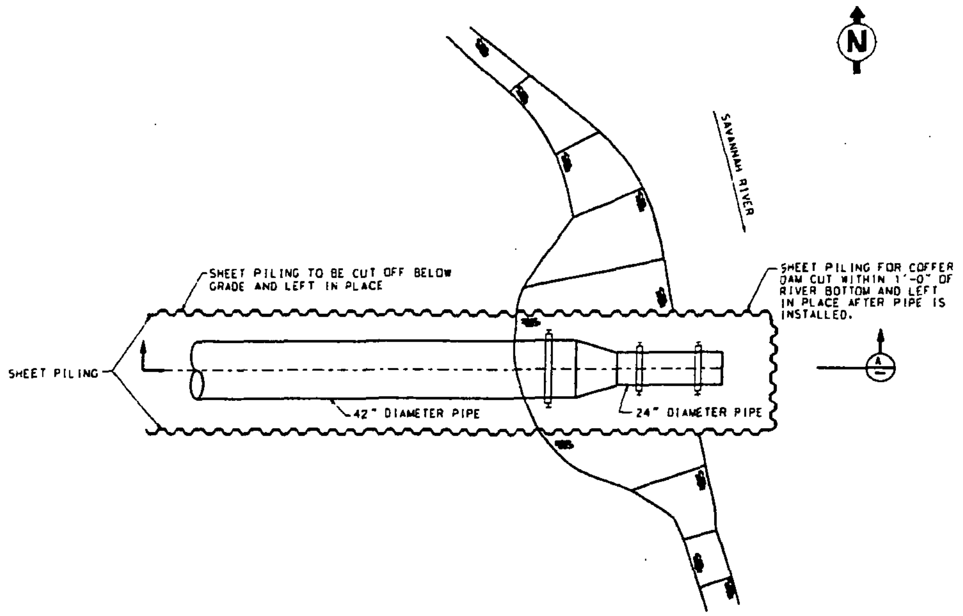

Figure 3-6. Plan View of New Discharge Outfall for the Discharge System (Southern 2007a)

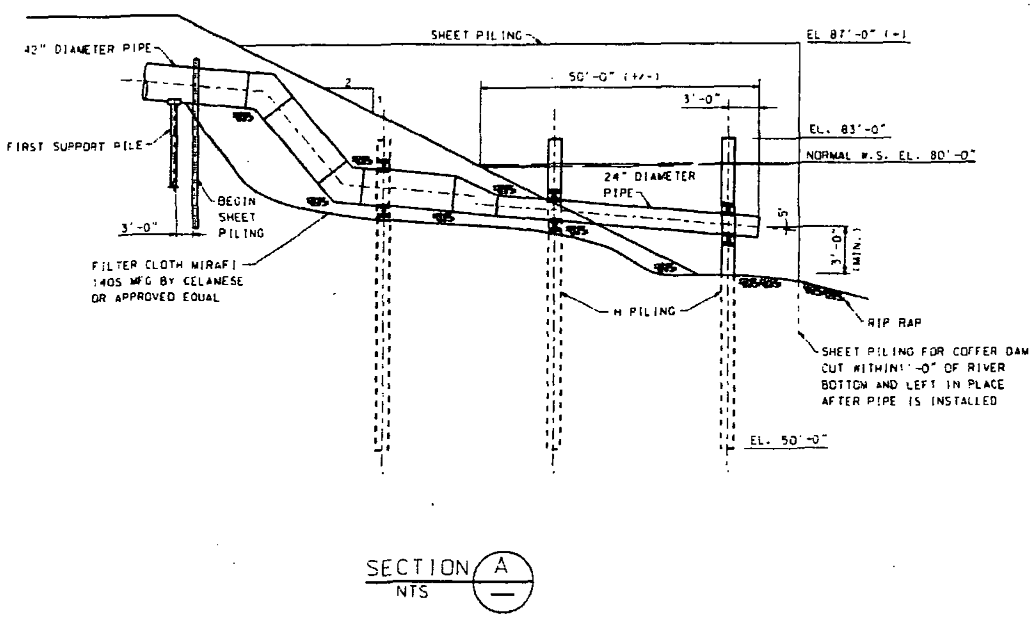

Figure 3-7. Section View of New Discharge Outfall for the Discharge System (Southern 2007a)

The maximum flow rate from the new discharge pipe to the Savannah River would be 1940.72 L/s (30,761 gpm) (Southern 2007a). The CWS blowdown water would be the major contributor to the total discharge with a maximum flow rate of 1822.04 L/s (28,880 gpm) (Southern 2007a) and a maximum discharge temperature to the Savannah River of 32.8°C (91°F) (Southern 2007a). The water quality of all effluents discharged to the Savannah River would be regulated by the State of Georgia via an NPDES permit, and would need to meet established discharge limits on both the quantity of the waste and the quality/ concentration of each constituent pollutant.

Heat Dissipation System

The proposed VEGP Units 3 and 4 would have several different heat dissipation systems. The largest heat load would be dissipated by the normal heat sink that cools the CWS. The heat dissipation system would consist of one natural draft hyperbolic cooling tower per unit (i.e., two cooling towers would be constructed for the proposed VEGP plant). The SWS waste heat would be dissipated using mechanical draft cooling towers. The UHS for the proposed ESP plant incorporates a passive design, so it does not require a cooling tower. Instead, evaporated water exits the containment through a plenum located between the steel containment and concrete wall of the shield building, and eventually exhausts to the atmosphere via a shield building chimney (Southern 2007a).

3.2.3 Radioactive Waste-Management System

Liquid, gaseous, and solid radioactive waste-management systems would be used to collect and treat the radioactive materials produced as by-products of operating the proposed VEGP Units 3 and 4. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as reasonably achievable before releasing them to the environment. Waste-processing systems would be designed to meet the design objectives of 10 CFR Part 50, Appendix I ("Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents"). Radioactive material in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in light-water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products would be contained in the sealed fuel rods, but small quantities escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system would also be responsible for coolant contamination.

Southern did not identify specific radioactive waste-management systems for the new units on the VEGP site, thus deferring analysis of the radioactive waste-management system to the CP or COL stage. The description provided by Southern is based on information in the *AP1000 Design Control Document* (Westinghouse 2005). Solid radioactive wastes produced from operating the proposed VEGP Units 3 and 4 would be either dry or wet solids. The solid-waste-management system would receive, collect, and store solid wastes prior to onsite storage or shipment offsite. Bounding liquid and gaseous effluent releases were not provided by Southern; however, Southern did provide information on normal liquid and gaseous effluent releases along with solid waste activities (Southern 2007a). The bounding total annual volume of solid radioactive waste shipped is estimated at 162 m^3/yr (5717 ft^3/yr) with an expected total amount of radioactive material activity of 6.527×10^{13} Bq/yr (1764 Ci/yr) (Southern 2007a).

3.2.3.1 Liquid Radioactive Waste-Management System

The liquid radioactive waste-management system functions to control, collect, process, handle, store, and dispose of liquids containing radioactive material. This is managed using several process trains consisting of tanks, pumps, ion exchangers, and filters. The system is designed to handle both normal and anticipated operational occurrences. Normal operations include processing of (1) reactor coolant system effluents, (2) floor drains and other wastes with potentially high suspended solid contents, (3) detergent wastes, and (4) chemical wastes. In addition, the radioactive waste-management system can handle effluent streams that typically do not contain radioactive material, but that may, on occasion, become radioactive (e.g., steam generator blowdown as a result of steam generator tube leakage). With two exceptions, liquid effluents processed through the liquid radioactive waste-management system are discharged to the environment. The exceptions are steam generator blowdown that is normally returned to the condensate system after processing and reactor coolant that can be degassed prior to reactor shutdown and returned to the reactor coolant system.

3.2.3.2 Gaseous Radioactive Waste-Management System

The gaseous radioactive waste-management system functions to collect, process, and discharge radioactive or hydrogen-bearing gaseous wastes. This is managed using a once-through, ambient-temperature, activated-carbon delay system. Radioactive isotopes of iodine and the noble gases xenon and krypton are created as fission products within the fuel rods during operation. Some of these gases escape to the reactor coolant system through cladding defects and subsequently decay to stable isotopes, are released to the environment via plant ventilation, or are captured and then released by the gaseous radioactive waste-management system. In addition, various gaseous activation products, such as Ar-41, are formed directly in the reactor coolant during operation. The gaseous radioactive waste-management system is typically active only when gaseous concentrations are monitored to reach a given threshold. The gaseous system cannot collect noble gases, so if noble gases are monitored to reach a threshold value, the reactor coolant system is diverted to the liquid radioactive waste-management system that can collect noble gases using the degasifier.

3.2.3.3 Solid Radioactive Waste-Management System

The solid radioactive waste-management system functions to treat, store, package, and dispose of dry or wet solids. This is managed with the same process used to treat, store, and dispose of solid radioactive waste at currently operating VEGP Units 1 and 2. The solid radioactive wastes include spent ion exchange resins, deep bed filtration media, spent filter cartridges, dry active wastes, and mixed wastes. The system is designed to handle both normal and anticipated operational occurrences. There are no onsite facilities for permanent disposal of solid wastes, so the packaged wastes would be temporarily stored in the auxiliary and radwaste buildings prior to being shipped to a licensed disposal facility.

3.2.4 Nonradioactive Waste Systems

The following sections provide descriptions of the nonradioactive waste systems proposed for the VEGP site, including systems for chemical, biocide, sanitary, and other effluents.

3.2.4.1 Effluents Containing Chemicals or Biocides

Water withdrawn from the Savannah River for use in the CWS would be treated with both biocides and chemicals (Southern 2007a). The biocides would be used to control biofouling of the CWS, and chemicals would be added to control scaling, corrosion, and solids deposition (Southern 2007a). Depending on the intended use, groundwater would be treated with chemicals and/or biocides (Southern 2007a). Southern provided a representative list of chemicals or biocides that may be used in the proposed VEGP Units 3 and 4. These chemicals include sodium hypochlorite, sodium bromide, ammonium bisulfite, tolytriazole, and polymers that control corrosion or that act as a dispersant (Southern 2007b). Southern states that a GDNR-issued NPDES permit for the VEGP site would limit the volume and concentration of these discharges (Southern 2007a).

3.2.4.2 Sanitary System Effluents

A treatment system for sanitary waste currently is operated on the VEGP site to dispose of waste from the VEGP site. This treatment system would be expanded to accommodate the additional waste stream associated with the proposed VEGP Units 3 and 4 (Southern 2007a). Discharges from this plant would be controlled in accordance with a GDNR-issued NPDES permit. Southern states that the normal sanitary-waste discharge rate would be 2.65 L/s (42 gpm), and the maximum discharge rate would be 8.8 L/s (140 gpm) (Southern 2007a).

3.2.4.3 Other Effluents

Nonradioactive gaseous emissions result from operating the auxiliary boiler and from testing and operating the standby diesel generators. Emissions from these systems include particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides. Gaseous releases would comply with levels permitted by the GDNR (Southern 2007a).

Nonradioactive liquid effluents from laboratory drains, equipment decontamination, and chemical additives would be collected in liquid waste sumps or approved chemical storage units. Oily waste would be removed via an oil/water separator and sent to a waste storage tank prior to shipment offsite for disposal (Southern 2007a). Liquid effluent not containing oily waste would be monitored, treated, and discharged to the Savannah River as allowed under an NPDES permit issued by the GDNR (Southern 2007a). No liquid waste would be discharged to groundwater (Southern 2007a).

Nonradioactive solid wastes would be disposed of in accordance with applicable regulations. At present, a private industrial landfill permitted by GDNR is located on the VEGP site near the location of the proposed switchyard for VEGP Units 3 and 4. During construction, the landfill would either be relocated onsite, or the material would be removed and disposed in an offsite permitted facility (Southern 2007a). Nonradioactive resins and sludge would be disposed of in a permitted industrial landfill, and putrescible wastes would be disposed of in a permitted offsite facility (Southern 2007a). Recyclable solid waste materials generated on the VEGP site, such as scrap metal, used oil and antifreeze, office paper, and aluminum cans, would be collected for recycling or recovery (Southern 2007a).

Nonradioactive hazardous wastes would be stored temporarily onsite and periodically disposed of at a permitted disposal facility (Southern 2007a). These wastes are regulated under the Resource Conservation and Recovery Act, and all hazardous wastes activities would be performed in compliance with all applicable regulations (Southern 2007a).

3.3 Power Transmission System

As discussed in Section 2.2.2 of this EIS, the VEGP site is connected to the regional power grid via two 500-kV transmission lines and four 230-kV transmission lines in four rights-of-way. Information on the dimensions of each existing transmission line right-of-way is provided in Section 2.2.2. The transmission lines are operated by the GPC, which is a wholly owned subsidiary of Southern Company. Southern Nuclear Operating Company, Inc. also is a wholly owned subsidiary of Southern Company. No changes to the existing system would occur (Southern 2007a).

One new 500-kV transmission line would be constructed to handle the power generated by the proposed VEGP Units 3 and 4. The proposed new transmission line would be routed from the VEGP site to the Thomson-Vogtle substation west of Augusta, Georgia. This substation would be upgraded to contain a 500-kV bus by the time the connection is made (Southern 2007a). Although the precise route of the new transmission line had not yet been determined, GPC prepared a routing study (GPC 2007). Routing information, transmission line dimensions, and land-use characteristics in the planned route are discussed in Section 4.1.2 of this EIS. In conjunction with selecting a final route, the GPC would consult with appropriate State and Federal agencies, including the Georgia State Historic Preservation Officer, the U.S. Fish and Wildlife Service, the GDNR, and the U.S. Army Corps of Engineers (Southern 2007a).

Currently, all of the GPC's 500-kV transmission lines are supported by steel, lattice-type towers designed to provide clearances consistent with the National Electrical Safety Code and the GPC's engineering standards. At a minimum, all clearances would equal or exceed 13.7 m (45 ft) phase-to-ground. For 500-kV transmission lines, the GPC uses a three-subconductor-per-phase system with two overhead ground wires. All towers are grounded with either ground rods or a counterpoise system. Any new transmission lines would be constructed using the same standards. No transmission line tower would be higher then 60 m (200 ft) above the ground surface (Southern 2007a).

3.4 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

Clean Water Act (also referred to as the Federal Water Pollution Control Act). 33 USC 1251, et seq.

Georgia Power Company (GPC). 2007. *Corridor Study – Thomson Vogtle 500-kV Transmission Project.* Atlanta, Georgia. Available on ADAMS; Accession No. ML070460368.

Resource Conservation and Recovery Act of 1976. 42 USC 6901, et seq.

Southern Nuclear Operating Company, Inc. (Southern). 2007a. *Southern Nuclear Operating Company, Vogtle Early Site Permit Application: Environmental Report, Rev. 2.* Southern Company, Birmingham, Alabama.

Southern Nuclear Operating Company, Inc. (Southern). 2007b. *Southern Nuclear Operating Company, Vogtle Early Site Permit Application, Response to Requests for*

Additional Information on the Environmental Report. Letter report from Southern Nuclear Operating Company (Birmingham, Alabama) to the U.S. Nuclear Regulatory Commission (Washington, D.C.). January 31, 2007. Accession number ML0760460323.

Southern Nuclear Operating Company, Inc. (Southern). 2007c. Supplemental Information on Water Treatment Chemical Residues in the Vogtle Unit 3 and 4 Discharge. Email from Southern to NRC, July 20, 2007. Adams Accession No. ML072080259.

Westinghouse Electric Company, LLC (Westinghouse). 2003. *AP1000 Siting Guide: Site Information for an Early Site Permit.* APP-0000-X1-001, Revision 3, Pittsburgh, Pennsylvania.

Westinghouse Electric Company, LLC (Westinghouse). 2005. *AP1000 Design Control Document.* AP1000 Document APP-GW-GL-700, Revision 15, Pittsburgh, Pennsylvania.

4.0 Construction Impacts at the Proposed Site

This chapter examines the environmental issues associated with potential site-preparation activities and construction of proposed new Units 3 and 4 at the Vogtle Electric Generating Plant (VEGP) as described in the application for an early site permit (ESP) submitted by Southern Nuclear Operating Company, Inc. (Southern). As part of its application, Southern submitted an Environmental Report (ER) and a site redress plan (Southern 2007a). The ER provides information used as the basis for the environmental review. The parameters included in design documents for the Westinghouse AP1000 advanced light-water reactors at the VEGP site and the values for these parameters are listed in Appendix I of this environmental impact statement (EIS). The site redress plan allows for specific site-preparation and preliminary construction activities to be conducted with approval of an ESP. The activities evaluated for the proposed site, designated the VEGP site, are those permitted by Title 10 of the Code of Federal Regulations (CFR), 50.10(e)(1) and 52.25(a). In the event that the ESP is approved and Southern conducts site-preparation activities but does not build the new units, Southern would be required to implement its site redress plan.

In Sections 4.1 through 4.9 of this chapter, the U.S. Nuclear Regulatory Commission (NRC) staff evaluates the potential impacts on land use; meteorology and air quality; water use and quality; terrestrial and aquatic ecosystems; socioeconomics; historic and cultural resources; environmental justice; nonradiological and radiological health effects; and applicable measures and controls that would limit the adverse impacts of station construction. In accordance with 10 CFR Part 51, impacts have been analyzed, and a significance level – SMALL, MODERATE or LARGE – of potential adverse impacts has been assigned to each analysis. In the socioeconomic area where the impacts of taxes are assessed, the impacts may be considered beneficial and are stated as such. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.10, followed by a description of Southern's site redress plan in Section 4.11. A summary of the construction impacts is presented in Section 4.12. Full citations for the references cited in this chapter are listed in Section 4.13. Cumulative impacts of construction and operation are discussed in Chapter 7. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 10 and 11.

The staff relied on the mitigation measures and the required Federal, State, and local permits and authorizations presented in the ER in reaching its conclusion on the significance level of the adverse impacts. The staff relied on the infrastructure upgrades planned by the counties, cities, and towns, such as road and school expansions, in assigning significance levels to the impacts. Failure to implement such infrastructure upgrades may result in larger impact levels.

4.1 Land-Use Impacts

This section provides information on land-use impacts associated with site-preparation activities and construction of the proposed Units 3 and 4 at the VEGP site. Topics discussed include land-use impacts at the VEGP site and in the vicinity of the site and land-use impacts in transmission line rights-of-way and offsite areas.

4.1.1 The Site and Vicinity

The VEGP site is located entirely within the existing VEGP site where no zoning regulations currently apply.

All construction activities for the proposed VEGP Units 3 and 4, including ground-disturbing activities, would occur within the existing VEGP site boundary (Southern 2007a). The area that would be affected on a long-term basis as a result of permanent facilities at the site is approximately 125 ha (310 ac). An additional 77 ha (190 ac) would be disturbed for temporary facilities and spoils storage (Southern 2007a). Southern states that it would conduct any site-preparation and construction activities in accordance with applicable Federal, State, and local regulatory requirements (Southern 2007a). Southern's application includes a site redress plan covering any site-preparation and preliminary construction activities that might be conducted on the VEGP site. The redress plan is evaluated in Section 4.11 of this EIS.

No new railroad lines to support the construction of VEGP Units 3 and 4 are planned; however, three new roads would be constructed. A heavy-haul road would be constructed from the barge slip on the Savannah River to the construction site. A construction access road would be constructed from River Road near the rail spur crossing. A third new road would be constructed to the new intake structure (Southern 2007a). The 500-kV Thalmann transmission line would be rerouted on the VEGP site to avoid the footprint of the planned new units. An existing landfill on the VEGP site (Landfill #3) would be relocated onsite or the materials removed and disposed in an offsite disposal facility.

Clearing and removal of trees growing within the VEGP site would be required. No agricultural lands would be directly affected by construction activities. Borrow material would be taken from the excavation for the powerblock and switchyard for the proposed VEGP Units 3 and 4 (Southern 2007b). Areas for soil storage are shown in Figure 2-1.

A few small wetland areas and three small unnamed streams exist on the VEGP site (Figure 2-1). Southern intends to avoid watercourses and wetlands to the extent possible during construction. Any work that has the potential to impact a wetlands area would be performed in accordance with applicable State and Federal regulatory requirements.

The cooling water intake structure (CWIS) and discharge structure for the proposed VEGP Units 3 and 4 (Figure 2-1) would be located in the Savannah River floodplain. The barge slip, also located in the Savannah River floodplain, would be expanded. All other construction activities would be outside the 500-year floodplain (Southern 2007a). Some dredging in the Savannah River would be needed for a passage from the main channel of the river to the barge slip to accommodate movement of heavy equipment and components to the site by barge. Dredging would also be needed to enlarge the barge slip. Dredge material would be removed and transported to a spoils area, as shown in Figure 2-1, for disposal.

A few offsite land-use changes in the vicinity of the VEGP site would be expected as a result of construction activities. For example, a recreational vehicle park and store within 10 km (6 mi) of the VEGP site operated during construction of VEGP Units 1 and 2 and could reopen during construction of VEGP Units 3 and 4. Additional information on roads, housing, and construction-related infrastructure impacts can be found in Sections 4.5.1.3, 4.5.4.3, and 4.5.4 respectively.

Based on information provided by Southern, the site redress plan, and NRC's own independent review, the staff concludes that there are no significant environmental impacts related to land use that would influence the granting of an ESP to Southern for the VEGP site. The staff concludes that the land-use impacts of construction would be SMALL, and further mitigation is not warranted.

4.1.2 Transmission Line Rights-of-Ways and Offsite Areas

Southern and Georgia Power Company (GPC) plan a new 500-kV transmission line to serve the proposed new units at the VEGP site. VEGP Units 3 and 4 would use the new transmission line or some combination of the new and existing transmission lines. The new transmission line right-of-way would be routed northwest from the VEGP site, passing west of Fort Gordon, a U.S. Army facility west of Augusta, Georgia, and then north to the Thomson substation. The Thomson substation is located about 32 km (20 mi) west of Augusta, Georgia. The transmission line right-of-way would be approximately 46 m (150 ft) wide and approximately 97 km (60 mi) long (Southern 2007c). The new transmission line would require approximately 390 towers (Southern 2007a). Each tower would require foundation excavations.

Transmission line siting in Georgia is regulated under Title 22 of the Georgia Code. Although the precise route for the planned new transmission line has not yet been determined, the area where the new transmission line right-of-way would be sited is shown in Figure 4-1. Land use for a representative route within the right-of-way is approximately as shown in Table 4-1 (GPC 2007).

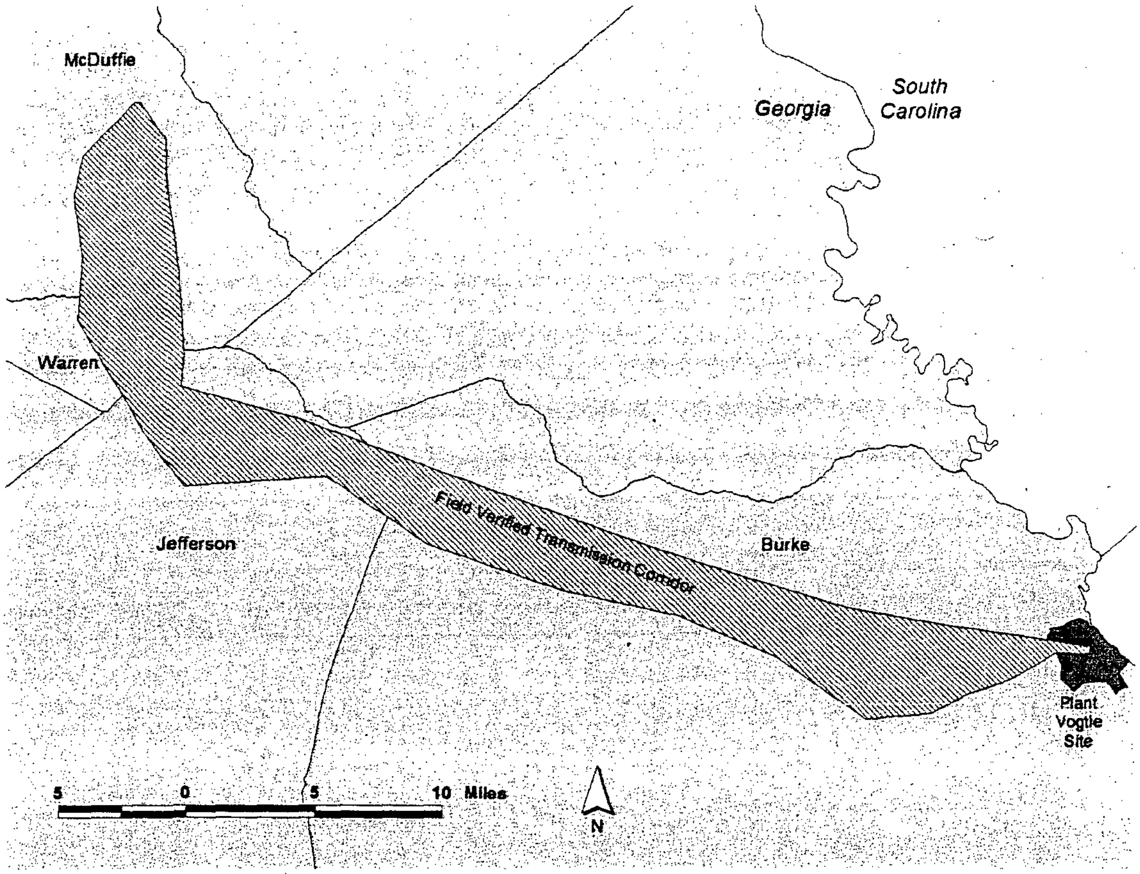

Figure 4-1. Approximate Siting of the Planned New Transmission Line Right-of-Way (GPC 2007)

Table 4-1. Existing Land Uses in Planned New Transmission Line Right-of-Way

Land Use	Percentage
Forested	23.3
Open land	15.3
Open water	0.6
Planted pine	32.0
Mine/Quarry	1.0
Residential	0.5
Transportation	5.6
Utility	7.1
Row crop	14.6

Source: GPC 2007

In siting the new transmission right-of-way, the GPC would consult with the Georgia State Historic Preservation Officer (SHPO), the U.S. Fish and Wildlife Service (FWS), the Georgia Department of Natural Resources (GDNR), and the U.S. Army Corps of Engineers (USACE) (Southern 2007a). In siting new transmission lines, GPC has indicated a number of areas to be avoided, if possible, including buildings, mines, airports, military facilities, park and wetlands (GPC 2007). In the event that wetlands are encountered, construction would be conducted in accordance with necessary State and Federal permits to protect wetland areas (Southern 2007a).

Based on information provided by Southern and the GPC and NRC's own independent review, the staff concludes that the land-use impacts of constructing an additional transmission line to serve the VEGP site would be MODERATE.

4.2 Meteorological and Air-Quality Impacts

Sections 2.3.1 and 2.3.2 describe the meteorological characteristics and air quality of the site. The primary impacts of construction of a new unit on local meteorology and air quality would be from dust from construction activities, open burning, emissions from equipment and machinery used in construction, concrete batch plant operations, and emissions from vehicles used to transport workers and materials to and from the site.

4.2.1 Construction Activities

Construction of the proposed VEGP Unit 3 and 4 would result in temporary impacts to local air quality as a result of emissions associated with construction activities. Similar to any large-scale construction project, dust particle emissions would be generated during ground-clearing, grading, and excavation activities. Fugitive dust particles would be generated from the movement of machinery and materials as well as during windy periods over recently disturbed or cleared areas. The Air Protection Branch of the GDNR Environmental Protection Division, which regulates air-quality control for the State of Georgia, does not require a permit for dust generated by construction activities (Rules and Regulations of the State of Georgia 391-3-1-02(n)). However, Southern stated in its ER (Southern 2007a) that it would develop a dust-control plan prior to construction that would include specific dust mitigation measures. Techniques such as imposing speed limits on unpaved construction roads, minimizing material handling, covering haul trucks, wetting of potential source areas during dry periods, limiting grading and excavation activities during high winds or periods of poor air quality, and stabilizing bare ground areas are possible mitigation actions that would be considered (Southern 2007a).

Exhaust emissions from construction vehicles and equipment would also generate smaller amounts of particulate matter. In addition, these emissions would contain carbon monoxide, oxides of nitrogen, and volatile organic compounds. As was discussed in Section 2.3.2, Burke

County is in attainment or unclassified for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR 81.314). As a result, a conformity analysis on direct and indirect emissions is not required (58 FR 63214). If construction activities include the burning of debris, refuse, or residual construction materials, a permit would need to be secured from the State, and Southern would need to contact local county officials to determine which local ordinances, if any, must be followed.

In general, emissions from construction activities would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. The staff therefore concludes that the impacts from construction activities on air quality at the VEGP site would be SMALL, and additional mitigation beyond the actions stated above is not warranted.

4.2.2 Transportation

In the ER, Southern estimates that during peak construction there would be 4400 workers divided equally into four shifts, or 1100 workers per shift (Southern 2007a). Using a conservative assumption of one worker per vehicle in their transportation analysis, Southern estimates that an additional 2200 vehicles would be added to the roadway system during a shift change (Southern 2007a). The majority of the construction workers would likely reside in Burke, Richmond, and Columbia Counties in a proportion comparable to the existing workforce (Southern 2007a) and use primary roadways to commute to the VEGP site. In addition to construction workers, Southern estimates increased traffic from approximately 100 daily truck deliveries would occur at the site (Southern 2007a).

Depending on the actual residency location of workers, roadways leading to the site would experience increased traffic volume. NRC staff believes that vehicle occupancy rate would likely be higher than Southern's conservative estimate, and would range between 1.5 to 2.0 occupants per vehicle. This would result in 33 to 50 percent fewer construction worker vehicles than conservatively estimated by Southern. Nevertheless, River Road, the primary access road to the VEGP site, would still experience a significant increase in traffic during shift changes that could lead to periods of congestion. Stopped vehicles with idling engines would lead to increased emissions beyond what would occur from normal vehicle operation alone. However, the overall impact caused by increased traffic volume and congestion is difficult to estimate because timing of construction activities, shifts, and exact worker residence locations are largely unknown.

In its ER, Southern has committed to develop mitigation measures that would be included in a construction management traffic plan prior to the start of construction (Southern 2007a). Numerous measures, such as installing turn lanes near the construction entrance, encouraging car pools, establishing central parking and shuttling services to and from the construction site, and scheduling shift changes for operating personnel, outage workers, and construction workers would be considered to mitigate the impact of vehicular traffic on air quality. Based on Southern's commitment to develop and implement a traffic management plan and NRC's own independent review, the staff concludes that the impact on the local air quality from the increase in vehicular traffic related to construction activities would be temporary and SMALL, and additional mitigation beyond the actions stated above is not warranted.

4.3 Water-Related Impacts

Water-related impacts involved in the construction of a nuclear power plant are similar to impacts that would be associated with any large industrial construction project, and not much different than those seen during the construction of VEGP Units 1 and 2. Prior to initiating construction, including any site-preparation work, Southern would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. These authorizations would likely include:

- Clean Water Act Section 404 Permit. This permit would be issued by the USACE, which governs impacts of construction activities on wetlands or waters of the United States and management of dredged material.

- Clean Water Act Section 401 Certification. This certification would be issued by the GDNR and would ensure that the project does not conflict with State water-quality management programs.

- Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) construction and industrial stormwater permits. These permits would regulate point source stormwater discharges. The U.S. Environmental Protection Agency's (EPA's) stormwater regulations have established requirements for stormwater discharges from various activities including construction activities. The EPA has delegated the authority for administering the NPDES program in the State of Georgia to the GDNR.

- Section 10 of the Rivers and Harbors Act of 1899. This section prohibits the obstruction or alteration of navigable waters of the United States without a permit. Appropriate USACE permits would be obtained for construction in the Savannah River.

4.3.1 Hydrological Alterations

Construction of VEGP Units 3 and 4 would potentially affect several surface waterbodies as well as the aquifers underlying the site. Potentially affected surface waterbodies include Mallard Pond and the associated downstream unnamed creek, several of the onsite debris/sediment basins and their associated drainage areas,. and the Savannah River.

Dewatering of the foundation excavations would occur for 18 months during construction of VEGP Units 3 and 4 (Southern 2007d). Dewatering systems would potentially depress the water table in the vicinity of the construction excavation; however, these systems would not dewater the confined aquifers (i.e., Tertiary or Cretaceous aquifer systems) underlying the water table because the Blue Bluff Marl acts to provide a hydraulic separation. Southern has stated that Mallard Pond continued to flow throughout the dewatering activity associated with construction of VEGP Units 1 and 2 (Southern 2007c). The powerblock dewatering program persisted for almost 7 years, from June 1976 through March 1983 (Southern 2003a). Southern states in its ER that water pumped from the excavation would be discharged into a settling basin if necessary before being released through a NPDES permitted outfall (Southern 2007a).

Southern has proposed construction of a 73-m (240-ft) long and 52-m (170-ft)-wide intake structure along the shoreline of the Savannah River to support cooling system water demands for VEGP Units 3 and 4 (see Figures 3-4 and 3-5). The bottom of the canal would be constructed at an elevation of 21.3 m (70 ft) above mean sea level (MSL), and vertical sheet piles would be driven into the river bottom along the sides of the canal that extend upwards to an elevation of about 29.9 m (98 ft) MSL (Southern 2007a).

A discharge pipe would extend approximately 15.2 m (50 ft) into the Savannah River from the normal water surface shoreline (an elevation of 24 m (80 ft) MSL). The centerline elevation of the pipe would be approximately 0.9 m (3 ft) above the river bottom, and rip-rap material would be placed around the pipe outfall to resist erosion (Southern 2007a). A cofferdam would be built using sheet piles before installation of the pipe. The sheet piling would be cut to within 0.3 m (1 ft) of the river bottom grade and left in place after installation of the pipe (Figures 3-6 and 3-7).

Southern would construct a barge slip to support delivery of heavy equipment and components associated with construction of VEGP Units 3 and 4 (Southern 2007a). Southern states in its ER that the main channel of the Savannah River may need to be dredged to intercept the expanded barge slip (Southern 2007a) but current bathymetry suggests that no dredging is needed at this time (NRC 2007).

Activities supporting construction of the barge slip, the new intake structure, and the new discharge outfall would involve dredging, and Southern is required to obtain permits from the USACE prior to construction. Southern states in its ER that dredge materials would be removed from the river and deposited in an area pre-approved for dredge spoils (Southern 2007a).

Southern states in its ER that new debris basins would be constructed, and that debris basins built for construction of the existing facilities would not be reused (Southern 2007a). The new debris basins would serve as sedimentation basins for surface-water runoff and water pumped from the powerblock excavation (Southern 2007a).

Wetlands delineations and jurisdictional determinations of the sites impacted by construction, including the equipment laydown areas and associated infrastructure such as roads and stormwater drainage, would be required for Southern to submit an application for a Section 404 Permit to the USACE. Southern has made preliminary wetlands delineations and jurisdictional determinations and has initiated consultation with the USACE (Southern 2007c). These determinations are discussed in Section 2.7.1.1. The USACE permitting process would ensure that construction impacts to wetlands are avoided or minimized by implementation of appropriate best management practices (BMP).[a]

Southern has not obtained a Section 401 certification from the State of Georgia for ESP-related site preparation and preliminary construction activities at the VEGP site. The USACE would require that Southern obtain a certification, which is required pursuant to Section 401 of the Clean Water Act, before issuing a Section 404 permit. In accordance with the Clean Water Act, a Section 401 certification must therefore be obtained before ESP-permitted limited construction activities can commence.

Because the impacts of hydrological alterations resulting from construction activities would be localized and temporary, and the NPDES stormwater permits, 401 Certification, and USACE Section 404 and Section 10 permit processes would minimize impacts. The staff concludes that the impacts of hydrological alterations would be SMALL and further mitigation beyond the actions stated is not warranted.

4.3.2 Water-Use Impacts

Other than a small quantity of surface water that may be used to wash construction equipment or spray roads for dust abatement, Southern generally does not plan to use surface water during construction of the proposed VEGP Units 3 and 4 (Southern 2007a). Southern states in its ER that groundwater wells placed in the Cretaceous aquifer would provide water needed during construction of the proposed VEGP Units 3 and 4 for standard construction purposes including dust abatement, mixing concrete, and all potable water required by the construction workforce (Southern 2007a).

Among the proposed construction activities, dewatering would potentially impact the groundwater environment temporarily in the immediate vicinity of the VEGP site. Construction of the proposed VEGP Units 3 and 4 would employ a dewatering method similar to the method used when VEGP Units 1 and 2 were constructed (Southern 2007c). That experience is summarized in Section 2.6.2.2 of this EIS. Dewatering during construction of VEGP Units 1 and 2 involved the same aquifer at a nearby location and employed four pumps, each with a 32 L/s

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(a) Best management practices are recommended site management, maintenance, or monitoring activities that have been shown to work effectively to mitigate impacts. Government agencies sometimes use BMPs to specify standards of practice where a regulation may not be sufficiently descriptive.

(500 gpm) capacity (thus, a maximum capacity of 126 L/s [2000 gpm]). There were instances when greater capacity was needed for brief periods because of storm events (Southern 2003a).

Data from observation wells monitored during construction of VEGP Units 1 and 2 suggest a variable response in the Water Table aquifer near the excavation (Southern 2007a). The most distant well in the vicinity of the excavation for which a record exists (well #804), which is located approximately 300 m (1000 ft) southwest of the excavation, was not substantially impacted (0.6 m [2 ft] decline and subsequent recovery). Southern states that the stream discharging from Mallard Pond and the west branch of the drainage below the pond are perennial streams (Southern 2007c). The applicant stated that Mallard Pond continued to flow throughout the dewatering activity for VEGP Units 1 and 2, which lasted from mid-1976 until mid-1983 (Southern 2007a). Monitoring data from the period of VEGP Unit 1 and 2 construction indicate recovery from dewatering within 2 years (Southern 2007a). The Blue Bluff Marl is believed to substantially isolate the Water Table aquifer from the underlying confined Tertiary aquifer. Locally, the existing downward hydraulic gradient from the Water Table aquifer toward the Tertiary aquifer would be maintained as downward directed but be somewhat less during the dewatering period. Southern has committed to protect the aquifer from impact during the construction process, and "if a significant impact to the groundwater resource is discovered... This information would be evaluated as potentially new and significant information and provided to the NRC for review as appropriate" (Southern 2007c). Therefore, the staff determined a dewatering activity conducted in the Water Table aquifer would be localized and temporary, and not impact substantially local groundwater users in the vicinity of the VEGP site.

The Water Table aquifer in the vicinity of the VEGP site may also experience a change in net infiltration (i.e., recharge from precipitation) because of the clearing of land, the construction of facilities including a stormwater drainage system, and the temporary disturbance of vegetated areas. The staff reviewed plots provided in the ER for wells in the immediate vicinity of VEGP Units 1 and 2 (Southern 2007a). These graphical data illustrate the water table change over the 20-year period since construction of VEGP Units 1 and 2. The net change is variable; some locations exhibit an increase, others a decrease, and all changes appear to be less than 0.9 m (3 ft) in magnitude.

Southern proposes to supply water for construction from the confined aquifer system under its existing groundwater permit for which there is unused groundwater capacity. Southern estimates current pumping at 46.1 L/s (730 gpm) to operate VEGP Units 1 and 2, a maximum of 26.5 L/s (420 gpm) during construction of VEGP Units 3 and 4, and 47.44 L/s (752 gpm) to operate the two new units when they begin operations. In this analysis well MU-2A, the deep confined aquifer well nearest the VEGP site property boundary (1740 m [5700 ft] distant) is assumed to supply all of the water. Three pumping rates are of interest.

1. A drawdown in the year 2015 associated with a baseline for VEGP Units 1 and 2 operation; the total rate would be 46.1 L/s (730 gpm).

2. A drawdown in the year 2015 associated with operation of VEGP Units 1 and 2 and maximum construction pumping; the total rate would be 72.55 L/s (1150 gpm).
3. A drawdown in the year 2017 associated with operation of VEGP Units 1, 2, and 3, and construction of VEGP Unit 4; the total rate would be 83.03 L/s (1316 gpm).

The projected annual average groundwater resource use during construction of VEGP Units 3 and 4 is shown in Table 4-2 as outlined in the three cases above. These three cases examine the construction period including the time when VEGP Unit 3 is in operation and VEGP Unit 4 is still under construction.

Table 4-2. Drawdown Due to Groundwater Withdrawal During VEGP Unit 3 and 4 Construction

Water Withdrawal Scenario	Time Period (yr)	Pumping Rate L/s (gpm)		Drawdown at 5700' m (ft)		Drawdown at 3500' m (ft)	
Aquifer response 2015							
Units 1 and 2 Operation	30	46.1	(730)	1.75	(5.75)	1.91	(6.26)
Aquifer Response 2015							
Units 1 and 2 Operation	30	46.1	(730)	1.75	(5.75)	1.91	(6.26)
Units 3 and 4 Construction	6[(a)]	26.5	(420)	0.86	(2.82)	0.95	(3.11)
		72.6	(1150)	2.61	(8.56)	2.86	(9.38)
Aquifer Response 2017							
Units 1 and 2 Operation	32	46.1	(730)	1.75	(5.78)	1.92	(6.30)
Units 3 and 4 Construction	8	26.5	(420)	0.88	(2.90)	0.98	(3.20)
Unit 3 Operation	2	10.5	(166)	0.30	(0.98)	0.34	(1.10)
		83.0	(1316)	2.95	(9.67)	3.23	(10.60)

(a) Assume construction period of 6 years

Conservative models are employed by Southern and the staff to estimate drawdown in the confined Cretaceous aquifer as a result of groundwater withdrawal. A simplified form of the Theis equation (Theis 1935; Cooper and Jacob 1946) for estimating drawdown in a confined aquifer was used to estimate drawdown in the Cretaceous aquifer. The assumptions of this model are described in Section 5.3.2.2. Conservatism in this analysis also comes from the use of a single well to produce the water and from that well being closest to the VEGP site boundary.

Estimated drawdown for the three water withdrawal scenarios are shown in Table 4-2. The resulting drawdown levels are estimated as 1.8 m (5.8 ft), 2.6 m (8.6 ft), and 2.9 m (9.7 ft), respectively, for the three events. Increased drawdown over that of VEGP Unit 1 and 2 operation at the property boundary in the Cretaceous aquifer during construction of VEGP Units 3 and 4 is estimated to be 0.85 m (2.8 ft). Similarly, increased drawdown for startup of VEGP Unit 3 and continued construction of VEGP Unit 4 is estimated to be 1.1 m (3.9 ft).

These estimates reflect the potential impact at the property boundary, which is 1740 m (5700 ft) from the production well. The closest users of the Cretaceous aquifer are a municipal well 23.3 km (14.5 mi) away, an industrial well 13.7 km (8.5 mi) away, and wells located 6.4 km (4 mi) away in the D Area of the Savannah River Site. At these distances, the change in drawdown resulting from the supply of water during the construction period is estimated as less than 0.9 m (3.5 ft) for these wells in 2017. These drawdowns are small relative to the 120 m (400 ft) of confining hydraulic head in the Cretaceous aquifer.

The staff also estimated drawdown impacts if all groundwater demand was drawn from the proposed well location approximately 1070 m (3500 ft) from the property boundary. The estimated drawdowns for a neighboring water user on the VEGP site property boundary were approximately 10 percent greater. The more distant users are not influenced by this relatively minor change in well location.

Based on Southern's commitment to protect the aquifer and the groundwater resource during construction (Southern 2007c), on the existing water-use permit (i.e., State of Georgia, Groundwater Use Permit No. 017-003) being of adequate capacity for construction water demand, on the forgoing analysis of the change in groundwater drawdown, and because water-use impacts during construction would be localized and temporary, and recovery from construction activity would be short term, the staff concludes that water-use impacts caused by construction activities would be SMALL, and mitigation is not warranted.

4.3.3 Water-Quality Impacts

During construction of VEGP Units 3 and 4 and their associated infrastructure, a potential exists for soil erosion to degrade the water quality of surface-waterbodies such as Mallard Pond, Telfair Pond, and the Savannah River. Southern would be required to obtain a NPDES construction stormwater permit before the start of construction, which would ensure that BMP are followed. Southern states in its ER that they would also develop an Erosion, Sedimentation and Pollution Control Plan (Southern 2007a).

Construction activities in and along the shoreline of the Savannah River would disturb river sediments, thus increasing turbidity both near and downstream of the construction sites. To limit the downstream effects of these activities, Southern states in its ER that cofferdams would be constructed around the sites to limit downstream distribution of the river sediments (Southern 2007a).

The VEGP site is served by a private wastewater treatment facility sized for the workforce of the existing units (see Section 3.2.4.2). During construction, the temporary office and warehouse facilities would use the existing waste treatment facility. Portable toilets would be employed on the construction area (Southern 2007a).

Because the impacts of hydrological alterations resulting from the above construction activities would be localized and temporary, and the NPDES stormwater permits, 401 Certification, and the USACE permits require the implementation of BMP to minimize impacts, the staff concludes that the impacts on water quality during construction would be SMALL, and further mitigation beyond the actions stated is not warranted.

4.4 Ecological Impacts

This section describes the potential impacts to ecological resources from construction of VEGP Units 3 and 4 including the construction of a new transmission line to connect the units to the grid. The section is divided into three subsections: terrestrial impacts, aquatic impacts, and impacts to threatened and endangered species.

4.4.1 Terrestrial Impacts

This section provides information on the site-preparation activities and construction of VEGP Units 3 and 4 at the VEGP site and the impacts on the terrestrial ecosystem. Topics discussed include terrestrial resource impacts at the VEGP site and terrestrial ecosystem impacts associated with the expansion of the transmission system to include a new 500-kV transmission line right-of-way. Southern stated that "BMPs used to minimize impacts during preconstruction and construction activities begin with a programmatic construction Environmental Control Plan being put in place" (Southern 2007c). This plan would address BMP that would be used to minimize impacts. The plan would cover topics such as erosion and sedimentation control, sensitive resources, spill prevention and response, noise and vibration, air emissions, and general site maintenance. In addition, the applicant states that regular environmental compliance inspections of construction activities would be performed to ensure that site activities are in compliance with all applicable environmental requirements (Southern 2007c).

4.4.1.1 Wildlife Habitat

The VEGP Site

The VEGP site includes land developed for industrial use, previously disturbed land, and undeveloped land. Approximately 200 ha (500 ac) of land would be disturbed by construction of VEGP Units 3 and 4. The area that would be affected as a result of construction related to permanent facilities is approximately 125 ha (310 ac). An additional 77 ha (190 ac) would be disturbed for temporary facilities and spoils storage (Southern 2007c). The total number of acres needed for each major construction activity and the associated habitat types that would be disturbed is provided in Table 4-3. Southern stated that "it is unlikely that each activity will disturb the entire area identified, and where possible, efforts will be made to minimize disturbance" (Southern 2007c).

Table 4-3. Habitat Types and Acreage Associated with Permanent and Temporary Construction Areas Associated with Construction of VEGP Units 3 and 4

Construction Area	Hectares (Acres) Affected	Dominant Habitat Type
Permanent		
Powerblock	30.4 (75.2)	Planted loblolly pine previously disturbed
Cooling Tower	28.0 (69.3)	Previously disturbed/industrial
Switchyard	27.8 (68.7)	Open fields/planted loblolly pine
Cooling Water Intake	5.1 (12.5)	Bottomland hardwoods/wetlands
Barge Slip/Discharge structure	4.2 (10.3)	Bottomland hardwoods/wetlands
500-kV transmission line (onsite)	9.8 (24.3)	Planted loblolly pine, previously disturbed industrial, open fields
	0.6 (1.4)	Pond and bottom land hardwood
Simulator building	1.6 (4.0)	Mixed hardwoods and pine
Onsite Roads	16.7 (41.3)	Open fields, planted pine, previously disturbed
Temporary		
Parking	18.2 (44.5)	Planted longleaf pine
Batch House	4.1 (10.2)	Planted longleaf pine
Warehouse, Office, and Laydown	26.0 (63)	Previously planted disturbed/mixed loblolly/longleaf pine
Spoils Areas, two at 14.6 ha (36 ac) each	29.1 (72)	Mixed planted loblolly/longleaf pine

Source: Southern (2007b, 2007c)

Temporary impacts on the 77 ha (190 ac) associated with spoils areas, parking lots, warehouses, offices, and laydown yards would occur in planted longleaf and loblolly pine habitats and in previously disturbed areas. Of the 125 ha (310 ac) that would be disturbed to construct the powerblock, cooling towers, switchyard, roads, and simulator building, approximately 113 ha (279 ac) or 90 percent of the land area would be composed of previously disturbed, open fields or planted pine habitats. About 1.6 ha (4 ac) of mixed hardwoods and pine would be permanently removed for the simulator building (Southern 2007c).

Approximately 10.4 ha (25.7 ac) of habitat onsite would be permanently removed for construction of the new 500-kV transmission line. The new transmission line would originate in the new switchyard and would be routed west across the south end of Mallard Pond. It would follow the existing Vogtle-Scherer 500-kV right-of-way west until it exits the site boundary. The right-of-way would be 46 m (150 ft) wide, and six transmission tower structures would be located onsite. Transmission towers would be located to free span Mallard Pond and minimize habitat impacts. The area near Mallard Pond that would be crossed by the line is approximately 0.57 ha (1.4 ac) and is composed of pond and bottomland hardwood habitat. The remaining 9.8 ha (24.3 ac) is a mixture of planted loblolly pine, previously disturbed industrial areas, and open fields (Southern 2007b).

About 9.11 ha (22.5 ac) of wetlands would be directly affected by Unit 3 and 4 construction activities including approximately 5.1 ha (12.5 ac) during construction of the CWIS and 4 ha (10 ac) during the construction of the barge facility and discharge structure (Southern 2007c). Most of the acreage involved would be along the Savannah River (Southern 2007c). Though Southern included the total of 5.1 ha (12.5 ac) of wetlands in the estimate for permanent disturbance, they estimate that the actual intake structure and canal would be located on about 1.2 ha (3 ac) of wetlands. Impacts to the remaining 3.84 ha (9.5 ac) of the construction area associated with the CWIS would be temporary (Southern 2007c). The applicant stated "Temporary construction ramps at the canal and CWIS area would be removed and disturbed areas around the intake structure would then be stabilized and re-vegetated to preclude future erosion. Erosion and sediment controls would remain in place and would be maintained as long as necessary" (Southern 2007c). One hundred twenty-two meters (400 ft) of shoreline would be disturbed at the CWIS, 27 m (90 ft) would be disturbed at the barge facility, and 6.1 m (20 ft) would be disturbed at the discharge structure (Southern 2007c; NRC 2007).

Southern has committed to minimize impacts to adjacent wetland areas and the Savannah River during the construction process. Construction of the CWIS, barge facility, and discharge structure would be conducted under a Section 404 permit. In early 2007, Southern submitted the Request for Jurisdictional Determination Form to the USACE and began the Section 404 permitting process (Southern 2007c). The Section 404 permit would also require a Water Quality Certification issued by the GDNR Environmental Protection Division to control discharge of water from the construction process to the Savannah River (Southern 2007c). A Section 10 permit under the Rivers and Harbors Act would be required. This project would also require a Georgia General Stormwater Permit for Construction (Southern 2007c).

The CWIS houses the river water make-up pumps, traveling screens, screen wash pumps, and associated equipment. To minimize dewatering and potential for impact to the Savannah River and adjacent wetlands, Southern may perform the excavation of the intake structure primarily from land rather than working on the water. Prior to cut-and-fill operations associated with the building of the access road, silt fences and other erosion and sediment controls would be installed in drainage areas and at the perimeters of the disturbed areas. Southern stated, "The access road would be built incorporating erosion and sediment control measures and road drainage systems consistent with the requirements of the Georgia stormwater permit for the upland portions of the project. Additional controls required by the USACE Section 404 permit would be applied in wetland areas" (Southern 2007c).

Southern plans to excavate the intake canal and intake area to just above the high water mark. The excavated material would be stored in an upland area onsite. These materials may be reused in the canal banks. Southern stated, "Erosion and sediment control measures would be installed, and BMP would be employed, as necessary, for this upland storage area" (Southern 2007c).

The final operations associated with the construction of the CWIS would be conducted from a barge located in the Savannah River. Southern stated that "appropriate environmental controls would be used for this phase of the operation to prevent spills and minimize environmental impact to the river and adjacent wetlands" (Southern 2007c).

At this time, Southern anticipates only having to dredge during construction of the barge facility (Southern 2007c). The dredge material associated with construction of the barge facility (approximately 230 m^3 [300 yd^3]) would be transported and placed in an uplands spoils area. Fill activity in the areas would primarily be limited to that associated with barge facility construction. Construction of the barge facility would require an over-excavation approximately 0.9 m (3 ft) deep to allow for placement of a 0.9-m (3-ft)-thick gravel bed (approximately 1990 m^3 [2600 yd^3]). Southern stated that after construction of the barge facility "the site will be stabilized and re-vegetated in accordance with permit requirements after all construction activity is complete at the barge facility. Erosion and sediment controls would remain in place as long as necessary and would be removed only after vegetation is well established and controls are no longer necessary" (Southern 2007c).

Southern does not anticipate having to conduct sediment characterization of the material dredged in support of the new barge facility (Southern 2007c). In addition, based on a bathymetry survey conducted in 2006, the need for dredging from the end of the barge facility to connect with the Federal navigation channel is not anticipated at this time. However, dredging may be required in the future due to natural movement of sediment in the river (Southern 2007c, NRC 2007).

The discharge structure would consist of a buried pipe with a submerged discharge outlet into the Savannah River. Impacts related to construction and placement of the discharge structure would include the removal of native vegetation, grading, and cut-and-fill activities. Southern stated that "the disturbed area would be re-vegetated to prevent erosion and allowed to revert to its native condition once the discharge pipe is in place and covered. Once installed, the discharge pipe is expected to permanently disturb less than 0.04 ha (0.1 ac)" (Southern 2007c). A small amount of rip-rap material would also be placed in the river at the end of the discharge pipe to "armor" the bottom in the immediate area of the discharge to minimize scour (Southern 2007c).

Southern has not discussed specific mitigation activities related to wetlands with the USACE. If mitigation for wetlands is required, Southern stated that sufficient areas are available within the VEGP site for potential mitigation actions (Southern 2007c).

There is the potential for other construction activities associated with the proposed VEGP Units 3 and 4 to have indirect impacts to wetlands at the VEGP site. Indirect impacts to the debris basins, Mallard Pond, Telfair Pond, and Beaverdam Creek could occur as a result of construction activities (e.g., sedimentation).

Construction of the heavy-haul road and the new switchyard could result in sediment transport into Mallard Pond after heavy rainfall events (Southern 2007c). Southern stated that they would implement the necessary erosion and sediment controls and BMP to ensure runoff does not negatively indirectly impact wetlands (Southern 2007c). Excavated soil placed in the proposed spoils and overflow storage areas south of the Main Plant Access Road could move with runoff into Telfair Pond or Beaverdam Creek along one of the small intermittent unnamed streams in the area (Southern 2007a).

New upland retention ponds would be constructed and used to accept surface water runoff and water from the dewatering process. These new retention ponds would function as sedimentation basins. The existing debris basins would not be used for sedimentation, but they would be used for storm water management and would likely receive the outflow from the new retention basins (NRC 2007).

Excavation for the powerblock would extend below the normal water table in the unconfined (i.e., Water Table) aquifer, and a dewatering system (described in Section 4.3.2) would be installed to remove groundwater from the excavation during the construction process (Southern 2007c). Excavation is expected to take place over a 6-month period, and operation of the dewatering system would occur over an 18-month period (Southern 2007b, 2007c). Mallard Pond, which is located a short distance to the north of the excavation, is fed by a spring believed to originate in Utley Cave, a karst formation that intercepts groundwater from the unconfined (Water Table) aquifer. Southern recently conducted an evaluation of the potential to indirectly dewater Mallard Pond and the stream that drains Mallard Pond through the removal of groundwater as part of the excavation process. Based on the evaluation, Southern believes there may be a short-term reduction in recharge flow to Mallard Pond during the dewatering of the powerblock excavation. This evaluation showed the pond level would not be substantially affected and the stream below the pond may experience a reduction in flow, but it is not expected that this reduction would significantly alter the stream habitat, beyond what might be experienced during a drought period (Southern 2007c). Southern stated they would visually monitor Mallard Pond to determine "if activities produce changes in pond level or flow reductions in the drainage below the pond" (Southern 2007c). It is expected that dewatering would impact the fringe vegetation surrounding Mallard Pond and in the stream below Mallard Pond, but these impacts would be temporary and not beyond that of a typical drought. Therefore, the impacts should be negligible. If the excavation process extends beyond 18 months or the dewatering results in a drop in flow that is lower than the flow expected during a drought year, impacts to Mallard Pond and the wetlands in the stream below Mallard Pond could be greater than negligible. Southern stated "if a significant impact to the groundwater resource is discovered, this information will be evaluated as potentially new and significant information and provided to the NRC for review, as appropriate" (Southern 2007c).

In summary, an estimated 9.11 ha (22.5 ac) of wetlands habitat on the VEGP site would be removed to construct permanent structures and facilities associated with construction of the proposed VEGP Units 3 and 4 at the VEGP site. This represents about 13 percent of the total 69 ha (170 ac) of wetlands that have been identified onsite. Within 16 km (10 mi) of the site there are 41,092 ha (101,538 ac) of wetlands, including 33,369 ha (82,455 ac) of wetlands along the Savannah River (FWS 2004a, b). Wetlands habitat that would be removed is less than 0.03 percent of the total wetlands acreage in the vicinity. An estimated 112.5 ha (278 ac) of upland habitat including planted pines, previously disturbed areas, and open fields would be removed during construction of permanent structures and facilities (including the onsite portion of the new transmission line), representing about 16 percent of the total 700 ha (1730 ac) of planted pine and open areas currently available onsite. An estimated 1.6 ha (4 ac) of mixed hardwood and pine habitat would be lost to permanent structures and facilities, representing less than 1 percent of the total 247.7 ha (612 ac) of hardwood habitat available onsite. Approximately 0.57 ha (1.4 ac) of land, composed of pond and bottomland hardwood would be crossed by the new transmission line onsite.

Habitats associated with temporary impacts to 77 ha (190 ac) resulting from construction of parking areas, the batch plant, warehouses, laydown yards, and spoils areas would be re-vegetated following construction activities.

Upland hardwood forests and bottomland wetlands have much greater plant species and structural diversity than upland fields, planted pines, and previously disturbed areas, and are thus assumed to be much more important as wildlife habitat. The combined onsite upland hardwood forest and bottomland wetlands lost to permanent structures and facilities represent a small percentage of the combined total of these available onsite and in the vicinity of the VEGP site. Therefore, the staff finds the impact would be negligible.

Proposed 500-kV Transmission Line Right-of-Way

The extent and type of wildlife habitat within the proposed new transmission line right-of-way is not known at the time of this draft. Currently, Southern and the GPC are evaluating the actual right-of-way alternatives for the transmission line within the Representative Delineated Corridor (RDC). It is anticipated that the transmission line would cross primarily Burke, Jefferson, McDuffie and Warren Counties and would be 46 m (150 ft) wide and 97 km (60 mi) long. There are no U.S. Forest Service Wilderness Areas, Wild/Scenic Rivers or Wildlife Refuges, or State or National Parks within the RDC (GPC 2007). If possible, wetland areas would be avoided in the routing of the proposed 500-kV transmission line. In the event that wetlands are encountered, construction would be conducted in accordance with the necessary permits to protect wetland areas (GPC 2007).

A hypothetical transmission line right-of-way that represents what GPC believes is a feasible route within the RDC was identified as part of the 2007 right-of-way study (GPC 2007). Habitats within the hypothetical right-of-way include approximately 97 ha (240 ac) of forested habitat, 133.1 ha (329 ac) of planted pine, 2.6 ha (6.4 ac) of open water, and 63.9 ha (158 ac) of open land. Other land-use categories that were identified as potentially being impacted such as quarry mine, pecan orchard, row crop, transportation, and utility provide little value as wildlife habitat. Southern stated that wetlands would not be impacted by construction of the new right-of-way (NRC 2007). In the region surrounding the RDC and any new transmission line, there are approximately 18,085 ha (44,688 ac) of forest, 1354 ha (3346 ac) of open water, and 17,262 ha (42,656 ac) of open land (GPC 2007). Assuming the actual routing iss similar to the hypothetical route, the number of acres of forested habitat, open water, open land, and planted pine that would be impacted represent a very small portion of the available habitat, and thus impacts on wildlife habitat would be negligible. However, if the actual routing differs from the hypothetical route, impacts on wildlife habitat could be greater.

Wildlife Habitat Summary

Construction of the Units 3 and 4 at the VEGP site and the new 500-kV transmission line would be done according to Federal and State regulations, permit conditions, existing procedures, and established BMP. Waterways and wetlands would be avoided to the extent possible (Southern 2007a). Therefore, the staff concludes construction impacts to wildlife habitat on the VEGP site would be negligible. Because of the uncertainty regarding the actual routing of the new transmission line right-of-way, impacts to wildlife habitat caused by construction of the transmission line could be greater than negligible.

4.4.1.2 Wildlife

During construction of VEGP Units 3 and 4 and the new 500-kV transmission line, wildlife may be destroyed or displaced, primarily as a result of operating heavy equipment (e.g., during land clearing). Less mobile animals, such as reptiles, amphibians, and small mammals, are expected to incur greater mortality than more mobile animals, such as birds. Although undisturbed forested and wetlands habitat would be available for displaced animals during construction, increased competition for available space during construction activities may result in increased predation and decreased fecundity, ultimately leading to a temporary reduction in population size. Species that can adapt to disturbed or developed areas may readily re-colonize portions of the disturbed area where suitable habitat remains or is replanted or restored. The destruction, temporary displacement and reduced productivity, and re-colonization of wildlife also apply to offsite disturbances in forest habitat that would result as land is cleared for the new transmission line. As construction activities end and habitats are restored naturally or through mitigation activities, habitats would again become available to wildlife species that previously occupied these spaces.

Noise from construction can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense (Larkin 1996). However, it is not unusual for wildlife to habituate to such noise (Larkin 1996). Construction activities that would generate noise include operation of equipment such as jack hammers, pile drivers, and heavy construction vehicles. In addition, construction noise results from the movement of workers, materials, and equipment. Short-term noise levels from construction activities onsite could be as high as 110 dBA. These noise levels would not extend far beyond the boundaries of the project site. At 120 m (400 ft) from the construction site, the construction noise would range from 60 to 80 dBA (Southern 2007a). The threshold at which birds and small mammals are startled or frightened is 80 to 85 dBA (Golden et al. 1980). The staff expects that noise levels associated with construction of the transmission line right-of-way would be similar to noise levels associated with construction at the VEGP site and would be below threshold levels for wildlife at 120 m (400 ft). Thus, impacts on wildlife from construction noise are expected to be negligible.

The use of natural draft cooling towers for VEGP Units 3 and 4 as well as the addition of transmission towers for the new transmission line introduces additional tall structures, and therefore increases the potential for avian collisions. Avian collisions with fabricated structures are a result of numerous factors related to species' characteristics such as flight behavior, age, habitat use, seasonal habits, and diurnal habitats; and to environmental characteristics such as weather, topography, land use, and orientation of the structures. Most authors on the subject of avian collisions with utility structures agree that collisions are not a significant source of mortality for thriving populations of birds with good reproductive potential (EPRI 1993). In the *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants*, the NRC reviewed monitoring data concerning avian collisions at nuclear power plants with large cooling towers and determined that overall avian mortality is low (NRC 1996). Southern has not quantitatively assessed the number of bird collisions with construction equipment or new structures. However, avian collisions with existing structures at the VEGP site have been infrequent and transmission line maintenance personnel have not reported any dead birds from collisions or contact with the existing transmission lines for VEGP Units 1 or 2 (Southern 2006a). The additional number of bird collisions, if any, would not be expected to cause a measurable reduction in local bird populations. Consequently, the number of construction-related bird collisions with structures is expected to be negligible.

Workers commuting to the VEGP site take one of three routes to access the site. All three routes converge on River Road. Southern estimates the current peak traffic rate on River Road nearest to the site is 1200 vehicles per hour (see Section 4.5.4.1). This number is projected to increase during construction of VEGP Units 3 and 4 by a maximum of 2200 vehicles per hour at peak traffic times (see Section 4.5.4.1). This would likely increase traffic-related wildlife mortalities. Local wildlife populations could suffer declines if road-kill rates were to exceed the rates of reproduction and immigration. However, while road kills are an obvious source of wildlife mortality, except for special situations not applicable to the VEGP site (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible), traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, the overall impact on local wildlife populations from increased vehicular traffic on the VEGP site during construction would be expected to be negligible.

The staff has determined that the construction related impacts of habitat loss, noise, collisions with elevated structures, and increased traffic may adversely affect onsite wildlife. However, these impacts would be temporary, minor, and mitigable.

4.4.1.3 State-Listed Species

The VEGP Site

The bay star-vine (*Schisandra glabra*) is the only State-listed plant species known to occur on the VEGP site. It was recorded on the wooded bluffs above the floodplain in the vicinity of the proposed CWIS during the 2005 threatened and endangered species survey (TRC 2006). Its habitat preferences are such that it could occur in the floodplain forest as well. Southern stated that they would work with the GDNR to ensure that any protected species, including the bay star-vine are protected during construction (Southern 2007c). No other Georgia or South Carolina State-listed plant or animal species are known to occur within 3.2 km (2 mi) of the VEGP site (GDNR 2007). However mounds indicative of the Georgia State-threatened southeastern pocket gopher (*Geomys pinetis*) were recorded on property just north of the VEGP site (Southern 2007a).

Four Georgia State-listed plant species have been recorded in Burke County within 16 km (10 mi) of the VEGP site: Ocmulgee skullcap (*Scutellaria ocmulgee*), Georgia plume (*Elliottia racemosa*), sweet pitcherplant (*Sarracenia rubra*), and Indian olive (*Nestronia umbellula*). All are listed as State threatened except for the Indian olive, which is listed as rare. Because the VEGP site is located along the Savannah River, which forms the boundary between Georgia and South Carolina, State-listed species occurring across the river but within 16 km (10 mi) of the VEGP site (Aiken and Barnwell Counties in South Carolina) also were examined (SCDNR 2007). The smooth coneflower (*Echinacea laevigata*) is listed in both Georgia and South Carolina as State-endangered; rose coreopsis (*Coreopsis rosea*) and bog spicebush (*Lindera subcoriacea*) are of concern regionally; and 29 other plant species are of regional and local concern within 16 km (10 mi) of the site in South Carolina. None of these State-listed species occur on the VEGP site or within the areas affected by construction. No impacts to these species are expected.

Three Georgia State-listed bird species, the bald eagle (*Haliaeetus leucocephalus*), wood stork (*Mycteria americana*), and red-cockaded woodpecker (*Picoides borealis*), have potential to occur in suitable habitats within Burke County (FWS 2004c). The wood stork and red-cockaded woodpecker are also Federally endangered. Impacts on these species are discussed in Section 4.4.3.

Although no herpetofauna species of concern have been recorded in Georgia within 16 km (10 mi) of the VEGP site, seven species have been recorded within this distance of the site in South Carolina (SCDNR 2007). Recorded were the South Carolina endangered and Georgia rare gopher frog (*Rana capito*) and six species of various levels of concern in one or both states: eastern tiger salamander (*Ambystoma tigrinum tigrinum*), southern hognose snake (*Heterodon simus*), bird-voiced treefrog (*Hyla avivoca*), eastern coral snake (*Micrurus fulvius*), pine or gopher snake (*Pituophis melanoleucus*), and black swamp snake (*Seminatrix pygaea*). These species have not been reported on the VEGP site. Impacts to these species are expected to be negligible.

In summary, the impact on State-listed species from construction of Units 3 and 4 at the VEGP site is expected to be negligible.

Proposed 500-kV Transmission Line Right-of-Way

Three State-listed species have been documented by the GDNR to occur within the RDC: the bald eagle, silky camellia (*Stewartia malacodendron*), and sandhill rosemary (*Ceratiola ericoides*). GPC has committed to establishing a 180-m (600 ft) buffer around the active eagle nest to minimize any potential impacts from transmission line construction (GPC 2007).

The impact on common wildlife within the new transmission line right-of-way resulting from land-clearing, noise, and bird collisions is expected to be negligible. The impact on State-listed wildlife species in the transmission line right-of-way is not known at this time. Impacts to State protected species are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction and consultation with GDNR is initiated, as needed. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

4.4.1.4 Terrestrial Ecosystems Impact Summary

The impact of construction on wildlife habitat within the VEGP site (including permanent and temporary losses of upland hardwood forest and bottomland forested wetlands) would be minimal. Southern is required to comply with conditions of the 404 permit from USACE including any wetland mitigation. The onsite impact on wildlife populations, including State-listed species, would be minimal, and Southern stated they would consult with the GDNR to ensure any State-threatened and endangered species would be protected during construction. Southern would implement construction mitigation at the VEGP site and within the transmission line right-of-way including BMP for erosion and dust control, proper equipment maintenance, and adherence to all applicable permit conditions. The staff reviewed the potential impacts of constructing Units 3 and 4 on terrestrial ecological resources on the VEGP site, including the loss of habitat and wetlands, noise, traffic mortality, and avian collisions. Based on NRC's independent review and the BMP identified in the ER and in Southern's responses to NRC's Requests for Additional Information (RAIs), the staff concludes that the overall impact of construction-related activities on terrestrial ecological resources in the vicinity of the VEGP site would be SMALL, and further mitigation beyond the actions stated above is not warranted.

The staff reviewed the potential impacts of constructing the new 500-kV transmission line right-of-way on terrestrial ecological resources, including noise, avian collisions, and the loss of habitat and wetlands. The impact on State-listed wildlife species in the right-of-way is not precisely known. GPC would site the transmission line in accordance with Georgia Code Title 22, Section 22-3-161. GPC's procedures for implementing this code include consultation with GDNR as well as an evaluation of impacts to special habitats (including wetlands) and threatened and endangered species. In addition, the GPC would comply with all applicable laws, regulations, and permit requirements, and would use good engineering and construction practices (Southern 2007a). If the actual transmission line route is similar to the hypothetical route proposed by GPC, and adequate threatened and endangered surveys are conducted prior to commencement of construction, consultation with GDNR is initiated as needed, and appropriate mitigation is implemented, impacts to terrestrial resources along the transmission line are likely to be minimal. Based on this independent review, the potential BMP identified in the ER, and Southern's responses to NRC's RAIs, the staff concludes that the overall impact of construction-related activities on terrestrial ecological resources in the vicinity of the new transmission line would likely be SMALL. However, due to the uncertainty regarding the actual transmission line route, as well as the uncertainty regarding the distribution of state protected species along and within the right-of-way, impacts could be MODERATE. Mitigation actions would be dependent on the exact location and nature of environmental impacts associated with construction within the transmission line right-of-way.

4.4.2 Aquatic Impacts

Impacts on the aquatic ecosystem from construction of VEGP Units 3 and 4 would mainly be associated with impacts to the Savannah River from the construction of a new CWIS, a new cooling water discharge line, and a barge slip. Also, ponds and streams on the site could be impacted by soil-disturbing activities that lead to soil erosion during site preparation and construction of VEGP Units 3 and 4. In addition, there could potentially be impacts to streams or other waterbodies during the construction of the new Thomson-Vogtle 500-kV transmission line.

4.4.2.1 Impacts of Construction on Aquatic Ecosystem in the Savannah River

The construction of the intake and discharge structures and a new barge facility would result in the loss of aquatic habitat, both temporary and permanent, in the Savannah River (Southern 2007a). All work would be conducted in accordance with a Clean Water Act Section 404 permit, a Rivers and Harbors Act Section 10 permit issued by the USACE, and a Section 401 Water Quality Certification issued by the GDNR Environmental Protection Division. This project would also require a Georgia General Stormwater Permit for Construction (Southern 2007c)

Cooling Water Intake Structure

The proposed location of the new CWIS is upstream of the existing intake structure for VEGP Units 1 and 2. The intake structure and canal are sized for three Westinghouse AP1000 reactors at the VEGP site; however, only the mechanical components supporting the proposed VEGP Units 3 and 4 would be installed (Southern 2007c). A schematic of the intake structure and canal are shown in Figures 3-4 and 3-5. The intake canal would be approximately 73 m (240 ft) long by 52 m (170 ft) wide with an earthen bottom at 21 m (70 ft) MSL and vertical sheet pile sides extending to 29.9 m (98 ft) MSL (Southern 2007a). The new intake structure and canal construction would affect approximately 5 ha (12.5 ac) with most of it in the Savannah River floodplain (Southern 2007c). Southern indicated that it is anticipated that the construction on the intake structure would occur in the summer, fall, and early winter to minimize the potential for unwanted flooding of the construction area (Southern 2007c). This timing would also minimize the impact to fish and other aquatic organisms that move into the floodplain with the high-water conditions that typically occur during the months of February, March, and April.

Southern has indicated that to minimize turbidity entering the river, excavation would begin at the west end of the canal cofferdam face and proceed toward the river (Southern 2007c). Permanent sheet piles forming the north and south banks of the intake canal would be driven using a vibratory or diesel hammer to form the north and south walls of a cofferdam. Temporary sheet piling would be driven around the perimeter of the intake structure and across the east and west face of the intake canal to complete the cofferdam. The piling installations would be completed from the land side (Southern 2007c). Material within the intake area cofferdam would be excavated followed by the excavation of material within the intake structure cofferdam. The interior of the cofferdam would be dewatered to 6 m (20 ft) below water level and excavated (Southern 2007c). Southern has indicated that the excavation process would include controls to manage erosion and sediment and, as necessary, controls to ensure that runoff from the excavation process does not create environmental or aesthetic problems (Southern 2007c). The discharge from the dewatering system, and potentially from a hydraulic dredge, would be managed in accordance with the Section 401 Water Quality Certification to be issued by the GDNR Environmental Protection Division in support of the USACE Section 404 permit (Southern 2007c) to control discharge of water from the construction process to the Savannah River. This typically includes controls of turbidity and use of BMP to prevent spills of oils or hazardous materials associated with the excavation equipment operation (Southern 2007c). A tethered and floating silt curtain would also be used during excavation of the canal interior down to an elevation of 21 m (70 ft) above MSL. The installation of the inner serrated weir wall and the outer serrated wall and guide vanes at the mouth of the intake would occur from a barge located in the Savannah River. Southern has also committed to using appropriate environmental controls during this process to prevent spills and minimize environmental impact to the river and adjacent wetlands (Southern 2007c).

Barge Slip

The existing barge slip is located between the existing VEGP Units 1 and 2 intake canal and the ring crane foundation. The barge slip would be enlarged to support the unloading of the Westinghouse AP1000 reactor components and modules at the VEGP site (Southern 2007a). The downstream sheet pile wall would be removed and the slope excavated to extend the barge slip 27 m (90 ft) along the shoreline (Southern 2007a). The downstream sheet pile wall would be reconstructed and the shoreline stabilized (Southern 2007a). The barge slip is currently on fill that was put into place during the initial construction of VEGP Units 1 and 2 (Southern 2007c). A tethered, floating silt curtain would be at the entrance to the barge slip prior to excavating below 27 m (90 ft) MSL (Southern 2007b). Excavation would begin at the west end of the barge slip and move toward the river, thus minimizing turbidity entering the river (Southern 2007c).

Southern estimated that approximately 230 m^3 (300 yd^3) of sediment would be dredged or excavated from the Savannah River at the east end of the barge slip where the barge slip enters the river. The depth of dredging is approximately 20.4 m (67 ft) MSL (normal water elevation is 24 m [80 ft] MSL) (Southern 2007c). In addition, construction of the barge slip would require approximately 1988 m^3 (2600 yd^3) of stone fill within the barge slip basin (most of which is not in the Savannah River) to provide a stable foundation for grounding the loaded barges (Southern 2007a). Some of this fill would be placed in the area that is currently a part of the river.

A bathymetry study documented in the ER indicates that there is currently no need to dredge from the end of the barge slip to the navigation channel (Southern 2007c). However, river bathymetry may change and dredging could be performed in the future (NRC 2007). In-river dredging requires authorization from USACE, which may result in time-of-year restrictions to protect aquatic resources.

Discharge Structure

The proposed discharge structure would be placed near the southwest bank of the Savannah River, extending about 15 m (50 ft) into the river (Southern 2007a). The discharge pipe would be approximately 1.07 m (3.5 ft) in diameter, narrowing to 0.6 m (2 ft) in diameter before the discharge point (Southern 2007a). The anticipated centerline elevation of the discharge pipe is 0.9 m (3 ft) above the river bottom elevation (Southern 2007a). Construction would involve the installation of a temporary sheet pile cofferdam (installed using a vibratory or diesel hammer) (Southern 2007a) and a dewatering system. The interior of the cofferdam would be excavated so that the pipe can be installed approximately 0.9 m (3 ft) below the invert elevation of the discharge piping and contoured up the river bank. H-piles that would be used for piping supports would be driven to 15 m (50 ft) MSL. After the pipe is laid, the dewatering system would be removed, and the pipe trench would be backfilled and graded to the required river bank slope contours. The cofferdam would be removed and rip-rap material would be installed to stabilize the river bank and the river bottom in the vicinity of the discharge point.

Summary of Impacts

The construction activities previously described are expected to have minimal impacts on the aquatic ecology of the Savannah River. The amount of benthic habitat altered during the construction of the intake canal would be small because most of the activity would occur in the floodplain during the dry season when the floodplain is not flooded. There would be approximately 82 m (270 feet) of shoreline disturbance (55 m [180 ft] at the intake structure and 27 m [90 ft] at the barge facility) (Southern 2007a). Likewise, there would be very little disturbance of the benthic habitat during construction of the discharge structure. A greater amount of river habitat would be disturbed during the barge slip construction activities; however, the amount of benthic habitat, open water, shoreline, and benthic fauna that would be lost is a small fraction of the total present in this area of the Savannah River. During the construction process, fish inhabiting the river in the vicinity of the construction activities may leave temporarily as a result of noise from pile driving or other construction activities. However, after construction is completed, fish would be expected to return to the area. Most of the habitat loss would be temporary and is a minor percentage of the total fish habitat in this area of the Savannah River. In addition, none of the species specifically mentioned as species of interest, concern, or listed are known to spawn specifically in the areas where construction would occur; thus, the activities would not disturb major spawning areas. Disruption of silt and debris during construction is expected to be minor based on the use of siltation curtains and other BMP. Based on this review, the staff concludes that the overall impact of construction-related activities on aquatic ecological resources of the Savannah River would be minor, and further mitigation beyond the actions identified above is not warranted.

4.4.2.2 Impacts to Ponds and Streams Onsite from Site-Preparation and Construction Activities

Construction activities could also result in indirect impacts to wetlands on the VEGP site (see Figure 2-1) (Southern 2007a). Although the construction activities for the powerblock and the cooling towers are in areas of the site where no wetlands are present, the stormwater drainage from these areas is routed to Debris Basin #2 (Southern 2007c). No runoff from areas disturbed by construction is expected to be received by Debris Basin #1. If Debris Basin #2 is determined to be a jurisdictional wetlands area, the basin would be left as it currently exists. If additional stormwater retention volume is required, Southern has committed to construct additional storage in an upland area in accordance with applicable regulatory requirements (Southern 2007a). It is not anticipated that there would be any significant construction-related impacts to Telfair Pond and Beaverdam Creek or the aquatic biota in these waterbodies.

Mallard Pond and its feeder stream would potentially be affected during construction activities (Southern 2007a). Construction of the new switchyard and a proposed heavy-haul road could convey stormwater into the head of Mallard Pond (Southern 2007a). However, Southern has committed to plan and conduct these construction activities in accordance with applicable regulations and BMP to prevent erosion that could impact the aquatic biota in Mallard Pond (Southern 2007a). Based on this review, the staff concludes that the overall impact of construction-related activities on the aquatic ecological resources of the onsite ponds and streams would be minor, and further mitigation beyond the actions identified above is not warranted.

4.4.2.3 Impacts to the Aquatic Ecosystem from Construction of the Thomson-Vogtle 500-kV Transmission Line

Currently, Southern and the GPC are evaluating the actual right-of-way alternatives for the Thomson-Vogtle transmission line within a larger RDC. It is anticipated that the transmission line would cross Burke, Jefferson, McDuffie, and Warren Counties (Southern 2007a). The GPC performed a routing study to identify potential rights-of-way for the proposed transmission line in relation to existing land uses, including wetlands (GPC 2007). The field-verified right-of-way for the Thomson-Vogtle 500-kV transmission line would potentially cross several waterbodies. The right-of-way study proposed a feasible route within a field-verified right-of-way that was hypothetically produced to represent potential impacts to land use. The feasible route contained slightly more than 2.6 ha (6.4 ac) of open water, including various streams (GPC 2007). This is not the actual transmission line routing, but provides an estimate of the likelihood of stream and water-body crossings. Southern has stated that wetlands would be avoided in the routing if at all possible (Southern 2007b). In the event that wetlands are encountered, construction would be conducted in accordance with the necessary permits to protect wetland areas (GPC 2007). The GPC sites new transmission lines in accordance with Georgia Code Title 12, Section 12-2-8, and complies with all applicable laws, regulations, permit requirements, good engineering, and construction practices (GPC 2007). In accordance with Georgia Sediment and Erosion Control Act BMP, a 7.6-m (25-ft) buffer would be maintained along all waters of the state that need to be cleared for new transmission line corridor rights-of-way. Southern has committed that no structures would be placed in the buffer (Southern 2007a). In addition, no State or Federally threatened and endangered aquatic species occur in the field-verified RDC as indicated in the corridor study dated January 2007 and the State of Georgia's Natural Heritage database. As a result, the staff concludes that the overall impact of construction-related activities from the Thomson-Vogtle 500-kV transmission lines on aquatic biota are minor, and further mitigation beyond the actions identified above is not warranted.

4.4.2.4 Impacts to State-Listed Species

Three State-listed species occur in the vicinity of the VEGP site. The robust redhorse (*Moxostoma robustum)* is found in the Savannah River; however, the only known spawning area is 40 river kilometers (rkm) (60 river miles [RM]) upstream from the site (Grabowski and Isley 2006). In addition, during their migrations, the robust redhorse appears to stay within the channel, entering the floodplains only during high-water events. Thus, it is anticipated that they would not be adversely affected by construction activities.

The Georgia State-endangered Atlantic pigtoe mussel (*Fusconaia masoni*), although reported in Burke County, is not known to occur in the Savannah River or on the VEGP site and, thus, would not be adversely affected by construction activities. The Savannah darter (*Etheostoma fricksium*) has been observed in Beaverdam Creek but not in the Savannah River in the vicinity of the VEGP site. It is unlikely that Beaverdam Creek would be adversely affected by construction of VEGP Units 3 and 4.

Seven South Carolina mussel species of concern (Table 2-9) are known to occur in the Savannah River near the VEGP site. Because these species have been found in multiple locations, as documented in recent surveys, there is a potential for impact during construction activities. The State of South Carolina (Price 2007) has expressed concern over the potential for impacts to freshwater mussels from dredging activities (specifically from removal and disposal of sediment containing mussels and the use of heavy equipment or other construction practices that could crush mussels), and has recommended that sampling for freshwater mussels be conducted in areas where dredging would occur to determine the impact on the population. Although the area of disruption for mussels during construction of the intake, discharge, and barge slip is small relative to the extent of the Savannah River benthic habitat at this location, further discussions with the State of South Carolina related to mitigative actions, such as sampling for and moving mussels, would be appropriate prior to dredging and construction activities, especially if dredging to the navigation channel is required in the future.

Because the area of disruption for mussels is small relative to the extent of the Savannah River benthic habitat at this location, and the impacts would be temporary and largely mitigable, the impacts to these mussel species are likely to be minor.

4.4.2.5 Summary of Impacts to Aquatic Ecosystems

The staff has reviewed the proposed construction activities for VEGP Units 3 and 4 and the potential impacts to aquatic biota in the onsite waterbodies and the Savannah River. Based on this review, the staff has determined that the impacts resulting from the proposed construction activities would be SMALL. Any impacts that would occur would be temporary and largely mitigable.

4.4.2.6 Aquatic Monitoring During Construction

Southern does not plan to perform any formal construction-related monitoring. Southern bases this decision on "...the fact that any ground- or river-disturbing activities would be of relatively short duration, permitted and overseen by State and Federal regulators, guided by an approved Stormwater Pollution Prevention Plan, and that any small spills would be mitigated according to the existing VEGP Spill Prevention Control and Countermeasures Plan, and that there are no sensitive habitats or species of interest at the proposed location...." (Southern 2007a). Although the shortnose sturgeon (*Acipenser brevirostrum*), a Federally listed endangered species, is located in the Savannah River, the known spawning areas are not near the VEGP site, and the timing of spawning coincides with high water levels, during which time construction activities would likely not occur. Other fish species also would avoid construction activities.

Southern also does not plan any formal construction-related monitoring of aquatic ecosystems during construction of the transmission line. If construction of the new transmission line would result in crossings of intermittent and perennial streams, the construction would be conducted in accordance with the necessary permits to protect wetland areas (GPC 2007). The GPC has stated that it sites new transmission lines in accordance with Georgia Code Title 12, Section 12-2-8, and it complies with all applicable laws, regulations, permit requirements, good engineering, and construction practices (GPC 2007). In addition, the proposed right-of-way for the new transmission line does not cross areas with known populations of Federally listed or State-listed aquatic species (Southern 2007a).

4.4.3 Federally Listed Species

This section describes the potential impacts to Federally listed or proposed threatened and endangered aquatic and terrestrial species and associated designated and proposed critical habitat resulting from construction of new units on the VEGP site, and the Thomson-Vogtle transmission lines. The biology of these species is presented in Sections 2.7.1 and 2.7.2.

The staff is preparing biological assessments documenting potential impacts to the Federally listed threatened and endangered aquatic and terrestrial species as a result of the site preparation and preliminary construction of the nonsafety-related structures, systems, or components in advance of issuance of a combined operating license. The staff's impact determinations are reiterated in this section.

4.4.3.1 Terrestrial Species

The potential impacts of construction activities on Federally listed terrestrial species are described below.

Red-Cockaded Woodpecker – Endangered

<u>The VEGP Site</u>

The endangered red-cockaded woodpecker (*Picoides borealis*) is listed as having the potential to occur in the vicinity of the VEGP site in Burke County, Georgia; and Aiken and Barnwell

Counties, South Carolina (FWS 1999, 2004c). However, there are no known occurrences within 16 km (10 mi) of the VEGP site (GDNR 2007; SCDNR 2007). Surveys were conducted for red-cockaded woodpeckers in February 2006 in support of a safe harbor agreement, from 2002 to 2005 in areas harvested for timber, and on 675.4 ha (1669 ac) of the site in support of this ESP application. However, the red-cockaded woodpecker has never been documented onsite (TRC 2006; Southern 2006b, c; 2007c). The closest active red-cockaded woodpecker group is located on the DOE Savannah River Site approximately 16 km (10 mi) from the VEGP site (Wike et al. 2006).

Suitable habitat for foraging and nesting occurs within the VEGP site, but does not occur in the proposed construction footprint. The types of habitat that would be disturbed during construction mainly consist of previously disturbed areas, planted pines, hardwoods, wetlands along the Savannah River, and open fields. Red-cockaded woodpeckers are found mainly in large stands of old longleaf pine and this type of habitat will not be disturbed. Based on the distance to the closest known active colony, and the fact that red-cockaded woodpeckers have not been recorded on the VEGP site or in the general vicinity of the site, it is unlikely red-cockaded woodpeckers would be affected during construction activities.

Proposed 500-kV Transmission Line Right-of-Way

The red-cockaded woodpecker is listed on the FWS website as potentially occurring in Burke and Jefferson Counties, Georgia (FWS 2004c). The red-cockaded woodpecker has been recorded on Fort Gordon in Richmond County, which is adjacent to the RDC (GDNR 1999), but there are no known occurrences of red-cockaded woodpeckers in the vicinity of the RDC. Impacts to red-cockaded woodpeckers are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Wood Stork – Endangered

The VEGP Site

The endangered wood stork (*Mycteria americana*) is listed as having the potential to occur in the vicinity of the VEGP site, Burke County, Georgia, as well as in Aiken and Barnwell Counties, South Carolina (FWS 1999; 2004c). Wood storks were not identified in threatened and endangered species surveys in 2005, and have not been documented onsite (TRC 2006; Southern 2006a). The closest known colony of wood storks is more than 40 km (25 mi) away. Foraging on the VEGP site may occur from June through September in suitable habitat. During construction of the CWIS, discharge structure and the barge facility, suitable foraging habitat may be affected. However, this species is highly mobile and any onsite impacts associated with construction on the VEGP site would be minimal.

Proposed 500-kV Transmission Line Right-of-Way

Wood storks have the potential to occur in Burke and Jefferson Counties (FWS 2004c). There are no known nesting colonies in these counties, with the nearest being 43 km (27 mi) away in Screven County. Wood storks have also been seen foraging on the U.S. Army's Fort Gordon installation in Richmond County adjacent to the RDC (Mitchell 1999). At this time, it is not known if these individuals use habitat along or in the RDC. Impacts to wood storks are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Flatwoods Salamander – Threatened

The VEGP Site

The Federally threatened flatwoods salamander (*Ambystoma cingulatum*) has the potential to occur in Burke County, Georgia. The last record for breeding flatwoods salamanders in Burke County was in the 1940s (FWS 2004c). There are no known historical occurrences of flatwoods salamanders on the VEGP site, and flatwoods salamanders were not identified in the 2005 threatened and endangered species survey (Southern 2006a; TRC 2006). There are no recorded occurrences within 16 km (10 mi) of the site (GDNR 2007). Suitable habitat for the flatwoods salamander may occur onsite, but suitable habitat is not found within the construction area footprint. The types of habitat that would be disturbed during construction mainly consist of previously disturbed areas, planted pine, hardwoods, wetlands along the Savannah River, and open fields. Flatwoods salamanders are not likely to be encountered during construction at the VEGP site, and adverse impacts are unlikely.

Proposed 500-kV Transmission Line Right-of-Way

Flatwoods salamanders have the potential to occur only in Burke County portion of the RDC (FWS 2004c). There are no known populations of flatwoods salamanders in the vicinity of the RDC, with the nearest occurrence 35 km (22 mi) away in Screven County, Georgia (GDNR 2007). Impacts to flatwood salamanders are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

American Alligator – Threatened Based on Similarity of Appearance

In 1967, the American alligator (*Alligator mississippiensis*) was classified by FWS as Federally endangered throughout its range, including Georgia. By 1987, following several reclassification actions in other states, it was reclassified to "threatened based on similarity of appearance" to the American crocodile (*Crocodylus acutus*) in the remainder of its range, including Georgia (52 FR 21059). The alligator is no longer biologically imperiled in Georgia. Its populations are considered disjunct (i.e., limited to suitable habitat) and stable. The reclassification helps prevent excessive take of the alligator and protects the American crocodile (52 FR 21059).

During surveys of the VEGP site made by Third Rock Consultants, LLC, in the summer of 2005, an alligator was observed in Mallard Pond (TRC 2006). Alligators appear to be relatively common in the Savannah River near and on the VEGP site (Wike et al. 2006). Alligators in the Savannah River floodplain may be displaced, but there is ample wetlands habitat in the region. The alligators may be minimally affected by construction at the VEGP site; impacts on alligators would be considered negligible. Potentially, alligators could be encountered during construction of the new transmission line, but it is likely that GPC would avoid alligators or alligator nests for safety reasons.

Canby's Dropwort – Endangered

The VEGP Site

The Federally endangered Canby's dropwort (*Oxypolis canbyi*) has the potential to occur in Burke County, Georgia (FWS 2004c). Canby's dropwort was not found on the VEGP site during the 2005 threatened and endangered species surveys, and there are no historical records of it occurring onsite (Southern 2006c; TRC 2006). There are two historical records in Burke County around Waynesboro, Georgia (51 FR 6690), and these populations are currently thought to be extirpated (FWS 1990). There are no recorded occurrences within 16 km (10 mi) of the VEGP site (GDNR 2007).

It is unlikely that the VEGP site contains suitable habitat for Canby's dropwort. Because of the lack of suitable habitat, it is unlikely there would be construction-associated impacts to this species at the VEGP site.

Proposed 500-kV Transmission Line Right-of-Way

Canby's dropwort occurs in Burke County (GDNR 2007). However, there are no known populations within the RDC. The nearest known occurrence is about 5.6 km (3.5 mi) from the RDC. Impacts to Canby's dropwort are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Smooth Coneflower - Endangered

The VEGP Site

The smooth coneflower (*Echinacea laevigata*) is listed as Federally endangered and is known to occur in Stephens County, Georgia (Patrick et al. 1995). The smooth coneflower is found in Aiken and Barnwell Counties, South Carolina, more than 8 km (5 mi) from the VEGP site (SCDNR 2007). There are no known occurrences of smooth coneflower in Burke County, no historical occurrences on the VEGP site, and it was not recorded in the 2005 threatened and endangered species survey (TRC 2006; FWS 2004c; Southern 2006a). It appears unlikely that there is suitable onsite habitat. Therefore, there would be no impacts to this species associated with construction at the VEGP site.

Proposed 500-kV Transmission Line Right-of-Way

The smooth coneflower has not been recorded within any of the counties that may be crossed by the new transmission line. No impact to this species is expected from transmission line construction activities.

Relict Trillium – Endangered

The VEGP Site

The relict trillium (*Trillium reliquum*) was listed as Federally endangered in 1988. Relict trillium is known to occur in Aiken County, South Carolina. Known populations in Aiken County are more than 16 km (10 mi) from the VEGP site (SCDNR 2007).

The relict trillium was not observed during the 2005 or 2007 threatened and endangered species onsite surveys, and it has not been recorded by either the FWS or the GDNR in Burke County, Georgia (TRC 2006; FWS 2004c; GDNR 2007; Patrick 2007). Therefore, there would be no impacts to this species associated with construction at the VEGP site.

Proposed 500-kV Transmission Line Right-of-Way

The relict trillium has not been recorded within any of the counties that may be crossed by the transmission line, and the nearest known location is more than 122 km (76 mi) away in Jones County, Georgia. No impact to this species is expected from transmission line construction activities.

Georgia Aster – Candidate

<u>The VEGP Site</u>

The Georgia aster (*Symphyotrichum georgianum)* is a candidate for Federal listing. However, it has not been recorded within Burke County, Georgia, and was not observed during the 2005 threatened and endangered on-site species survey (TRC 2006). Therefore, no impact to this species is expected from VEGP Units 3 and 4 construction activities.

<u>Proposed 500-kV Transmission Line Right-of-Way</u>

Georgia aster is known to occur in McDuffie County, Georgia about 9 km (5.5 mi) from the RDC (FWS 2004c; GDNR 2007). Impacts to Georgia aster are likely to be negligible provided that adequate surveys are conducted prior to commencement of transmission line construction, consultation with FWS is initiated as needed, and appropriate mitigation is implemented. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater than negligible.

Terrestrial Threatened and Endangered Species Summary

Based on the threatened and endangered species surveys, historical records, life history information, known threatened and endangered species locations, and information provided by Southern in its ER and Request for Additional Information (RAI) responses, the staff concludes the impacts on terrestrial Federally listed threatened and endangered species from construction activities on the VEGP site would be SMALL.

The GPC would site the new 500-kV transmission line in accordance with Georgia Code Title 22, Section 22-3-161. GPC procedures for implementing this code include consultation with FWS and an evaluation of impacts to special habitats and threatened and endangered species. In addition, the GPC would comply with all applicable laws, regulations, and permit requirements, and would use good engineering and construction practices (Southern 2007a). Surveys for threatened and endangered species have not been conducted in the RDC. The staff has determined that impacts to Federally-protected species within the proposed 500kV transmission line right-of-way would likely be SMALL. However, without adequate surveys, consultation, and appropriate mitigation, the impact to Federally-protected species could be MODERATE.

4.4.3.2 Aquatic Species

As described in Section 2.7.2.2 the only Federally listed aquatic species is the shortnose sturgeon. The species was identified through correspondence with NMFS (NMFS 2006). Construction of the proposed CWIS, discharge structure, and the barge slip would temporarily disturb the river bank environment. This disturbance would include the potential for turbidity and noise from pile-driving activities. However, Southern has committed to using BMP to avoid turbidity (Southern 2007a), and noise impacts would be transient.

As discussed in Section 2.7.2.2, the suspected spawning sites for shortnose sturgeon that have been reported are at rkm 179 to 190 and rkm 275 to 278 (Hall et al. 1991) and rkm 179 to 228 (Collins and Smith 1993) (Figure 2-23). The VEGP site is located at rkm 241 to 244 (RM 150 to 152). The spawning areas are characterized by fast-flowing river bends that provide substrate suitable for attachment for the highly adhesive sturgeon eggs. These areas include submerged timber, scoured sand, clay, and gravel as a substrate. Hall et al. (1991) also reports that the spawning depth is considered to be 6 to 9 m (20 to 28 ft). In contrast, the Savannah River adjacent to the VEGP site is relatively straight with very few bends. The maximum depth of the water in the vicinity of the proposed intake structure is approximately 3.7 to 4.0 m (12 to 13 ft) (Southern 2007a). The substrate in the deep sections of the Savannah River ranged from ...brown poorly graded gravel with sand..." to "...poorly graded gravel...." (Southern 2006a).

Based on the staff's review, it appears highly unlikely that shortnose sturgeon would spawn in the vicinity of the VEGP site. It is most probable that sturgeon moving through the area would avoid the construction on their way upstream as spawning adults or downstream as larvae, and would not be impacted by construction activities. As a result, the staff concludes that the overall impact of construction-related activities on the shortnose sturgeon would be SMALL, and further mitigation beyond the actions stated above is not warranted.

4.5 Socioeconomic Impacts

Construction activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of construction-related activities and of the construction workforce on the region. Unless otherwise specified, the primary source of information for this section is the ER (Southern 2007a).

The planned onsite construction-related activities would differ significantly from those activities required to construct VEGP Units 1 and 2.[a] Although many activities would be similar, VEGP Units 1 and 2 were constructed almost entirely onsite. For VEGP Units 3 and 4, many of the components of the Westinghouse AP 1000 nuclear units would be made at dedicated fabrication facilities outside the VEGP site region and would be delivered to the ESP site ready to assemble, thus reducing onsite construction labor requirements. The peak workforce for VEGP Units 1 and 2 was around 14,000 construction workers.[b] Southern estimates the peak onsite construction requirements for VEGP Units 3 and 4 to be 4400 workers (specific

(a) The construction on VEGP Unit 1 was completed in 1987, and Unit 2 was completed in 1989 (Southern Website at http://www.southerncompany.com/Southernnuclear/Vogtle.asp).

(b) Taken from *The Blazer*, which is a weekly newsletter serving the "Plant Vogtle Community." The specific article is entitled "The Vogtle Report," June 7, 1986. Volume 5, Number 12.

assumptions discussed in following sections). Because approximately 70 percent fewer onsite workers would be needed to construct VEGP Units 3 and 4 than were needed for VEGP Units 1 and 2, the staff expects the construction-related physical, social, and economic impacts on the region, both beneficial and adverse, would be smaller than the impacts associated with the construction of VEGP Units 1 and 2.

Although the staff considered the entire region within an 80-km (50-mi) radius of the VEGP site when assessing socioeconomic impacts, the primary region of interest for physical impacts is the area within a 16-km (10-mi) radius. The region of interest with regard to social and economic impacts encompasses the entire 80-km (50-mi) radius, but primarily includes Burke, Columbia, and Richmond Counties in Georgia. Based on commuter patterns and the distribution of residential communities in the area, the NRC staff found *de minimis* impacts on other counties within the 80-km (50-mi) radius in Georgia and South Carolina. While Barnwell County borders the VEGP site on the South Carolina side of the Savannah River, this county is primarily occupied by the Savannah River Site, which has no permanent residents. Furthermore, there are no bridges near the VEGP site for commuters to cross into South Carolina. Consequently, South Carolina is more isolated from the proposed site than it appears and has been excluded from much of the socioeconomic analysis pertaining to construction and operation at the VEGP site.

4.5.1 Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odors, vehicle exhaust, and dust. Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section addresses potential construction impacts that may affect people, buildings, and roads.

4.5.1.1 Workers and the Local Public

The VEGP site is located in an area used for industrial purposes and is bounded by agricultural and forested land. No significant industrial or commercial facilities other than the VEGP site exist or are planned in the vicinity. The recreational areas closest to the plant include the Yuchi Wildlife Management Area (WMA) and the Crackerneck WMA, which are both adjacent to the plant site (Figure 2-21). These recreational areas could be affected by construction on the VEGP site because of an increase in traffic, noise, and dust from construction activities (Southern 2007a). However, Crackerneck WMA is on the South Carolina side of the Savannah River approximately 80 km (50 mi) from the VEGP site by road and would probably experience little or no traffic-related effects.

All construction activities would occur within the VEGP site boundary and would be performed in compliance with all Occupational Safety and Health Administration (OSHA) standards, BMP, and other applicable regulatory and permit requirements. Offsite areas supporting construction activities (e.g., borrow pits, quarries, and disposal sites) are already permitted and operational.

Therefore, the staff expects the incremental construction-related impacts on those facilities to be small. While approximately 3500 people live within 16 km (10 mi) of the VEGP site (see Section 2.8.1), the people most vulnerable to noise, fugitive dust, and gaseous emissions resulting from construction activities include construction workers and personnel working onsite, people working or living immediately adjacent to the site, and transient populations such as recreational visitors, tourists, or temporary employees (Southern 2007a).

Construction workers would have adequate training and personal protective equipment to minimize the risk of potentially harmful exposures. Emergency first-aid care would be available at the construction site, and regular health and safety monitoring would be conducted during construction. People working onsite or living near the VEGP site would not experience any construction-related physical impacts greater than those that would be considered an annoyance or nuisance. Construction activities would be performed in compliance with Federal, State, and local regulations, and site-specific permit conditions (Southern 2007a).

Burke County is part of the Augusta-Aiken Interstate Air Quality Control Region, which is classified as in attainment of the National Ambient Air Quality Standards[(a)] (40 CFR 81.114) for all criteria pollutants. The nearest non-attainment area to the proposed site is in Columbia, South Carolina, which is a non-attainment area under the 8-hour ozone standard. Columbia is approximately 130 km (80 mi) northeast of the proposed VEGP site. Temporary and minor effects on local ambient air quality may occur as a result of normal construction activities. Emissions of fugitive dust and particulate matter smaller than 10 micrometers (PM_{10}) in size are generated during earth-moving and material-handling activities. Construction equipment and offsite vehicles also produce emissions during construction. The pollutants of primary concern include PM_{10} fugitive dust, reactive organic gases, oxides of nitrogen, carbon monoxide, and, to a lesser extent, sulfur dioxides. Mitigation measures (e.g., paving or stabilizing disturbed areas, water suppression, reduced material handling) would minimize such emissions. Odors could result from exhaust emissions, but odors dissipate onsite and would have no discernible impact on the local air quality. All equipment would be serviced regularly and all construction activities would be conducted in accordance with Federal, State, and local emission requirements.

Construction activities are inherently noisy, but the VEGP site's relative isolation from populated areas and the wooded areas surrounding the site would provide natural noise abatement. If exceptionally noisy construction activities would be necessary, Southern would provide public announcements or notifications. All construction activities would be subject to regulations stemming from the Noise Control Act of 1972, Federal regulations for noise from construction equipment (40 CFR Part 204), and OSHA regulations (29 CFR 1910.95).

(a) Areas of the United States having air quality as good as or better than the National Ambient Air Quality Standards are designated by the EPA as "in attainment areas."

Sportsmen using the Yuchi WMA and the GPC boat landing on the Savannah River would be the transient population most affected by construction-related activities. Southern would inform transient populations of such activities and potential impacts to recreational activities by posting signs in the area.

Specific mitigation measures to control fugitive dust would be identified in a dust-control plan, or a similar document, prepared prior to project construction in accordance with all applicable State and Federal permits and regulations. These mitigation measures could include but are not limited to the following:

- stabilizing construction roads and spoils piles
- limiting speeds on unpaved construction roads
- periodically watering unpaved construction roads to control dust
- performing housekeeping (e.g., remove dirt spilled onto paved roads)
- covering haul trucks when loaded or unloaded
- minimizing material handling (e.g., drop heights, double-handling)
- ceasing grading and excavation activities during high winds and during periods of extreme air pollution
- phasing grading to minimize the area of disturbed soils
- re-vegetating road medians and slopes.

4.5.1.2 Buildings

Construction activities would not affect any offsite buildings. Onsite buildings have been constructed to safely withstand any possible impact, including shock and vibration, from activities associated with construction at the VEGP site (10 CFR Part 50, Appendix A). Except for the existing structures on the VEGP site, no other industrial, commercial, or recreational structures would be directly affected by the construction of the new facility.

4.5.1.3 Roads

Public roads and railways would transport construction materials and equipment. Burke County has a well-developed transportation system and would not be significantly impacted as a result of Southern's proposed construction activities. No significant alterations or construction of roads would be needed, but some roads may need minor repairs or upgrades to allow safe access to the plant site. Southern would repair any damage to public roads, markings, or signs caused by construction activities to pre-existing conditions or better. Southern plans to build a new private access road to the construction site, a heavy-haul route from the VEGP site barge facility on the Savannah River, and a new road from the new intake structure to the construction site. These roads would be fully contained within the existing site boundary. The railway spur that connects the VEGP site to the main spur north of Waynesboro has recently been upgraded and would be used to transfer heavy equipment to the site.

Construction workers would use a dedicated construction access road rather than the primary VEGP site access road. This road would be marked clearly with signs and maintained clear of debris. Southern would select hauling routes based on equipment accessibility, existing traffic patterns, and noise restrictions, logistics, distance, costs, and safety. Impacts to the surrounding region would be minimized by avoiding routes that could adversely affect sensitive areas, such as residential neighborhoods, hospitals, schools, and retirement communities. They also would restrict activities and delivery times as much as possible to daylight hours.

4.5.1.4 Aesthetics

Approximately 200 ha (500-ac) on the VEGP site would need to be cleared and excavated to construct VEGP Units 3 and 4. Most of the clearing would be at the VEGP site; however, approximately 5.06 ha (12.5 ac) of river shoreline would be cleared, excavated, and graded for the CWIS, and approximately 4 ha (10 ac) would be cleared and graded for the barge facility and discharge pipe. In addition, temporary roads and a barge facility would need be constructed, and heavy equipment would have to be brought to the site. The two construction sites would be approximately 460 m (1500 ft) apart. The clearing and excavation for the new units and adjacent support facilities would not be visible from offsite roads. However, clearing and construction activities for the river-front facilities would be visible from the river. Southern would use BMP to prevent erosion and sedimentation, including seeding bare earth, but the affected river front would be exposed during construction of the barge dock and CWIS and discharge structures.

The proposed site is bounded by agricultural and forested land. Some construction activities may be visible from the Savannah River and parts of River Road, but most of the construction activity would be masked by woods and the bluff along the river. The VEGP site is already aesthetically altered by its existing nuclear power plant and 180 m (600 ft) high cooling towers. Because construction-related impacts would be temporary, the staff expects any construction-related adverse aesthetic impacts to the site and vicinity would also be temporary. The new transmission lines, however, would be constructed offsite and aesthetic impacts are likely to be MODERATE.

4.5.1.5 Summary of Physical Impacts

The proposed footprint for VEGP Units 3 and 4 is in an industrial area, surrounded by forested land. All construction activities would occur within the construction site boundary. Based on the information provided by Southern in its ER (Southern 2007a) and the NRC's own independent review, the staff concludes that the overall physical impacts of construction on workers and the local public, buildings, roads, and aesthetics near the VEGP site would be SMALL as long as the mitigative actions identified above are undertaken. Aesthetic impacts along the new transmission line are likely to be MODERATE.

4.5.2 Demography

The following assessment of population impacts is based on Southern's estimated peak construction workforce of 4400 workers.[a] The proposed construction schedule assumes 18 months for site preparation and 66 months of construction, for a total construction duration of 84 months (Figure 4-2). Southern estimates approximately 1000 workers already live within commuting distance of the plant (Southern 2007a). From NRC's own interviews of local building trade leaders, the staff believes it may be possible that the number of locally available skilled crafts workers might be considerably greater. However, given an assessment of negative impacts from in-migrating skilled crafts workers provides a more conservative (worst-case) scenario. The staff assumes 3400 workers would likely in-migrate to the region (PNNL 2006). Of these, 2700 jobs would last two or more years and the remainder would be for less than two years (Southern 2006a).

Based on information collected by the Tennessee Valley Authority (TVA) in 2003 related to the construction workforce in-migrant patterns at the Brown's Ferry Nuclear Plant, the staff estimated the in-migrating workers who stay for more than two years would bring families, increasing the number of in-migrants by approximately 4000, for a total increase of the population of approximately 6700. Of the additional 4000 in-migrants, approximately 1500 would be school-age children (Southern 2006a).[b]

To approximate the commuting patterns of the in-migrating workers, Southern assumed all workers would find housing in the same proportions as the current operations and maintenance workforce at the VEGP site. Therefore, the staff likewise assumes a residential distribution for the long-term construction workers that resembles the residential distribution of the current VEGP site workforce (see Table 2-15), and that over 90 percent of the in-migrating workers would live in Columbia, Richmond, Burke, Screven, or Aiken County. Consequently, there would be net population increases of approximately 1340 in Burke County, 1740 in Richmond County, 2280 in Columbia County, 470 in Screven County, and 270 in Aiken County, and 600 in all other counties in the 80-km (50-mi) radius. These numbers represent a 6 percent increase in the year 2000 Census population of Burke County, a 3 percent increase in Screven County, a 2 percent increase in Columbia County, a 1 percent increase in Richmond County, and less than 1 percent in Aiken County. Given the magnitude of the estimated population increases, the staff determined the influx of workers because of VEGP construction activities would only impose SMALL and temporary, unnoticeable demographic impacts to the more populous

(a) This estimate was based on Bechtel historical construction data for a proposed construction schedule for two Westinghouse AP1000 reactors, considering total estimated net generation output and total number of job hours necessary to install and start up the two units (Southern 2006c).

(b) TVA assumes 65 to 85 percent of the long-term, in-migrating construction workers bring families, with an average of 1.762 dependents per worker. Approximately half of the dependents are assumed to be children, and 74 percent of the children are school age. Thus, 2700 x 0.85 x 1.762 = 4044 total additional in-migrants and 4044 x 0.5 x 0.74 = 1496 school-age children.

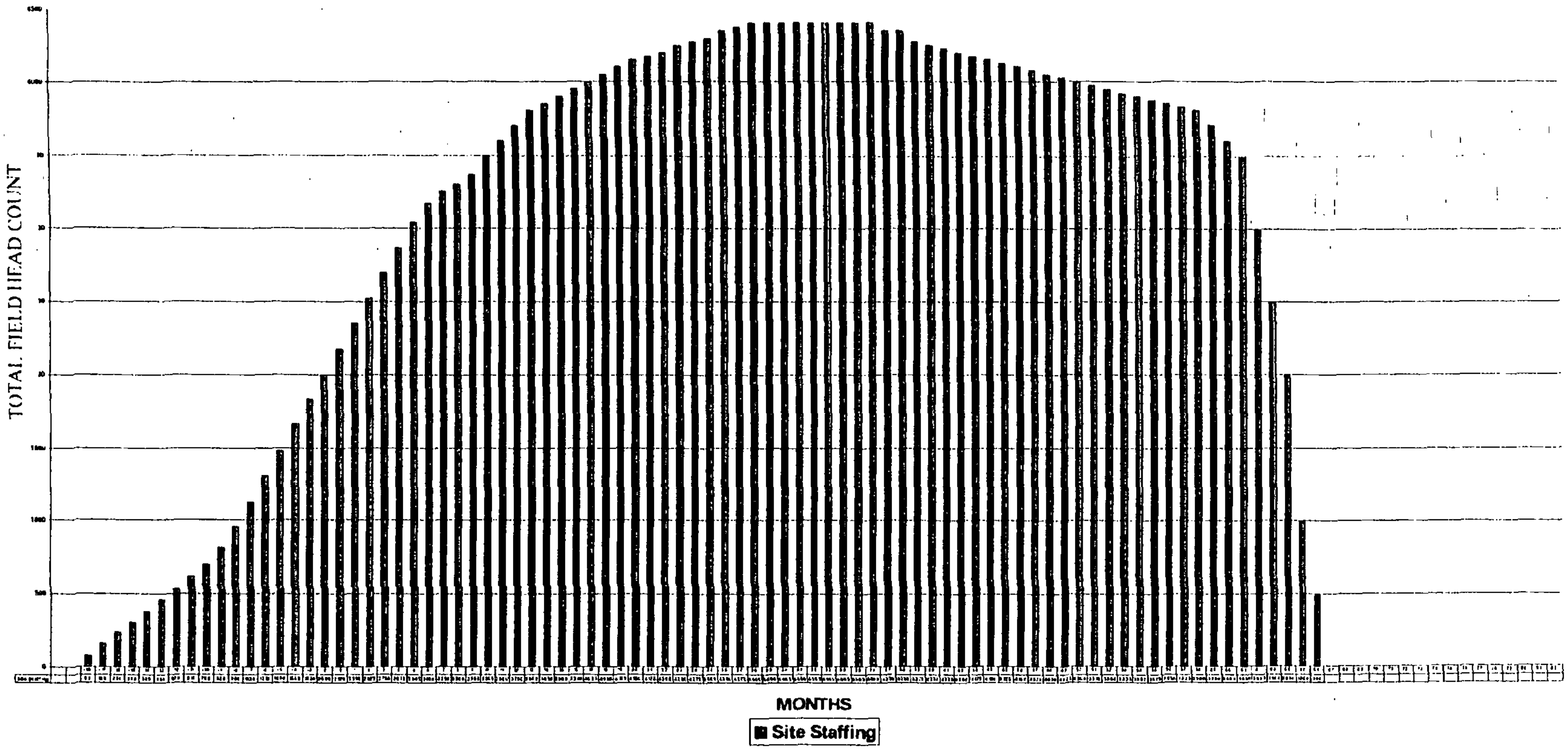

Figure 4-2. Projected Construction Workforce by Month, Including Limited Work Authorization Activities for VEGP Units 3 and 4 (Southern 2007a)

counties. However, depending on where these workers choose to reside, Burke County would likely experience MODERATE and temporary impacts because of the increases in population. The staff expects any impacts to all other counties within 80 km (50 mi) of the VEGP site would be SMALL and temporary.

4.5.3 Economic Impacts to the Community

This section evaluates the social and economic impacts on the area within 80 km (50 mi) of the VEGP site as a result of constructing VEGP Units 3 and 4. The evaluation assesses the impacts of construction and demands placed by the larger workforce on the surrounding region.

4.5.3.1 Economy

The impacts of construction on the local and regional economy depend on the region's current and projected economy and population. The VEGP site, if approved, would be available for 20 years after approval, and construction could begin anytime in that 20 years assuming issuance of a construction permit (CP) or combined license (COL). For this analysis, the staff assumes site-preparation construction would be completed by 2010 and construction of the new reactors would have a start date of 2010, with a commercial operation date of 2015 for VEGP Unit 3 and 2016 for VEGP Unit 4.

The in-migration of approximately 3400 workers would create new indirect jobs in the area through a process called the spending/income multiplier effect, which explains how each dollar spent on goods and services by one person becomes income to another, who saves some money but re-spends the rest. In turn, this re-spending becomes income to someone else, who in turn saves a portion and re-spends the rest, and so on. The percentage by which the sum of all spending exceeds the initial dollar spent is called the "multiplier." The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides regional multipliers for industry jobs and earnings (BEA 2005). For every construction worker, BEA estimates an additional 0.70 jobs would be created in the area near the VEGP site. Considering this multiplier effect, the construction activities at the VEGP site could create approximately 4600 additional (direct plus indirect) jobs in the 80-km (50-mi) region during the construction phase.[a]

The employment of such a large workforce over a 7-year period would have positive economic impacts on the surrounding region. Even if these workers earned no more than average construction wage rates, this large pool of jobs would inject millions of dollars into the regional economy, thus reducing unemployment and creating business opportunities for housing and service-related industries. The largest economic impacts would most likely be felt in Burke

(a) Where only the workers that are expected to work over 2 years at the site are considered (2700 total). With the multiplier effect, the total number of direct and indirect jobs would be approximately 4600 (2700 + (2700 x 0.70) = 4590).

County, particularly in the town of Waynesboro, Georgia, since it may house the largest percentage of permanent and temporary employees. The staff expects a relatively small population increase in Screven County, relative to its small base population and economy, this increase could produce a noticeable upsurge in the local economy.

The NRC staff concludes that beneficial economic impacts could be experienced throughout the region. In Burke County and possibly Screven County, MODERATE potentially beneficial economic impacts would occur as a result of construction activities at the VEGP site. Economic impacts elsewhere would be SMALL.

4.5.3.2 Taxes

Several tax revenue categories would be affected by the construction of VEGP Units 3 and 4. These include taxes on wages, salaries, and corporate profits; sales and use taxes on construction-related purchases; workforce expenditures; property taxes related to the new units; and personal property taxes on owned real property.

Personal and Corporate Income Taxes

Georgia has personal and corporate income taxes. Construction workers would pay taxes to the State of Georgia on their wages and salaries if their residence is in Georgia or if they are nonresidents working in Georgia and have Georgia income that exceeds 5 percent of income from all sources. The staff considers the wages of Georgia residents who would work at the proposed site to be a net transfer with no analytical worth. For in-migrating workers, the staff considers the full value of their VEGP-based earnings as applicable to this analysis. While the exact amount of income taxes the project would generate for the State of Georgia cannot be known, assuming in-migrating workers earn a representative annual construction salary of approximately $64,000 per year,[(a)] the income from in-migrating workers could generate millions of dollars of additional revenue over the 7-year pre-construction and construction period.[(b)] However, this revenue would be paid into the general fund to the State of Georgia. Therefore, the impact of additional income tax revenues would be relatively small for the counties within 80 km (50 mi) of the proposed site (Southern 2007a). Similarly, contractors building the new units at the VEGP site would pay corporate income taxes on the net income earned from the construction activity, which would be paid to State general fund.

(a) Personal communication with Charles Hardegree, Business Manager, Plumbers and Steamfitters Local Union #150, Augusta, GA. June 20, 2007. (Accession No. ML072290212)
(b) Impact and sensitivity analysis provided by Southern in RAI response letter (Southern 2006b).

Sales and Use Taxes

The area around the proposed site would experience an increase in sales and use taxes generated by retail expenditures (e.g., restaurants, hotels, merchant sales, food, etc.) by the construction workforce. The region would also experience an increase in the sales and use taxes collected from construction materials and supplies purchased for the project. Given its proximity to the proposed site and relatively small population and economic base, Burke County would probably receive the largest benefit from sales tax revenues. Columbia and Richmond Counties may also experience an increase in sales and use tax revenues; however, it would likely be a much smaller percentage because of the larger sales and use tax base in these counties. Screven County has limited services and shopping; thus, any impact on sales and use tax revenues would likely be small.

Property Taxes

The VEGP site's current property tax payments represent approximately 80 percent of Burke County's total county property tax revenues (see Table 2-16). Although an exact property tax revenue estimate is not available, during construction the new units would be assessed at some negotiated valuation that would likely range from $1.2 to $2.6 million, based on net electrical output of 1117 MW(e) (Southern 2007a). It is likely that this negotiated value would be no more than 50 percent of the invested capital each year. VEGP would pay Burke County some taxes on VEGP Units 3 and 4 during the 5-year construction period.

A second source of revenue from property taxes would be housing purchased by the long-term construction workforce. In- migrating workers may construct new housing, which would add to the counties taxable property base, or these workers could purchase existing houses, which would drive housing demand and housing prices up, thus slightly increasing values (and property taxes levied). The increased housing demand would have little effect on tax revenues in the more heavily populated jurisdictions.

Summary of Tax Impacts

The amount of income taxes collected over a potential 7-year preconstruction/construction period could be large in absolute terms, but small when compared to the total amount of taxes that Georgia collects in any given year or in a 7-year period. In absolute terms, the amount of sales and use taxes collected over a potential 7-year construction period could be large, but small when compared to the total amount of taxes collected by Georgia, South Carolina, and the governmental jurisdictions within the region. However, given the smaller economic bases, sales and use tax impacts in Burke County could be MODERATE. The construction site-related property taxes collected and distributed to Burke County would likely be MODERATE when compared with the total amount of taxes Burke County collects in any given year over the 7-year construction term, depending on the terms of the *ad valorem* tax revenue payments made for VEGP Units 3 and 4. Burke, Richmond, Columbia, and Screven Counties may also benefit from small property tax revenue increases stemming from changes in house values and increased inventory from the influx of the long-term construction workforce.

4.5.3.3 Summary of Economic Impacts to the Community

Based on the information provided by Southern, NRC staff interviews with local public officials, and NRC's own independent review of data on the regional economy and taxes, the staff concludes that, for most of the region within an 80-km (50-mi) radius of the proposed site, the revenue-derived impacts on the regional economy from constructing VEGP Units 3 and 4 would be SMALL, with a possible MODERATE beneficial impact on Burke County.

4.5.4 Infrastructure and Community Service Impacts

Infrastructure and community services include transportation, recreation, housing, public services, and education.

4.5.4.1 Transportation

Impacts of the proposed construction on transportation and traffic would be most obvious on the rural roads of Burke County, particularly River Road, a two-lane highway that provides the only access to VEGP's main gate and the proposed new access road for construction personnel. Construction-related impacts on traffic are determined by five elements:

1. the number and timing of construction worker vehicles on the roads per shift
2. the number of shift changes for the construction workforce per day
3. the number and timing of truck deliveries to the construction site per day
4. the projected population growth rate in Burke County
5. the capacity and usage of the roads.

Southern's analysis assumed four construction shifts, with each comprising 25 percent of the total construction workforce[a] made up of two shifts working 10-hour days Monday through Thursday (day shift and swing shift), and two additional crews working 12-hour days Friday through Sunday (day shift and graveyard shift). To assess the maximum impact on the local road network, Southern assumed one worker per vehicle and no staggered shifts, so construction and operations schedules would overlap. Southern also estimated 100 truck deliveries would be made daily to the construction site. Truck deliveries and construction worker vehicles would enter the site via the construction access road. The construction and

(a) This analysis uses simplified, conservative assumptions. In reality, Southern already employs staggered operations shifts and would employ varied and staggered construction shifts to mitigate congestion (Southern 2006a).

operations workforces would access the VEGP site via River Road. Beyond River Road, construction traffic from the VEGP site is dispersed in several directions, and road capacities increase as the roads approach Richmond and Columbia Counties. Therefore, the focus of the staff's impact analysis is on River Road.

The Georgia Department of Transportation estimates road capacity on two lane highways at 1700 cars per hour for one direction and 3200 cars per hour for both directions. The 2004 Average Annual Daily Traffic report measured traffic on River Road north of the VEGP as 1277 cars per day in one direction. Because the Average Annual Daily Traffic does not consider hourly traffic volume, Southern estimated maximum peak hourly traffic on River Road by assuming the peak would occur during the afternoon shift change, and that the majority of traffic on the road results from plant employees commuting to and from work. Based on these assumptions, Southern's ER estimated hourly peak traffic on River Road at about 1200 cars per hour in both directions (Southern 2007a). The current capacity of River Road is 3200 cars per hour. Therefore, Southern determined River Road has sufficient capacity for an additional 2000 cars per hour beyond its current rate.

Given the construction schedule presented in Figure 4-2, and assuming approximately 1200 cars per hour as the current peak hourly traffic, River Road's capacity could be reached during year 2 (month 17) of construction and exceeded from then until the end of year 5 (month 50). Table 4-4 presents the analysis of traffic impacts to River Road. More detail regarding the assumptions and calculations made to complete this analysis can be found in Section 4.4 of Southern's ER (Southern 2007a).

In addition to the operations and construction workforce analyzed above, Southern employs an average outage[(a)] workforce of approximately 800 workers for approximately 1 month during every refueling outage. During outages most of the plant staff and outage workforce are on 12-hour shifts, 2 shifts per day, 7-days a week. Their additional pressure on River Road could conceivably push hourly traffic counts over its capacity for 1 or 2 months each year from years 1 through 5 of the construction period.

Traditionally, traffic not associated with VEGP activities along River Road consists of a small number of local commuters, local school buses, and sports hunters and fishermen seeking access to the Savannah River or nearby hunting lands. Southern determined the impact of construction worker traffic on these groups can be mitigated in several ways. Considering that River Road is not the only access to major highways for the area, to the extent possible, Southern could try to reroute non-VEGP traffic to other traffic corridors.

(a) Each of the current VEGP units undergoes a scheduled refueling outage every 18 months. A typical outage consists of fuel reloading activities, equipment maintenance, and special projects, such as major equipment replacements and refurbishment and cleaning of chemicals (Southern 2006a).

Table 4-4. Number of Construction Workforce Cars per Hour on River Road during Peak Shift Changes

Construction Phase (coordinates with Figure 4-2 time line by month)	Number of Construction Workers	Number of Construction Workforce cars on the two-lane highways during shift changes, both directions	"Current" assumed hourly traffic peak plus construction impact	River Road Capacity
First month of "preconstruction"/ (18 months before Year 1 of "Construction Phase")	80	40	1240	3200
Final month of "preconstruction"/ (1 month before Year 1 of "Construction Phase")	2175	1087	2287	3200
Year 1/Month 5	3045	1088	2288	3200
Year 2/Month 17	4000	2000	3200	3200
Year 3/Month 28-36	4400	2200	3400	3200
Year 5/Month 49-50	4000	2000	3200	3200
Year 6/Month 62	3000	1500	2700	3200
Month 64	2000	1000	2200	3200
Month 65	1000	500	1700	3200
Month 66	500	250	1450	3200

Source: Southern 2007a

Construction workers would impose a MODERATE impact on the two-lane highways in Burke County, particularly River Road and the highways that feed into it. Traffic impacts could also be felt to a lesser degree on other rural roads and major commuter routes to Columbia and Richmond Counties. To mitigate these impacts, it may be necessary to accommodate the additional vehicles on Burke County roads, particularly River Road, by developing a traffic management plan prior to the start of construction. The traffic management plan should include such mitigating measures as installing turn lanes at the construction entrance, establishing a centralized parking area away from the site, and shuttling construction workers to the site in buses or vans, using incentive programs to encourage car-pooling, and staggering construction shifts so they do not coincide with operational shifts. Southern could also establish a shuttle service from the central Augusta area or another area where a concentration of construction workers reside.

Rail and Waterways

CSX Transportation, Inc. (CSX) and Norfolk Southern Corp. operate the two primary freight rail carriers servicing Burke, Richmond, and Columbia Counties. From Augusta, CSX has three lines leading to Atlanta, Georgia; Greenwood, South Carolina, and Savannah, Georgia. The line to Savannah runs through South Carolina and comes to within 6.9 km (4.3 mi) of the VEGP site at its closest point. Each line runs approximately 12 to 20 freight trains a day. Also from Augusta, Norfolk Southern has a rail line that goes through Waynesboro, Georgia, to points south and west, running approximately 12 to 20 freight trains a day. Both rail lines have the capacity to run additional trains. A 32-km (20-mi) rail spur runs from the VEGP site to the Norfolk Southern line, connecting north of Waynesboro. Southern recently upgraded the spur to support the transfer of heavy equipment to the VEGP site, and it is likely that this spur would be used to transfer equipment during the construction of Units 3 and 4 at the VEGP site. Since a number of new residential subdivisions have been developed near the rail spur in Waynesboro, it may be necessary to upgrade rail crossings with additional safety features.

Southern plans to use the Savannah River navigation channel to support delivery of large components and modules for construction of VEGP Units 3 and 4. A barge slip was installed approximately 90 m (100 yd) downstream of the CWIS for VEGP Units 1 and 2 to support the unloading of major equipment. The Savannah River navigation channel is operated and maintained by the Savannah District of the USACE. Southern has contacted the USACE and would work with them to develop a strategic plan to support the transport of equipment on the Savannah River.

Based on the information provided by Southern, interviews with local planners and officials, and the NRC's own independent review, the staff concludes that the offsite impacts of construction of VEGP Units 3 and 4 on transportation could be MODERATE during the peak construction period in year 5 of the 7-year construction schedule; however, mitigating activities such as those discussed above could reduce impacts to a SMALL level when implemented.

4.5.4.2 Recreation

Construction of the reactors would require a 76-m (250-ft)-tall crane tower that may be visible from River Road and the Savannah River. There is very little recreational boating or fishing near the VEGP site. Hunters or fishers seeking access to the Savannah River or nearby hunting or fishing areas may be impacted by the construction worker traffic to the site. However, Southern would attempt to mitigate these impacts by posting signs and re-routing traffic. Because the aesthetic impacts of construction would be localized and only limited recreational boating takes place on this reach of the river near the site, the staff anticipates that the impacts on local recreation from construction activities would be SMALL.

4.5.4.3 Housing

The assumptions behind the NRC staff's estimated in-migration of workers was established in Section 4.5.2 of this chapter. If the entire construction workforce required to construct VEGP Units 3 and 4 originated within a reasonable commuting distance of the VEGP site, there would be no impact on housing demand. However, the NRC staff expects that approximately 3400 construction workers would migrate into the region; 2700 of these workers would reside in the area for two or more years and would require long-term housing, and 700 workers would need temporary housing (e.g., hotels, motels, rooms in private home, etc.) or they would live in their own campers or mobile homes.

Although rental properties are limited in Burke and Screven Counties, they are in plentiful supply in the larger municipalities such as Augusta, Martinez, and Evans in Georgia; and Aiken and North Augusta in South Carolina. Table 2-18 provides information on housing in Burke, Columbia, Richmond, and Screven Counties in Georgia, and Aiken County in South Carolina.

The staff's assumptions in Section 4.5.2 indicate long-term workers would require approximately 540 housing units in Burke County, 700 in Richmond County, 920 in Columbia County, 190 in Screven County, and 110 in Aiken County. All of these counties have enough housing units available to absorb the influx of workers. For example, Richmond County had over 10,000 vacant housing units in 2005. Therefore, the staff expects housing impacts would be SMALL.

Some relocating construction workers might bring campers or mobile homes for the duration of their employment. There are a limited number of recreational vehicle (RV) parks available near the VEGP site. When VEGP Units 1 and 2 were constructed, numerous mobile home parks operated on private property throughout Burke and Screven Counties to support the influx of workers. There were no zoning restrictions in place at the time in either county. By the time construction begins for VEGP Units 3 and 4, Burke County would have established zoning regulations to restrict RV and trailer park developments in the county[a]. However, temporary RV parks would likely provide housing to a number of construction workers during the construction of VEGP Units 3 and 4.

Based on the information provided by Southern, interviews with local real estate agents and city and county planners, and NRC's own independent review, the staff expects the housing-related impacts of construction of VEGP Units 3 and 4 would be SMALL.

(a) Interview on October 18, 2006, with Bill Owens, Building Official, Department of Planning, Permits, and Inspections, Burke County, Georgia. Part of meeting with Burke County officials held in Waynesboro, Georgia.

4.5.4.4 Public Services

This section describes the public services available and discusses the impacts of construction at the VEGP site on water supply and waste treatment, police, fire and medical services, education, and social services in the region.

Water Supply Facilities

A detailed description of construction-related water requirements and its impact is presented in Section 4.3 of this document. The VEGP site does not use water from a municipal system. Onsite wells provide potable water, and would provide the water for the construction project as well. Therefore, water usage by the workforce, while onsite, would not impact municipal water suppliers. Southern estimated the total daily groundwater usage at the VEGP site during construction to be approximately 6.8 million L/d (1.8 million gpd), which is well within Southern's permitted limits and, therefore, the construction-related impacts to the VEGP site groundwater use would likely be SMALL.

Municipal water suppliers in the region have excess capacity (see Table 2-20; 2-21). The impact to the local water supply systems from construction-related population growth can be estimated by calculating the amount of water that would be required by total population increase. According to a 2003 EPA report on potable water usage, the average person in the United States uses about 340 L/d (90 gpd) (EPA 2003). For an assumed construction-related population increase of 6700 people, the estimated 2.28 million L/d (603,000 gpd) increase in water consumption amounts to about one-fifth of Burke County's excess capacity. Therefore, the staff expects construction-related impacts on municipal water supplies would be SMALL.

Wastewater Treatment Facilities

The VEGP site has a private wastewater treatment facility sized for VEGP Units 1 and 2. As part of the construction project, the facility would be expanded to support the increased capacity that would be needed for VEGP Units 3 and 4. During construction, temporary office and warehouse facilities would be tied to the existing facility. In addition, portable toilets would be provided in the construction area. Therefore, additional wastewater associated with construction activities would not impact the existing the VEGP site wastewater treatment facility.

Section 2.8.2.6 describes the public wastewater treatment systems in Burke, Richmond, and Columbia Counties, their permitted capacities, and current demands. Wastewater treatment facilities in the three counties have excess capacity. Assuming that 100 percent of the water consumed by in-migrating workers would be disposed of through the wastewater treatment facilities, the construction-related population increase of 6700 people could require 2.28 million L/d (603,000 gpd) of additional wastewater treatment capacity. Given a reported excess treatment capacity of over 60 million L/d (16 million gpd) in Burke, Richmond, and

Columbia counties the staff expects the impacts on wastewater treatment from the in-migrating construction workforce in the region would be SMALL.

Police, Fire, and Medical Facilities

A temporary increase in population from the construction workforce for a new nuclear facility can increase the burdens on local fire and police departments, but this increase is transitory in nature. Once the project has been completed, many of the construction workers would leave the area, relieving those burdens. During construction, the temporary increase in demand for community resources could be mitigated in several ways. Larger communities would have an easier time assimilating the influx of new people because the additional new population comprise a smaller percentage of the communities' base populations. Likewise, the more communities that host new workers, the less pressure each community would experience on its infrastructure. Consequently, any incentives Southern can provide its employees to move into the area in a planned manner would mitigate (but not remove) this short-term demand. Next, communities can avoid the long-term commitment to the maintenance and operation of infrastructure purchases to fulfill short-term demand increases. Instead of purchasing new fire or police equipment, affected communities could lease vehicles or building space. Additional tax revenues from the influx of construction workers would help offset the cost to expand local police and fire departments.

In 2001, the citizen-to-police-officer ratios in Burke, Richmond, and Columbia Counties were 271:1, 998:1, and 992:1, respectively (Southern 2007a). Burke County has the largest police force relative to the size of its population. According to a 2005 draft planning report produced by the Central Savannah River Area Regional Development Center, planning officials consider police and fire protection adequate in the region (Southern 2007a). Southern would retain its own security force at the VEGP site during construction of VEGP Units 3 and 4.

Assuming current staffing levels, the assumed population increases in Burke (1340), Richmond (1740), and Columbia (2280) Counties would increase the citizen-to-police-officer ratio to 288:1 (a 6 percent increase) in Burke County, 1008:1 (a 2 percent increase) in Richmond County, and 1017:1 (a 3 percent increase) in Columbia County. Therefore, the NRC staff concludes that the potential impacts of construction on police services in Richmond and Columbia Counties would be SMALL.

Burke County, Georgia, was the county most affected during construction of VEGP Units 1 and 2. Consequently, it has three distinct advantages over other affected counties when responding to construction-related effects.

1. Southern has a history of working closely with Burke County and the city of Waynesboro on many safety and security issues, and already shares certain assets with these governments (e.g., buses for public transport). Consequently, Burke County and the city of

Waynesboro have sufficient excess capacity in their existing programs to accommodate a much greater increase in demand for services than the staff has assumed for its analysis.

2. Burke County and the city of Waynesboro have the benefit of experience. During the construction of the VEGP Units 1 and 2, Waynesboro and Burke County incurred the greatest impact from the construction workforce. That experience had compelled community leaders to plan ahead and mitigate anticipated problems to a much greater extent than a similar community could without such historic lessons to rely upon.

3. Burke County is the beneficiary of the tax revenue stream that flows from the VEGP site. Consequently, it has an excellent bond rating and has existing excess capacity in many of its community services.

Therefore, despite the much larger anticipated effect on its police and fire infrastructure, the NRC staff has determined that the construction-related impact on these services for Burke County would also be SMALL.

The region is well supplied with hospitals and medical services, as Richmond County serves as a regional medical hub, with four general hospitals, one military hospital, one mental and psychiatric hospital, one rehabilitation hospital, and two Federal hospitals. Burke County also has one general hospital. The extensive medical complex in the city of Augusta could treat most any injury. Southern expects minor construction-related injuries incurred during the construction of VEGP Units 3 and 4 would be treated onsite. More serious injuries would be treated at one of the hospitals in the region. Based on the size and availability of medical services in the region, temporary construction workers would not overburden existing medical services and the staff expects the adverse impact on medical services near the proposed site would be SMALL.

Social Services

Social services in Georgia are overseen by the Georgia Department of Human Resources through four main divisions: (1) Aging Services; (2) Public Health; (3) Mental Health, Developmental Disabilities, and Addictive Diseases; and (4) Family and Children Services. In addition to government-provided services, there are a number of private, philanthropic, and religious organizations who provide social services within the 80-km (50-mi) radius of the VEGP site. To the extent Southern's contractors hire individuals who use the services provided by the Department of Human Resources or nonprofit organizations, construction of VEGP Units 3 and 4 could reduce the burden on social service providers. However, new families moving into a community would bring new demand for both state-provided and privately provided social services. Overall, while the counterbalancing effects of new jobs and new families cannot be fully quantified, the staff believes the overall impact of construction on social services should be SMALL.

Summary of Impacts to Public Services

Assuming 1000 of the 4400 construction workers already reside in the region and most of the in-migrating workers would choose to live in the larger cities of the region, the impacts on public services from construction activities would be dispersed and SMALL. The NRC staff expects no demand beyond capacity limits for regional water and wastewater treatment systems; police, fire and medical services; or social services. Although Burke County would experience some of the largest impacts on a per capita basis, its cooperative relationship with Southern would mitigate adverse impacts, and therefore, the staff expects the adverse impact in Burke County would also be SMALL.

4.5.4.5 Education

The staff expects a net construction-related increase of about 1500 school-age children (see Section 4.5.2) distributed throughout the region. Approximately 300 would reside in Burke County, 390 in Richmond County, and 510 in Columbia County. The remaining 300 school-age children that would be distributed throughout the remaining counties in the region but in such small numbers they are not considered in this analysis.

The Burke County School District currently operates with an excess capacity of about 800 students.[a] In addition, the Burke County School District plans on expanding school facilities to accommodate any possible construction-related influx of students (PNNL 2006). Although Richmond and Columbia County school districts do not operate with excess capacity, the expected number of additional students at each school is relatively small. In Columbia County, school capacity issues are driven by the rapid residential growth in the area. Between 2004 and 2006, enrollment in Columbia County schools increased by more than 800 students each year. The additional school-aged children that might move to the area as a result of construction of VEGP Units 3 and 4 would be absorbed as part of the rapid growth in this area.[b] Although the Richmond School District has not experienced a high growth rate in recent years, it is the largest of the three district school districts, and the total number of students expected to enroll in the Richmond School District would only constitute a 1 percent increase in total enrollment. Thus, the impacts on the Richmond School District would be expected to be SMALL.

(a) Data provided by Burke County School District office in e-mail from Wilbert Roberts, Assistant District Superintendent, March 6, 2007. (Accession No. ML072290177)

(b) Data provided by Columbia County School District office in e-mail from Pam Zgutowicz, March 5, 2007. (Accession No. ML072290140)

4.5.4.6 Summary of Infrastructure and Community Services Impacts

Based on the information provided by Southern, interviews with city and county planners, social service providers, and school district officials in Burke, Columbia, Screven, and Richmond Counties, the NRC staff concludes that the overall construction impacts on regional infrastructure and community services would be SMALL. The estimated workforce of 4400 would have a MODERATE temporary impact on traffic on River Road next to the plant; however, these impacts could be reduced with proper planning and mitigation measures. The impact on other road networks in the region would be dispersed and SMALL. The site is relatively isolated, industrial in nature, and well masked by forest in most directions; therefore adverse recreational impacts would also be SMALL. The impacts on public service infrastructure would be SMALL throughout the region, unless less populated counties draw a substantial share of the in-migrating construction workforce, which is not expected. In that case, the impacts on housing and public services in these counties may be MODERATE.

These conclusions are predicated on the specific assumptions about the size, composition, and behavior of the construction workforce discussed in detail in Section 4.5.2 of this EIS.

4.5.5 Summary of Socioeconomic Impacts

Based on information supplied by Southern, staff interviews conducted with public officials in Burke, Screven, and Richmond Counties, and the current availability of services and additional taxes that would likely compensate the need for additional services, the staff concludes the construction impacts on the affected local economies would be beneficial and SMALL in the 80-km (50-mi) radius region centered on the proposed site. The effect on tax revenues would be beneficial and SMALL, except for property tax receipts in Burke County, which would be beneficial and MODERATE. The temporary (7-year) impact on transportation would be MODERATE on River Road next to the VEGP site, but SMALL elsewhere. The site is relatively isolated, industrial in nature, and well masked by forest in most directions so the construction-related aesthetic and recreational impacts near the VEGP site would be SMALL, but aesthetic impacts along the new transmission line could be MODERATE. The impacts on public services would be SMALL throughout the region. The staff expects the overall impact on infrastructure and community services would be SMALL.

4.6 Historic and Cultural Resources

The National Environmental Policy Act of 1969 (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966 (NHPA), as amended through 2000, also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as "Historic Properties" in NHPA). As outlined in 36 CFR 800.8(c), "Coordination with the National Environmental Policy Act of 1969," the NRC coordinated NHPA Section 106 compliance with NEPA compliance.

Construction, operation, and decommissioning of new power units can affect either known or undiscovered cultural resources. Therefore, in accordance with the provisions of NHPA and NEPA, the NRC is required to make a reasonable and good faith effort to identify historic properties in the area of potential effect (APE) and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer (SHPO), American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing on the National Register of Historic Places) are present or affected, the NRC is required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve adverse effects of the undertaking.

For specific historic and cultural information on the VEGP site, see Section 2.9.2. As explained in Section 2.9.2, previous cultural resource identification efforts indicated the presence of 17 archaeological sites, two of which are eligible for listing in the National Register of Historic Places. The two eligible sites (9BK416 and 9BK423) are located adjacent to the proposed facilities, and at least one site would be adversely impacted. Southern has been in consultation with the Georgia SHPO concerning protective actions to be taken for 9BK423 and agreement has been reached (Georgia SHPO 2006; Southern 2007a). Because 9BK416 would be impacted by construction of utilities associated with the water intake structure, New South Associates has conducted a phase 1 archaeological survey in the proposed construction area. The results of this survey support the original findings that site 9BK416 is a multi-component prehistoric site that is eligible to be listed in the NRHP (NSA 2007). Site 9BK416 has the potential to yield significant information on prehistory for the area (NSA 2007). It is recommended that site 9BK416 be avoided; however, if avoidance is not possible, further excavations will be required to mitigate the project's adverse effects (NSA 2007). Southern will consult with the Georgia SHPO to determine the extent of archaeological mitigation that would be needed.

During construction, Southern would implement procedures that identify the actions that should be taken if archaeological or historical materials are encountered. Southern has agreed to follow these procedures. Procedures that would be in place prior to construction would identify measures that need to be taken if historic or cultural resources are discovered during construction (Southern 2007a).

Archaeological surveys of the new transmission line right-of-way that would be needed were not conducted. However, an analysis of potential impacts in historic and cultural resources was conducted for possible transmission line rights-of-ways (GPC 2007). The full extent of impacts cannot be determined until a specific route is defined. Once this process is completed, the appropriate cultural resource studies would be undertaken to ensure that resources are identified and addressed before construction. In addition, consultation by Southern with the State of Georgia would establish requirements to follow should archaeological, historical, or other cultural resources be uncovered during construction (Southern 2007a).

Based on (1) the adverse effect that the construction of the water intake structure and supporting infrastructure likely would have on the integrity of 9BK416, (2) the increased risk of inadvertent discoveries and impacts to archaeological deposits of 9BK416 and possible 9BK423 during construction, (3) the preconstruction and construction measures that Southern would take to mitigate adverse impacts to significant cultural resources, and (4) the staff's cultural resource analysis and consultation, it is the staff's conclusion that the potential impacts on historic and cultural resources would be MODERATE.

4.6.1 Cultural Resource Monitoring During Construction

Cultural resource monitoring may be required during construction, depending on the outcome of ongoing evaluation and consultation with the Georgia SHPO concerning impacts to 9BK416. As called for in plant procedures, construction workers would be given cultural resource training so they would be aware of the types of artifacts that might be encountered. If archaeological materials are discovered during construction, work would stop while an assessment is conducted, following plant procedures.

4.7 Environmental Justice Impacts

The staff evaluated whether the health or welfare of minority and low-income populations at those census blocks identified in Section 2.10 of this EIS could be disproportionately affected by the potential impacts of constructing VEGP Units 3 and 4 at the proposed site. To perform this assessment, the staff (1) identified all potentially significant pathways for human health and welfare effects, (2) determined the impact of each pathway for individuals within the identified census blocks, and (3) determined whether or not the characteristics of the pathway or special circumstances of the minority and low-income populations would result in a disproportionate impact on minority or low-income people within each census block.

4.7.1 Health and Environmental Impacts

Construction of a nuclear power plant is very similar in environmental effects to the construction of any other large-scale industrial project. There are three primary pathways in the environment: soil, water, and air. Discussions of the potential impacts to each of these pathways follow.

4.7.1.1 Soil

Construction activities at the VEGP site represent the largest source of soil-related environmental impacts. However, while construction activities would disrupt large volumes of soil, the effects are primarily localized and have little migratory ability. Furthermore, BMP at the construction site and a new construction strategy would mitigate these effects (Southern 2007a). Because Southern plans to ship in prefabricated pieces and assemble them onsite, proposed construction activities would involve roughly a third of the peak number of workers employed during construction of VEGP Units 1 and 2.[a] Therefore, the disruption of soils during construction would be mitigated by smaller workforces and a lower level of onsite activity, relative to historic levels. In addition, the soil disruption within those communities that would host in-migrating workers and their families would also be reduced, relative to historic levels. The staff interviewed community leaders in towns surrounding the proposed site and discovered there is a much greater state of preparedness now than in the past. Old problems of overcrowded trailer parks and vehicle dust have been addressed through local legislation, and sewer and septic systems now must meet stricter environmental standards.[b] Given these mitigating factors, the staff concludes soil-related environmental impacts during the construction of Units 3 and 4 at the VEGP site would pose little or no impacts on any populations within the region of interest (Southern 2007a).

4.7.1.2 Water

Water-related environmental impacts include erosion-related surface-water degradation and the introduction of anthropogenic substances into surface and groundwater. The staff expects no impact on the Savannah River from sediments and contaminants because of Southern's commitment to implementing BMP at the construction site (Southern 2007a).

As described in Section 4.3, the Staff expects construction-related impacts on the Water Table aquifer would be completely mitigated at a distance equal to that of the nearest person to the proposed site (about 1.6 km [1 mi]). Construction-related activities are not of sufficient magnitude to impact the Cretaceous or Tertiary aquifers beneath the proposed site. Therefore, the staff determined the potential negative environmental effects from water sources would be small; and, there are no water-related impacts on minority and low-income populations to consider.

(a) Taken from *The Blazer* newsletter – a weekly newsletter serving the "Plant Vogtle Community." The specific article is entitled "The Vogtle Report," June 7, 1986, Volume 5, Number 12.

(b) Interview on October 18, 2006, with Bill Owens, Building Official, Department of Planning, Permits, and Inspections, Burke County, Georgia. Part of meeting with Burke County officials held in Waynesboro, Georgia.

4.7.1.3 Air

Based on the findings in Section 4.2, motor vehicle exhaust and construction dust would cause minor and localized adverse impacts to air quality but would not extend as far as the site boundary. Therefore, the staff determined the negative environmental effects from construction-related reductions in air quality would be small, localized, and short-lived for any population in the region of interest. Consequently, the staff found no disproportionate and adverse impacts on minority and low-income populations because of changes in air quality.

4.7.1.4 Noise

Noise levels during construction may be as high as 110 dBA within the construction site, but noise levels diminish according to the inverse square rule, which says that if you double the distance from the source, the noise level diminishes by a factor of four. Because the loudest construction noise would register 60 to 80 dBA 120 m (400 ft) from the source and the VEGP site exclusion area boundary is more than a half mile from the construction site in all directions, the staff determined impacts from the noise of construction activities would be small and not require mitigation.

4.7.2 Socioeconomic Impacts

As described in section 4.5.4, the staff expects traffic to increase beyond the capacity of River Road during the construction phase. However, Southern plans to mitigate any negative impacts from such increases by encouraging car pooling, providing van pools, and/or staggering work shifts (Southern 2007a). The staff finds no disproportionate adverse impacts on minority and low-income populations because of changes in traffic and other community services.

4.7.3 Subsistence and Special Conditions

NRC's environmental justice methodology includes an assessment of populations of particular interest or unusual circumstances, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements.

Subsistence

The presence of a subsistence population along the Savannah River adjacent to the proposed site has been well documented in the literature (Burger et al. 1999). The primary contaminant of concern for the Savannah River is mercury, which among other heavy metals contaminating the waters of the Savannah River, has been traced to activities at the Savannah River Site and not to the VEGP site (Burger et al. 2001; Makhijani and Boyd 2004). Because they are not a by-product of any construction activities related to the proposed two new reactors, heavy metals cannot be considered a source of any environmental degradation attributable to the proposed VEGP site. Therefore, the staff determined there are no disproportionate adverse impacts on the subsistence activities of minority and low-income populations along the Savannah River that can be linked to the construction of Units 3 and 4 at the proposed VEGP site.

High-Density Communities

There are no Native American communities within the area of interest, and while some existing communities within the area exhibit disproportionately high percentages of minority (primarily Black races) and low-income populations, most of the higher percentages of minority and low-income populations can be attributed to the sparseness of the rural population in general. This was reinforced for the staff through a series of interviews with minority leaders and social service agency representatives in the affected counties, all of whom described the lower income and minority communities as "scattered" throughout the counties with no heavy concentrations in any one particular area.[a] Therefore, the staff determined there were no environmental justice effects to consider with respect to densely populated minority or low-income peoples.

4.7.4 Summary of Environmental Justice Impacts

The staff expects the impacts of plant construction on minority and low-income populations in the region of interest would be SMALL because no environmental pathways or preconditions exist that can lead to adverse and disproportionate impacts. The adverse socioeconomic impacts on minority and low-income populations are also expected to be SMALL because of the mitigation strategies employed by nearby communities and the reduced workforce needed because of offsite fabrication. Depending on how each community participates in the distribution of construction-generated income and tax revenues, the impacts on minority and low-income communities would likely be beneficial impacts. There is no evidence that any particular demographic group would be excluded or limited in their access to those benefits. Therefore, based upon the underlying assumptions of their analysis, the staff concludes the adverse impacts on minority and low-income populations resulting from construction of Units 3 and 4 at the VEGP site would be SMALL.

4.8 Nonradiological Health Impacts

The area around the VEGP site is predominantly rural with a population of approximately 3560 people within 16 km (10 mi) of the site (Southern 2007a). No significant industrial or

(a) Personal communication (phone interview) on October 9, 2006 with Reverend Robert Lynch, pastor of Bethel Apostolic Church, Waynesboro, Georgia, and head of the Burke County Citizens Hunger Action Committee (affiliated with the Golden Harvest Food Bank). Also confirmed in interviews with Screven County Family Services (with Mr. Bill Hillis), October 18, 2006, and Burke County Family Services (with Ms. Alane Hickman), October 19, 2006.

commercial facilities are currently located or planned in this area. The following sections discuss the results of the staff's assessment of nonradiological health impacts for the VEGP site. Southern (2007a) indicated that the physical impacts of construction, including public health, occupational health, and noise, would be small and were discussed qualitatively by the applicant in Sections 4.4 and 4.7 of the ER (Southern 2007a).

4.8.1 Public and Occupational Health

This sections includes a discussion of public health impacts from construction and site-preparation (construction) worker health.

4.8.1.1 Public Health

Southern stated in its ER that the physical impacts to the public from construction at the VEGP site might include dust and vehicle exhaust as sources of air pollution during site preparation and redress (Southern 2007a). Southern stated that operational controls would be imposed to mitigate dust emissions, employing such methods as stabilizing construction roads and spoils piles, periodically watering unpaved roads, and re-vegetating road medians and slopes (Southern 2007a).

Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order. Southern (2007a) stated that applicable Federal, State, and local emission requirements would be adhered to as they relate to open burning or the operation of fuel-burning equipment. The appropriate Federal, State, and local permits and operating certificates would be obtained as required.

The public would not be close to the construction site. The nearest accessible area is greater than 0.8 km (0.5 mi) from the construction site for VEGP Units 3 and 4, and the nearest residence is approximately 1.6 km (1 mi) from the construction site (Southern 2007a). Based on the mitigation measures identified by Southern in its ER, the permits and authorizations required by State and local agencies, and NRC's own independent review, the staff concludes that the nonradiological health impacts to the public from construction activities would be SMALL and that additional mitigation beyond the actions identified above is not warranted.

4.8.1.2 Site Preparation Worker Health

In general, human health risks for construction workers and personnel working onsite is expected to be dominated by occupational injuries (e.g., falls, electrocution, asphyxiation) to workers engaged in activities such as construction, maintenance, and excavation. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. According to the U.S. Bureau of Labor Statistics (USBLS), injury rates drop significantly for large construction projects such as nuclear power plants (e.g., for the years 2003 to 2005 the overall injury-only rate for utility system construction ranged from 5.4 to

6.7 percent compared to 2.0 to 3.0 percent for similar projects with 1000 or more workers) (USBLS 2007a). Southern (2007a) reports the average construction workforce for proposed VEGP Units 3 and 4 would be 3152 during an 84-month period.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks associated with construction. The staff assumes that the applicant would adhere to NRC, OSHA, and State safety standards, practices, and procedures during construction activities.

The USBLS reports occupational injuries and illnesses as total recordable cases, which includes those that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. Southern (2007a) provided a range of estimates for the annual number of total recordable cases (154 to 271) that might be expected to occur during construction of proposed VEGP Units 3 and 4. These estimates for the annual number of recordable cases are based on U.S. and State of Georgia total recordable case rates for the year 2003 (6.9 and 4.9 percent, respectively) and the actual rates experienced during construction of VEGP Units 1 and 2 in 1984 and 1985 (10.5 and 6.7 percent, respectively). The VEGP total recordable case rates for construction during 1984 and 1985 appear high; however, rates for the construction industry have been decreasing steadily and rates from the 1980s are not comparable to rates from the 2000s. A review of total recordable cases reported for the United States from 1994 to 2005 for heavy construction indicated a steady decline from 10.2 percent in 1994 to a low of 5.6 percent in 2005 (USBLS 2007b). Similarly, total recordable cases reported for the State of Georgia for heavy construction declined from 9.8 percent in 1996 to a low of 4.4 percent in 2005 (USBLS 2007c). A review of data published by the USBLS (2007a) for the period from 2003 to 2005 indicates the rate of total recordable cases for utility system construction is similar to that for heavy construction. Year 2003 was the first with separate results reported by the USBLS for utility system construction.

Other nonradiological impacts to construction workers discussed in this section include noise, fugitive dust, and gaseous emissions resulting from construction activities. Mitigation measures discussed in this section for the public would also help limit exposure to construction workers. Onsite impacts to construction workers would also be mitigated through training and use of personal protective equipment to minimize the risk of potentially harmful exposures. Emergency first-aid care and regular health and safety monitoring of construction personnel could also be undertaken.

Based on mitigation measures identified by Southern in its ER, on permits and authorizations required by State and local agencies, and on the staff's independent review, the staff concludes that the nonradiological health impacts to workers from construction activities would be SMALL and additional mitigation beyond the actions stated above is not warranted.

4.8.2 Noise Impacts

Construction of a nuclear power plant is similar to other large construction projects. It involves many noise-generating activities. Regulations governing noise from construction activities are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 and 40 CFR Part 204. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. Neither the State of Georgia nor Burke County have specific noise regulations.

The ER (Southern 2007a) indicates that activities associated with construction of a new unit at the VEGP site would have peak noise levels in the 100- to 110-dBA range. A 10-dBA decrease in noise level is generally perceived as cutting the loudness in half. At a distance of 15 m (50 ft) from the source these noise level would generally decrease to the 80- to 95-dBA range and at distance of 120 m (400 ft), the noise levels would generally be in the 60- to 80-dBA range. For context, Tipler (1982) lists the sound intensity of a quiet office as 50 dBA, normal conversation as 60 dBA, busy traffic as 70 dBA, and a noisy office with machines or an average factory as 80 dBA. Construction noise (at 3 m [10 ft]) is listed as 110 dBA, and the pain threshold is 120 dBA.

The ER (Southern 2007a) states that the exclusion area boundary of the VEGP site would be greater than 0.8 km (0.5 mi) from construction activities for new units. A 100-dBA noise level at 15 m (50 ft) from an activity would be expected to decrease to about 65 dBA at the exclusion area boundary. There are no major roads, public buildings, or residences within the exclusion area. Similarly, a 100-dBA noise level would be expected to decrease to less than 60 dBA at the nearest residence, which is approximately 1.6 km (1 mi) from the construction area. These estimates do not include the noise attenuation associated with vegetation and topography.

Construction activities would be expected to take place 24 hours per day, 7 days per week. However, the ER (Southern 2007a) lists a number of measures that could be taken to mitigate the potential adverse effects of construction noise. Among the mitigation measures are compliance with Federal and State regulations, use of hearing protection, inspection and maintenance of equipment, restriction of noise-related activities to daylight hours, and restriction of delivery times to daylight hours.

According to NUREG-1437 (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in NUREG-0586, Supplement 1 (NRC 2002). The criterion for assessing the level of significance was not expressed in terms of sound levels but based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG-0586, Supplement 1, is stated as follows:

> The noise impacts...are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts...are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Considering the temporary nature of construction activities and the location and characteristics of the VEGP site, the staff concludes that the noise impacts from construction would be SMALL and that further mitigation beyond that discussed above is not warranted.

4.8.3 Impacts of Transporting Construction Materials and Construction Personnel to the VEGP Site

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used for transportation of construction materials and construction personnel to and from the VEGP site. However, preliminary estimates are the only data available to estimate the demand for these transportation services. The assumptions made to fill in reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

Construction material requirements are based on information taken from the ER (Southern 2007a) and a previous ESP applicant's ER (Dominion 2006). Dominion (2006) stated that constructing a new 1000-MW(e) unit requires up to 150,000 m^3 (200,000 yd^3) of concrete and 14,000 MT (15,000 tons) of structural steel. These quantities would be doubled to account for a two-unit plant. Southern's ER estimates that an additional 1.98 million m (6.5 million lineal ft) of cable for a single unit and up to 83,800 lineal m (275,000 lineal ft) of piping greater than 5 cm (2.5 in.) in diameter per unit would be required.

- It was assumed that shipment capacities are 10 m^3 (~13 yd^3) of concrete per shipment, 10 MT (11 tons) of structural steel, and 300 lineal m (1000 lineal ft) of piping and cable per shipment.

- The number of construction workers was estimated at 4400 (peak) in the ER. This value represents the peak workforce for construction of two units simultaneously. At an average of 1.8 persons/vehicle, there would be about 2800 vehicles per day (NRC 2006). Each person was assumed to travel to and from the VEGP site 250 days per year. A 6.5-year construction period for each unit was assumed in the ER (Southern 2007a).

- Average shipping distances for construction materials were assumed to be 80 km (50 mi) one way. The average commute distance for construction workers was assumed to be 32 km (20 mi) one way.

- Accident, injury, and fatality rates for construction materials were taken from Table 4 in ANL/ESD/TM-150 *State-level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Rates for the State of Georgia were used for construction material shipments, typically conducted in heavy-combination trucks. The data in Saricks and Tompkins (1999) are representative of heavy-truck accident rates and do not specifically address the impacts associated with commuter traffic (i.e., workers traveling to and from the site). However, a single source that provided all three rates to estimate the impacts from worker transportation to/from the site was not available. To develop representative commuter traffic impacts, a source was located that provided a Georgia-specific fatality rate for all traffic for the years 2001 to 2005 (DOT 2005). The average fatality rate for the 2001 to 2005 period in Georgia was used as the base for estimating Georgia-specific injury and accident rates. Adjustment factors were developed using national-level traffic accident statistics in *National Transportation Statistics 2007* (DOT 2007). The adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the Georgia-specific fatality rate to approximate the injury and accident rates for commuters in the State of Georgia.

The estimated nonradiological impacts of transporting construction materials to the proposed VEGP site and of transporting construction workers to/from the site are shown in Table 4-5. Note that the nonradiological impacts are dominated by transport of construction workers to/from the VEGP site. The total annual construction fatalities represents about a 3 percent increase above the 12 traffic fatalities that occurred in Burke County in 2005 (DOT 2005). This represents a small increase relative to the current traffic fatality risks in the area surrounding the proposed VEGP site. Therefore, the staff concludes that the impacts of transporting construction and personnel to the VEGP site would be SMALL, and no mitigation is warranted.

Table 4-5. Impacts of Transporting Workers and Construction Materials to/from the VEGP Site

	Accidents per Year	Injuries per Year	Fatalities per Year
Workers	5.2×10^{1}	2.4×10^{1}	3.6×10^{-1}
Materials			
Concrete	5.0×10^{-1}	2.3×10^{-1}	3.4×10^{-3}
Rebar	4.5×10^{-2}	2.1×10^{-2}	3.1×10^{-4}
Cable	6.5×10^{-2}	3.0×10^{-2}	4.5×10^{-4}
Piping	2.8×10^{-3}	1.3×10^{-3}	1.9×10^{-5}
Total - Construction	5.3×10^{1}	2.4×10^{1}	3.6×10^{-1}

4.8.4 Summary of Nonradiological Health Impacts

The staff reviewed the information in the ER (Southern 2007a) and concludes that nonradiological health impacts to construction workers at the VEGP site, workers at the VEGP site, and the local population from fugitive dust, occupational injuries, noise, and transport of materials and personnel would be SMALL, and additional mitigation is not warranted.

4.9 Radiological Health Impacts

The sources of radiation exposure for construction workers include direct radiation exposure, exposure from liquid radioactive waste discharges, and exposure from gaseous radioactive effluents from the existing VEGP Units 1 and 2 during the site-preparation and construction phase. For the purposes of this discussion, construction and site-preparation workers are assumed to be members of the public; therefore, the dose estimates are compared to the dose limits for the public, pursuant to 10 CFR Part 20, Subpart D. Southern (2007a) noted that all major construction activities are expected to occur outside the VEGP site protected area boundary, but inside the restricted area boundary.

4.9.1 Direct Radiation Exposures

In its ER (Southern 2007a), Southern identified two sources of direct radiation exposure from the VEGP site: (1) the current reactor buildings for VEGP Units 1 and 2, and (2) the planned Independent Spent Fuel Storage Installation (ISFSI). In addition, Southern identified the proposed VEGP Unit 3 as a source of direct radiation exposure to proposed VEGP Unit 4 construction workers. The planned ISFSI is identified as a source of direct radiation exposure only to proposed VEGP Unit 3 construction workers. The staff did not identify any additional sources of direct radiation during the site visit or during document reviews.

Southern used fenceline thermoluminescent dosimeters (TLDs) and environmental TLDs to measure direct radiation levels at locations in and around the VEGP protected area (Southern 2004a). Sixteen fenceline TLDs are located along the protected area fence. Environmental TLDs are located in two rings around the VEGP site, an inner ring near the site boundary, and an outer ring about 8 km (5 mi) from the plant (Southern 2004a). All these TLDs are read quarterly and measure the contribution to dose from any source, either natural or anthropogenic including the current reactor buildings and planned ISFSI.

The average annual reading for the environmental TLDs was 0.49 mSv (49 mrem) (Southern 2007a). Southern concluded that these results were not significantly different from control locations and showed no increase in environmental gamma radiation levels resulting from plant operations at the VEGP site. Similar results were observed for the past several years (Southern 2002, 2003b, 2004b, 2005).

Southern estimated direct radiation exposure to construction workers by using protected area fenceline TLD measurements (Southern 2007a). The average annual readings for the six fenceline TLDs nearest the proposed construction site was 1.159 mSv (115.9 mrem) with a 95 percent plant capacity factor, which scales to 1.217 mSv (121.7 mrem) assuming a 100 percent plant capacity factor (Southern 2007b). Subtracting the average annual result for the environmental TLDs yields 0.727 mSv (72.7 mrem), the annual dose contribution to VEGP Unit 3 and 4 construction workers attributable to operating VEGP Units 1 and 2. Southern (2007a) estimated the direct radiation to construction workers from the planned ISFSI to be 0.15 mSv (15 mrem) per year for the VEGP Unit 3 construction workforce and negligible for the VEGP Unit 4 workforce. This corresponds to an annual dose rate to the VEGP Unit 3 construction workforce of 0.877 mSv (87.7 mrem) per year. Southern (2007b) also estimated that, in addition to the 0.727 mSv (72.7 mrem) per year contribution from VEGP Units 1 and 2, that VEGP Unit 4 construction workers would receive an additional 0.364 mSv (36.4 mrem) from operation of VEGP Unit 3. This corresponds to an annual dose rate to the VEGP Unit 4 construction workforce of 1.091 mSv (109.1 mrem). This corresponds to a dose rate of about 0.125 μSv/hr (12.5 μrem/hr). A construction worker present for 2080 hours per year in a dose rate field of about 0.125 μSv/hr (12.5 μrem/hr) would receive an annual dose of 0.260 mSv (26.0 mrem).

4.9.2 Radiation Exposures from Gaseous Effluents

The VEGP site releases gaseous effluents via the common station heating, ventilating, and air conditioning stack; the condenser air injector; the steam packing exhaust system; the Radwaste Processing Facility; and the Dry Active Waste Building. Releases from the waste gas decay tanks are through the VEGP Unit 1 plant vent, and containment purges are released through the VEGP Unit 1 and 2 plant vents (Southern 2007a). Southern estimated construction worker dose from gaseous effluents using release data for the year 2002, which resulted in the highest public exposure for the period from 2001 to 2004 (Southern 2007a). The annual total effective dose equivalent to a construction worker from gaseous effluents was 0.0116 mSv (1.16 mrem) (based on an occupancy of 2000 hr/yr) (Southern 2007a). Adjusting this dose for the expected occupancy of a construction worker (i.e., 2080 hours per year), the annual dose from gaseous effluent releases becomes 0.0121 mSv (1.21 mrem). A review of annual effluent release reports for the past several years showed this dose to be typical (Southern 2002, 2003b, 2004b, 2005). The dose to construction workers from the gaseous effluent releases would be negligible compared to the dose from direct radiation exposure.

4.9.3 Radiation Exposures from Liquid Effluents

Southern confirmed radiation exposures from liquid effluents to be a negligible contribution to construction-worker dose (Southern 2007a). Southern estimated the annual dose to a construction worker from liquid effluents to be 0.00034 mSv (0.034 mrem) (Southern 2007a). This estimate was based on an occupancy of 2000 hr/yr and assumed that construction workers would consume locally caught fish and drink surface water. Adjusting this dose for the expected occupancy of a construction worker (i.e., 2080 hr/yr) and assuming a 100 percent plant capacity factor yields an annual dose of 0.00037 mSv (0.037 mrem) per year. Using liquid effluents release data for the year 2001 (Southern 2002) resulted in the highest public exposure for the period from 2001 to 2004. A review of radioactive effluent release reports for the past several years confirmed these releases to be typical (Southern 2002; 2003b; 2004b; 2005). The dose to construction workers from the liquid effluent releases would be negligible compared to the dose from direct radiation exposure.

4.9.4 Total Dose to Site-Preparation Workers

Southern (2007b) estimated an annual dose to a site-preparation worker of 0.229 mSv (22.9 mrem) from the direct radiation pathway assuming an occupancy of 2000 hr/yr and a 95 percent plant capacity factor. Doses from liquid and gaseous effluent releases are negligible compared to the dose from direct radiation. The annual dose estimate for the site-preparation workers, based on an occupancy of 2000 hr/yr, would be approximately 0.241 mSv (24.1 mrem) (Southern 2007a). Adjusting this dose for the expected occupancy of a construction worker (i.e., 2080 hr/yr) and assuming a 100 percent plant capacity factor yields an annual dose of 0.263 mSv (26.3 mrem), which is less than the 1 mSv (100 mrem) annual dose to an individual member of the public found in 10 CFR 20.1301. If the dose estimate had exceeded 100 mrem annually, the site-preparation workers would need to be treated as radiological workers and would be subject to the annual occupational dose limit of 0.05 Sv (5 rem) found in 10 CFR 20.1201.

The maximum estimated annual collective dose to site-preparation workers, based on an annual individual dose of 0.263 mSv (26.3 mrem) and an estimated workforce of 4400 workers, is 1.16 person-Sv (116 person-rem).

4.9.5 Summary of Radiological Health Impacts

Having reviewed the Southern estimate of dose to site-preparation workers during construction activities, the staff found the doses to be well within NRC annual exposure limits (i.e., 1 mSv [100 mrem]) designed to protect the public health, even if workers exceeded an occupancy rate of 2080 hr/yr. Assuming the proposed location of VEGP Units 3 and 4 does not change, the staff concludes that the impacts of radiological exposures to site-preparation workers would be SMALL.

4.10 Measures and Controls to Limit Adverse Impacts During Site-Preparation Activities and Construction

The following measures and controls would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, spill response and cleanup, hazardous material management)

- compliance with applicable requirements of existing permits and licenses (e.g., the NPDES permit and the operating license) for the existing units and other permits or licenses required for construction of the new units (e.g., ACE Section 404 Permit)

- compliance with existing Southern processes and/or procedures applicable to construction environmental compliance activities for the VEGP site (e.g., solid waste management, hazardous waste management, and spill prevention and response)

- incorporation of environmental requirements into construction contracts.

- identification of environmental resources and potential impacts during the development of the ER and the ESP process.

Table 4-6 lists a summary of measures and controls proposed by Southern to limit adverse impacts during construction of Units 3 and 4 at the VEGP site (Southern 2007a).

Table 4-6. Summary of Measures and Controls Proposed by Southern to Limit Adverse Impacts during Construction of Units 3 and 4 at the VEGP Site (Southern 2007a)

Impact Category	Specific Measures and Control
Land-Use Impacts	
The Site and Vicinity	• Conduct ground-disturbing activities in accordance with regulatory and permit requirements. Use adequate erosion controls and stabilization measures to minimize impacts. • Limit vegetation removal to the area within the site designated for construction activities. • Minimize potential impacts to wetlands through avoidance and compliance with applicable permitting requirements. • Restrict soil stockpiling and reuse to designated areas on the site. • Restrict construction activities to the VEGP site.

Table 4-6. (contd)

Impact Category	Specific Measures and Control
Transmission Line Right-of-Way and Offsite Areas	• Site new right-of-way to avoid critical or sensitive habitats/species as much as possible. • Restrict sites of access of construction equipment to the right-of-way. • Minimize potential impacts through avoidance and compliance with permitting requirements and BMP.
Historic Properties and Cultural Resources	• Conduct cultural resource surveys, including subsurface sampling prior to initiating ground-disturbing activities to identify buried historic or cultural or paleontological resources. • Follow established Southern procedures to stop work if a potential historic or cultural or paleontological resource is discovered. • Follow established Southern procedure to contact appropriate regulatory agencies if a potential historic or cultural or paleontological resource is discovered.
Water-Related Impacts	
Hydrologic Alterations	• Adhere to applicable regulations and permits. • Install drainage controls to direct dewatering runoff. • Wells in area are in deep aquifer that should not be affected by construction.
Water-Use Impacts	Southern did not propose any additional measures or controls.
Water-Quality Impacts	• Install cofferdams in Savannah River. • Install stormwater drainage system at construction sites and stabilize disturbed soils. • Use BMP to minimize erosion and sedimentation. • Use good construction practices to maintain equipment, and prevent spills and leaks. • Invoke Southern's existing Spill Prevention Control and Countermeasure Plan (SPCC) for construction activities
Ecological Impacts	
Terrestrial Ecosystems	Southern did not propose any additional mitigation or controls.
Aquatic Ecosystems	• Develop and implement a construction Stormwater Pollution Prevention Plan (SWPPP). • Invoke the existing Southern SPCC plan for construction activities. • Implement erosion and sediment control plans that incorporates recognized BMP. • Install appropriate barriers in river prior to construction.

Table 4-6. (contd)

Impact Category	Specific Measures and Control
Socioeconomic Impacts	
Physical Impacts	• Train and appropriately protect Southern employees and construction workers to reduce the risk of potential exposure to noise, dust, and exhaust emissions. • Provide onsite services for emergency first aid, and conduct regular health and safety monitoring. • Provide appropriate job training to construction workers. • Make public announcements or prior notification of atypically loud construction activities. • Use dust-control measures (such as watering, stabilizing disturbed areas, covering trucks). • Manage concerns from adjacent residents or visitors on a case-by-case basis through an Southern Concerns Resolution Program. • Post signs near construction entrances and exits to make the public aware of potentially high construction traffic areas. • Develop traffic control mitigation plan.
Social and Economic Impacts	• Stagger shifts, encourage car or van pooling; time deliveries to avoid shift change or commute times. • Erect signs alerting drivers of the construction and the potential for increased construction traffic. • Mitigation of any housing shortage would be through new construction in anticipation of arrival of construction workforce. • Increased tax revenues as a result of the large construction project would fund additional community services.
Environmental Justice Impacts	Southern did not propose any additional measures or controls beyond those listed above.
Radiation Exposure to Construction Workers	Southern did not propose any additional measures or controls.
Nonradiological Health Impacts	• Provide job-training and implement procedures to ensure a safe working environment. • Provide first-aid capabilities at the construction site.

4.11 Site Redress Plan

Southern requested that it be allowed to conduct site-preparation activities at the VEGP site as authorized by 10 CFR 52.17(c), 10 CFR 52.25, and 10 CFR 50.10(e)(1). Southern stated that it might choose to perform some or all of the activities described in Section 1-3 of the site redress plan (Southern 2007a). Southern included in its application, as required by 10 CFR 52.17(c), a site redress plan that would be implemented if site-preparation and preliminary construction, activities were performed, and the ESP expires before the issuance of a CP or COL by the NRC (Southern 2007a). The objective of the site redress plan is to ensure that the VEGP site would be returned to an environmentally stable and aesthetically acceptable condition if the proposed VEGP Units 3 and 4 were not fully developed to provide new nuclear power generation. Under the site redress plan, areas that were permanently disturbed would be stabilized and contoured to conform to surrounding areas. Re-vegetation of disturbed lands would be conducted.

Prerequisites of site-preparation activities that must be fulfilled before performing such activities include:

- Documentation of existing site conditions within the VEGP site by way of photographs, surveys, listings of existing facilities and structures, or other documentation. This record would serve as the baseline for redressing the site in the event ESP site-preparation activities were terminated as a result of project cancellation or expiration of the ESP.

- Coordination of agreements between the site's co-owners and Southern. This agreement would allow Southern to carry out site-preparation activities.

- Coordination of the movement of the existing VEGP site protected area boundary, as required. These activities would be coordinated with the current VEGP units to accomplish the movement of structures reflected in the VEGP licensing basis in a manner consistent with its operating license and the applicable regulations governing that license.

- Movement, demolition, or ownership transfer of existing VEGP site buildings and structures within the VEGP site. These activities would be coordinated with VEGP to accomplish the movement, demolition, or ownership transfer of structures reflected in the VEGP licensing basis in a manner consistent with its operating license and the applicable regulations governing that license.

- Obtaining the necessary permits to perform preconstruction activities, such as local building permits, NPDES permit, Clean Water Act permit, General Stormwater Permit, etc.

After these prerequisites were completed, planned site-preparation activities could proceed and might include some or all of the following activities pursuant to 10 CFR 52.17(c) and 10 CFR 50.10(e)(1). In its ESP application, Southern requested approval to perform the following site-preparation and preliminary construction activities for the new units at the VEGP site (Southern 2007a):

- Prepare the site for construction of the facilities (including such activities as clearing, grading, construction of temporary access roads, and preparation of borrow areas).

- Install temporary construction support facilities (including items such as warehouses, shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and construction support buildings).

- Excavate for facility structures.

- Construct service facilities (including items such as roadways, paving, railroad spurs, fencing, exterior utility and lighting systems, on-site transmission lines, and sanitary sewage treatment facilities).

- Construct structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public, including but not limited to:

  + cooling towers
  + intake and discharge structures
  + circulating water lines
  + fire protection equipment
  + switchyard and onsite interconnections
  + barge slip modification.

The environmental impacts of site-preparation activities allowed pursuant to 10 CFR 50.10(e)(1) are bounded by environmental impacts for construction of the entire facility. In many cases, the impacts of site-preparation activities and construction may be similar, but the impacts resulting solely from site-preparation activities would be of a shorter duration. In the preceding sections in this chapter, the staff has presented impacts of construction that bound the impacts of site preparation. If the ESP expires before an application for a CP or COL is received under 10 CFR Part 52, Subpart C, and site-preparation activities have occurred, the site redress plan would be activated to return the VEGP site to an environmentally stable and aesthetically acceptable condition suitable for future alternative use (presumably non-nuclear) that conforms to local zoning laws, thus minimizing the long-term environmental impacts.

Southern provided a site redress plan as part of its ESP application in the event that site-preparation work did not proceed to full construction (Southern 2007a). The plan identifies the overall objective as to "...reverse, mitigate or stabilize environmental impacts incurred during the site-preparation activities." In its plan, Southern states that redress activities would reflect applicable land-use and zoning requirements and identifies the following two general redress activities for consideration:

- topographic approaches that accomplish the objective and preserve the potential of the site for future industrial use.

- completion or addition of site development features that enhance the value of the site for potential future industrial use.

The staff has reviewed the list of allowed site-preparation activities in the event that the ESP is granted and has reviewed the full site redress plan submitted by Southern. As a result of NRC's own independent review, the staff, in accordance with 10 CFR 52.25(a), concludes that the potential site-preparation activities described in Southern's site redress plan would not result in any significant adverse environmental impacts that could not be redressed.

4.12 Summary of Construction Impacts

Impact level categories are denoted in Table 4-7 as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. A brief statement explains the basis for the impact level. Some impacts, such as the addition of tax revenue from Southern for the local economies, are likely to be beneficial impacts to the community.

Table 4-7. Characterization of Impacts from Construction of New Units at the VEGP Site

Category	Comments	Impact Level
Land-Use Impacts		
Site and Vicinity	Construction activities would take place within existing site boundaries.	SMALL
Transmission Line and Offsite Areas	New right-of-way would be developed.	MODERATE
Air-Quality Impacts		
Construction Activities	Construction activities would be conducted in accordance with applicable State requirements, and dust and emissions would be minimized through a dust-control plan.	SMALL
Transportation	Air quality would not be degraded sufficiently to be noticeable beyond the immediate vicinity.	SMALL
Water-Related Impacts		
Hydrological Alterations	Impacts localized and temporary. CWA Section 401 and other permit processes would be adequate to ensure impacts would be SMALL.	SMALL
Water Use	Dewatering may cause localized temporary declines in the water table.	SMALL
Water Quality	Construction would be conducted using BMP to control spills and stormwater runoff.	SMALL

Table 4-7. (contd)

Category	Comments	Impact Level
Ecological Impacts		
Terrestrial Ecosystems		
Site and Vicinity	Construction activities would have minimal impact to terrestrial ecological resources and habitat in the vicinity of the VEGP site.	SMALL
Transmission Line Rights-of-Way	Impact would depend on specific routine of transmission line right-of-way.	SMALL to MODERATE
Aquatic Ecosystems	Construction activities would have minimal impact to aquatic ecological resources and habitat.	SMALL
Threatened and Endangered Species		
Site and Vicinity	Construction impacts to Federally listed species are expected to be negligible.	SMALL
Transmission Line Rights-of-Way	Impact would depend on specific routing of transmission line right-of-way.	SMALL to MODERATE
Socioeconomic Impacts		
Physical Impacts		
Workers/Local Public	Construction would take place within existing site boundaries, so impact on the public would be minimal. Impact on workers would be mitigated with training and protective equipment.	SMALL
Buildings	Construction would not affect any offsite buildings, and onsite buildings were constructed to withstand vibration from construction activities.	SMALL
Roads	Growth would put pressure on local road systems, but traffic control and management measures would protect any local roads during construction.	SMALL
Aesthetics	Construction activities would be temporary and would occur on a site already occupied by a nuclear power facility, resulting in SMALL onsite aesthetic impacts. Construction of the new transmission line will likely result in MODERATE impacts.	SMALL to MODERATE
Demography	Percentage of construction workers relocating to the region likely would be SMALL relative to the existing population base except in Burke County where the impact could be MODERATE.	SMALL to MODERATE
Economic Impacts to Community		
Economy	Economic impact of construction overall would be beneficial to local economies. In Burke County beneficial impacts would likely be MODERATE while impacts elsewhere would be SMALL.	SMALL to MODERATE Beneficial
Taxes	Degree of impact depends on the distribution of tax revenues to county or state; generally impact is beneficial, especially for property taxes. Under current tax laws, the beneficial impact of additional taxes would be MODERATE in Burke County.	SMALL to MODERATE Beneficial

Table 4-7. (contd)

Category	Comments	Impact Level
Impacts to Community - Infrastructure and Community		
Transportation	Traffic impacts on River Road could be MODERATE during peak construction period; however if properly planned and managed, impacts could be reduced with specified mitigation measures to deal with temporary construction impacts.	MODERATE
Recreation	Visual impact of construction would be limited to those boating on the Savannah River. Congestion during peak construction could interfere with hunting and fishing in area.	SMALL
Housing	Adequate housing is available in the greater Augusta area to handle construction workers. If workers concentrate in Burke County, the impact could be moderate.	SMALL
Public Services	Public services are adequate for any temporary influx of workers resulting from construction at the VEGP site.	SMALL
Education	Excess capacity in Burke County School District ensures adequate infrastructure exists to support the temporary influx of workers.	SMALL
Historic and Cultural Resources	Adverse effects are expected at one site (9BK416) and Southern is working with GA SHPO to address these impacts and to effect protective measures for another site (9BK423). Southern has committed to develop procedures to manage cultural resources in the event of an inadvertent discovery.	MODERATE
Environmental Justice	Physical impacts would be SMALL. Economic impacts would likely be beneficial.	SMALL
Nonradiological Health Impacts	Emission controls and remote location of the VEGP site would keep nonradiological health impacts small. Adherence to Federal and State Regulations assumed to protect occupational workers.	SMALL
Radiological Health Impacts	Exposures would be below NRC annual occupational and public dose limits.	SMALL

4.13 References

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10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor,* Part 1910, "Occupational Safety and Health Standards."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic and Cultural Properties."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

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5.0 Station Operational Impacts at the Proposed Site

This chapter examines environmental issues associated with operation of the proposed new nuclear Units 3 and 4 at the Vogtle Electric Generation Plant (VEGP) site for an initial 40-year period as described by Southern Nuclear Operating Company, Inc. (Southern). As part of this application, Southern submitted an Environmental Report (ER) that discussed the environmental impacts of station operation (Southern 2007a). This chapter is divided into 13 sections. Sections 5.1 through 5.11 discuss the potential operational impacts on land use, meteorology and air quality, water, terrestrial and aquatic ecosystems, socioeconomics, historic and cultural resources, environmental justice, nonradiological and radiological health effects, postulated accidents, and applicable measures and controls that would limit the adverse impacts of station operation during the 40-year operating period. In accordance with Title 10 of the Code of Federal Regulations (CFR) Part 51, impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned to each analysis. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such. The staff's determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades, as discussed throughout this chapter, are implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. A summary of these impacts is presented in Section 5.12. The references cited in this chapter are listed in Section 5.13.

5.1 Land-Use Impacts

Sections 5.1.1 and 5.1.2 contain information regarding land-use impacts associated with operation of the proposed VEGP Units 3 and 4 at the VEGP site. Section 5.1.1 discusses land-use impacts at the site and in the vicinity of the site. Section 5.1.2 discusses land-use impacts with respect to transmission line rights-of-way and offsite areas.

5.1.1 The Site and Vicinity

Some offsite land-use changes can be expected as a result of operational activities. Possible changes include the conversion of some land in surrounding areas to housing developments (e.g., recreational vehicles, apartment buildings, single-family condominiums and homes, and manufactured home parks) and retail development to serve plant workers. Property tax revenue from the addition of two new units could also lead to additional growth and land conversions in Burke County as a result of infrastructure improvements (e.g., new roads and utility services). Additional information on operational-related infrastructure impacts is in Section 5.5.4. However, the staff assumes that any growth would be managed because all Georgia counties surrounding the VEGP site have comprehensive land-use plans in place as required by the

Georgia Planning Act of 1989. Based on the existence and projected implementation of land-use plans, the information provided by Southern, and the U.S. Nuclear Regulatory Commission's (NRC's) own independent review, the staff concludes that the land-use impacts of operation would be SMALL, and further mitigation is not warranted.

5.1.2 Transmission Line Rights-of-Way and Offsite Areas

Most land-use impacts would occur during construction of the planned new 500-kV transmission line. Georgia Power Company (GPC) provides easements to allow agricultural activities under its transmission lines. Therefore, impacts are expected to be SMALL and no mitigation would be required. Transmission line right-of-way management practices are discussed in Section 5.4.1.5.

5.2 Meteorological and Air-Quality Impacts

The primary impacts of operation of two new units on local meteorology and air quality would be from releases to the environment of heat and moisture from the primary cooling system (cooling towers), operation of auxiliary equipment (generators and boilers), and emissions from workers' vehicles. The potential impacts of releases from operation of the cooling system are discussed in Section 5.2.1. Section 5.2.2 covers potential air-quality impacts from nonradioactive effluent releases at the VEGP site, and Section 5.2.3 covers the potential air-quality impacts of transmission line rights-of-way during plant operation.

5.2.1 Cooling Tower Impacts

The proposed cooling system for the proposed Units 3 and 4 at the VEGP site is a natural draft cooling tower. A total of two cooling towers would be constructed–one for each new nuclear unit. Natural draft cooling towers remove excess heat by evaporating water. Upon exiting the cooling tower, water vapor mixes with the surrounding air and this process can lead to condensation and the formation of a visible plume. Aesthetic impacts from the visible plume as well as land-use impacts from cloud shadowing, fogging, icing, increased humidity, and drift from dissolved salts and chemicals found in the cooling water can result.

The SACTI (Seasonal and Annual Cooling Tower Impacts) computer code was used by Southern to estimate impacts associated with operating the cooling towers. Select engineering data for the Westinghouse AP1000 reactor design and one year of onsite meteorological data from 1999 were used as input to the SACTI model. Cooling towers were simulated using a height of 180 m (600 ft) (Southern 2007a).

Results from the SACTI analysis, as reported in the ER (Southern 2007a), indicate that on average the longest plume lengths would occur during the winter and the shortest plume lengths would occur during the summer. For both seasons, the predominant plume direction is to the north, followed by northeast during the winter and north-northeast during the summer. The longest plume length is 9.7 km (6.0 mi), with a frequency of 3.9 percent in the winter and 0.5 percent in the summer. Ground-level fogging or icing is likely to be infrequent because of the height of the cooling towers. Deposition of salts from cooling tower drift would occur in all directions from the towers. The maximum estimated solids deposition rate for each tower is 4.0 kg/ha/mon (3.6 lb/ac/mon) and occurs 488 m (1600 ft) north of the towers.

An existing pair of cooling towers for VEGP Units 1 and 2 operate at the VEGP site. These cooling towers are located approximately 1219 m (4000 ft) to the east-northeast of the proposed cooling towers for the proposed VEGP Units 3 and 4 (Southern 2007a). This separation distance is greater than the distance to the maximum deposition rate of 490 m (1600 ft) predicted for the new cooling towers (Southern 2007a). Moreover, given the location and orientation of the proposed cooling towers with respect to the existing cooling towers, it is unlikely that plumes would interact appreciably for any extended period of time. Therefore, the NRC staff concludes that there are no significant cumulative impacts from the cooling towers on air quality.

Diesel generators and boilers currently operate at VEGP for limited periods; generators and boilers that would be associated with the proposed VEGP Units 3 and 4 would similarly operate for limited periods. Interaction between pollutants emitted from these sources and the cooling tower plumes would be intermittent and would not have a significant impact on air quality. Based on the above considerations and the assumption that cooling towers associated with the new units would be similar to existing cooling towers used at nuclear sites, the staff concludes the cooling tower impacts on air quality would be SMALL and that additional mitigation of air-quality impacts would not be warranted.

5.2.2 Air-Quality Impacts

Additional standby diesel generators and auxiliary power systems would be used for emergency power and auxiliary steam purposes. These systems would be used on an infrequent basis and pollutants discharged (e.g., particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides) would be permitted in accordance with the Georgia Department of Natural Resources (GDNR) and Federal regulatory requirements (Southern 2007a). Because these systems would be used on an infrequent basis (i.e., typically a few hours per month), the staff concludes that the environmental impact of pollutants from these sources would be SMALL and that additional mitigation would not be warranted.

Nuclear power generation by itself does not result in carbon dioxide emissions, and the emissions associated with auxiliary equipment are small because of the intermittent operation of the equipment. However, when the uranium fuel cycle is considered, there are carbon dioxide emissions associated with nuclear power. Table S–3 in 10 CFR 51.51 indicates that the oxides of nitrogen emitted in the fuel cycle are approximately 5 percent of the oxides of nitrogen emitted by a coal-fired plant. Extending this analogy to carbon dioxide and considering advances in fuel cycle technology, the staff estimates that uranium fuel cycle carbon dioxide emissions for the postulated plant would be less than 0.82 million metric tons (0.9 million tons).

5.2.3 Transmission Line Impacts

Impacts of existing transmission lines on air quality are addressed in the Generic Environmental Impact Statement for License Renewal (GEIS) (NRC 1996). Small amounts of ozone and even smaller amounts of oxides of nitrogen are produced by transmission lines. The production of these gases were found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1200-kV transmission line. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted.

One new 500-kV transmission line would be constructed to accommodate the new power generating capacity (Southern 2007a). This size is well within the range of transmission lines provided in the GEIS and the staff therefore concludes that air-quality impacts from transmission lines would be SMALL.

5.3 Water-Related Impacts

This section discusses water-related impacts to the surrounding environment from operation of the proposed VEGP Units 3 and 4. Details of the operational modes and cooling water systems associated with operation of the plant can be found in Section 3.2.2 of this environmental impact statement (EIS).

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, objectives. At the VEGP site, these objectives include navigation, recreation, visual aesthetics, a fishery, and a variety of beneficial consumptive domestic, farming, and industrial uses of water. The responsibility for regulating water use and water quality is delegated to the U.S. Army Corps of Engineers (USACE) and the GDNR through Federal and State of Georgia laws, respectively.

Water-use and water-quality impacts involved with operation of a nuclear plant are similar to the impacts associated with any large thermoelectric power generation facility. Accordingly, Southern must obtain the same water-related permits and certifications as any other large industrial facility. These would include:

- <u>Clean Water Act Section 401 Certification</u>. This certification would be issued by the GDNR and would ensure that operation of the plant would not conflict with State water-quality-management programs.

- <u>Clean Water Act Section 402(p) National Pollutant Discharge Elimination System (NPDES) Discharge Permit</u>. This permit would be issued by the GDNR and would regulate limits of pollutants in liquid discharges to surface water.

- Clean Water Act Section 316(a). This section regulates the cooling water discharges to protect the health of the aquatic environment.

- Clean Water Act Section 316(b). This section regulates cooling water intake structures to minimize environmental impacts associated with location, design, construction, and capacity of those structures.

- Surface-Water Withdrawal Permit. This GDNR permit limits the quantity of water withdrawn from surface waterbodies, such as the Savannah River (Georgia Code Title 12, Chapter 5, Article 2).

- Groundwater Water-Use Act. This GDNR permit limits the quantity of groundwater withdrawal on the VEGP site (Georgia Code Title 12, Chapter 5, Article 3) .

This section discusses the hydrological alterations and the resulting impacts from operation of the proposed VEGP Units 3 and 4. The combined impacts of operating the proposed VEGP Units 3 and 4 along with VEGP Units 1 and 2, as well as other activities in the surrounding environment are discussed in Chapter 7 (Cumulative Effects) of this EIS.

5.3.1 Hydrological Alterations

Southern states in its ER (Southern 2007a) that water pumped from the Savannah River would be used to make-up water lost by the circulating water system (CWS) to evaporation, blowdown, and drift. Water pumped from groundwater would be used to make-up water lost by the service water system (SWS) to evaporation, blowdown and drift and to satisfy operational demands for demineralized, potable, and fire protection water systems.

The expected maximum surface-water rates for operation of the proposed VEGP Units 3 and 4 are as follows:

- Maximum Savannah River withdrawal is 3646 L/s (57,784 gpm) (Southern 2007a).
- Maximum Savannah River effluent discharge is 1941 L/s (30,761 gpm) (Southern 2007a)

Effluent discharge from the plant would be collected into a common sump before being discharged to the river. The arithmetic difference between Savannah River withdrawals and blowdown are not equivalent to the consumptive water use of Savannah River water because systems fed by groundwater would also contribute to the common sump. The maximum consumptive use of Savannah River water was reported by Southern in its ER to be 1824 L/s (28,904 gpm) (Southern 2007a). Therefore, approximately 94 percent of the maximum effluent discharge is expected to be composed of water originating from the Savannah River, with the remaining 6 percent originating from groundwater.

Hydrogeological alterations to operate the proposed VEGP Units 3 and 4 would be:

- Groundwater would be withdrawn to provide the water needed for operation of the proposed new units.

- Surface infiltration in the vicinity of the proposed VEGP Units 3 and 4 would be altered by the construction of facilities, including a stormwater drainage system, buildings, and parking lots, and maintaining large, vegetation-free graveled areas.

5.3.2 Water-Use Impacts

The existing VEGP Units 1 and 2 are among the largest water users in the region. Likewise, the proposed Units 3 and 4 at the VEGP site would also become major users of surface water and groundwater. Most of the proposed water demands associated with operation of the proposed VEGP Units 3 and 4 would be satisfied through the use of surface water originating from the Savannah River. The ratio of total groundwater withdrawals to surface-water (consumptive) use would be approximately 9 percent. Groundwater would primarily be used to meet operational water demands associated with systems requiring/producing relatively pure water, such as demineralized and potable water systems (Southern 2007a).

5.3.2.1 Surface Water

J. Strom Thurmond Dam, which lies 113.8 river kilometers (RKM) (70.7 river miles [RM]) upstream of the VEGP site, regulates Savannah River discharge in the vicinity. Discharges released from the dam are a function of Drought Level, which is defined by the USACE to be a function of the water volume impounded at Thurmond Dam and the cascade of upstream reservoirs. The drought conditions of 2002 resulted in a new drought of record for the Savannah River Basin (USACE 2006). Following this period of drought, the Drought Contingency Plan was updated for the basin, and the releases from Thurmond Dam at each Drought Level are currently as follows (see Table 2-2 and USACE 2006; NRC 2007a, b):

- Level 1: Weekly-average release discharge of 119 m^3/s (4200 cfs)
- Level 2: Weekly-average release discharge of 113 m^3/s (4000 cfs)
- Level 3: Daily-average release discharge of 108 m^3/s (3800 cfs)
- Level 4: Inflow to Thurmond Dam equals release discharge.

The magnitude of the impact of surface-water withdrawals associated with operating the proposed VEGP Units 3 and 4 would fluctuate with discharge in the Savannah River. The staff evaluated the magnitude of the surface-water withdrawals against a range of river discharges. Results presented in Table 5-1 show that at the normal withdrawal rate of 2.35 m^3/s (83 cfs, 37,224 gpm), the proposed VEGP Units 3 and 4 would withdraw less than 1 percent of the average river discharge. At the maximum withdrawal rate of 3.65 m^3/s (129 cfs, 57,784 gpm), the proposed VEGP Units 3 and 4 would withdraw between 1.4 and 3.4 percent of the total flow of the Savannah River as the river fluctuates between average and Drought Level 3. Comparable levels for drought level 4 are not shown in Table 5-1 since they cannot be calculated because the river discharge is not specified.

A water surface elevation versus discharge relationship was developed by the U.S. Geological Survey (USGS) to monitor discharge near the VEGP site (USGS 2007). Using this relationship and the maximum withdrawal rate of 3.65 m^3/s (129 cfs), the resulting decrease in river stage as a result of operating the proposed VEGP Units 3 and 4 would be approximately 5 cm (2 in.) at Drought Level 3 and approximately 2.5 cm (1 in.) under average discharge conditions.

Approximately 150 m (500 ft) downstream of the existing VEGP Units 1 and 2 intake, an outfall pipe discharges effluent from Units 1 and 2 to the Savannah River. Approximately 120 m (400 ft) downstream of this outfall pipe, the proposed outfall pipe would discharge additional effluent from operation of the proposed VEGP Units 3 and 4. The magnitude of the surface-water withdrawals associated with operation of the proposed VEGP Units 3 and 4 downstream of the site was evaluated by staff by comparing consumptive use relative to Savannah River discharge. Results presented in Table 5-2 show that at normal river discharge, the maximum consumptive use of the proposed VEGP Units 3 and 4 would represent less than 1 percent of the river discharge. During periods when the proposed VEGP Units 3 and 4 would be consuming the maximum quantity of water, the consumptive use of the proposed units would increase to 1.7 percent of the total flow in the Savannah River.

Values in Table 5-2 represent Savannah River water consumed by the cooling water system only; all other plant operation system demands are satisfied from groundwater. Blowdown from these groundwater systems are commingled with cooling water system blowdown before being discharged to the Savannah River. Therefore from a mass balance perspective relative to the Savannah River, the values shown in the table are conservative, because under normal operations, 0.02 m^3/s (0.7 cfs) of additional effluent would be added from groundwater-fed systems. This additional effluent lowers the normal consumptive use by 0.02 percent of the river discharge at Drought Level 3. As in Table 5-1, comparable levels for drought level 4 are not shown in Table 5-2.

As noted in Chapter 2, the accuracy of the Savannah River Stream gauges ranges from approximately 5 to 10 percent of true. Since the maximum withdrawal and consumptive use values are less than 5 percent, the staff concludes that surface-water-use impacts of the proposed VEGP Units 3 and 4 would be SMALL, and mitigation is not warranted.

Table 5-1. Savannah River Discharge and Surface-Water Withdrawals

	River Discharge		**Normal Withdrawal**			**Maximum Withdrawal**		
Case	**m^3/s**	**(cfs)**	**m^3/s**	**(cfs)**	**as % of river**	**m^3/s**	**(cfs)**	**as % of river**
Average Conditions	250	8830	2.35	83	0.9	3.65	129	1.4
Drought Level 1	119	4200	2.35	83	2.0	3.65	129	3.1
Drought Level 2	113	4000	2.35	83	2.1	3.65	129	3.2
Drought Level 3	108	3800	2.35	83	2.2	3.65	129	3.4

Withdrawal source: Southern 2007a

Table 5-2. Consumptive Use of Savannah River Water

	River Discharge		Normal Consumptive Use			Maximum Consumptive Use		
Case	m^3/s	(cfs)	m^3/s	(cfs)	as % of river	m^3/s	(cfs)	as % of river
Average Conditions	250	8830	1.76	62	0.7	1.81	64	.7
Drought Level 1	119	4200	1.76	62	1.5	1.81	64	1.5
Drought Level 2	113	4000	1.76	62	1.6	1.81	64	1.6
Drought Level 3	108	3800	1.76	62	1.6	1.81	64	1.7

Withdrawal source: Southern 2007a

5.3.2.2 Groundwater

The potential impacts from groundwater use are described in Section 5.2.2.2 of the ER (Southern 2007a) and in Southern's response to Requests for Additional Information (Southern 2007b,c). The existing VEGP Units 1 and 2 are among the largest users of groundwater in the region. The proposed VEGP Units 3 and 4 at the VEGP site would use groundwater to supply make-up water for the SWS, the fire protection system, the plant demineralized water system, the potable water supply, and other miscellaneous water uses.

Wells at the VEGP site are permitted currently by the State of Georgia Environmental Protection Division, to withdraw an annual average rate of 20,800 m^3/d (5.5 MGD, 3819 gpm) with a maximum monthly average of 22,700 m^3/d (6 MGD, 4167 gpm). Records for 2005 (Southern 2007a) indicate that only 0.30 L/s (4 gpm) was withdrawn from the Tertiary aquifer while 36.72 L/s (582 gpm) was withdrawn from the Cretaceous aquifer. Thus, the majority of the groundwater resource used by the VEGP site is withdrawn from the Cretaceous aquifer, and the rate of withdrawal is well below the permitted level.

Three of the VEGP site's existing nine groundwater wells at the VEGP site are completed in the confined Cretaceous aquifer and are used now to supply make-up water for the operation of Units 1 and 2. The six additional wells are completed in the confined Tertiary aquifer and provide water for site-specific operations.

A potential offsite impact during the operation of the proposed VEGP Units 3 and 4 from projected water use is related to the water budget of the aquifer system. Impacts are the withdrawal of groundwater that would not be available to others, as well as the physical drawdown of the hydraulic head of the confined aquifer that implies pumping cost increases for neighboring groundwater users.

Projected annual average groundwater resource use for the operation of the existing and proposed units at normal and maximum operating conditions are shown in Table 5-3.

Table 5-3. Drawdown Resulting from Groundwater Withdrawal During Operation of the Proposed VEGP Units 3 and 4

Water Withdrawal Scenario	Time Period	Pumping Rate L/s	(gpm)	Drawdown at 5700' m	(ft)	Drawdown at 3500' m	(ft)
Aquifer response 2025							
Units 1 and 2 normal	39 yr	46.1	(730)	1.80	(5.89)	1.95	(6.40)
Units 3 and 4 normal	11 yr	47.4	(752)	1.64	(5.37)	1.80	(5.91)
		93.5	(1482)	3.44	(11.26)	3.75	(12.31)
Aquifer response 2045							
Units 1 and 2 normal	59 yr	46.1	(730)	1.86	(6.11)	2.02	(6.62)
Units 3 and 4 normal	31 yr	47.4	(752)	1.81	(5.94)	1.97	(6.47)
		93.5	(1482)	3.67	(12.05)	3.99	(13.09)
Unit 1 or 2 maximum 30 days							
Unit 1 or 2 max	30 d	72.5	(1150)	1.26	(4.13)	1.51	(4.94)
Unit 2 or 1 normal		23.1	(365)	0.40	(1.31)	0.48	(1.57)
Units 3 and 4 normal		47.4	(752)	0.83	(2.70)	0.99	(3.24)
				2.49	(8.14)	2.98	(9.75)
Unit 3 or 4 maximum 30 days							
Units 1 and 2 normal	30 d	46.1	(730)	0.80	(2.62)	0.96	(3.14)
Unit 3 or 4 normal		23.7	(376)	0.41	(1.35)	0.49	(1.62)
Unit 4 or 3 max		99	(1570)	1.72	(5.65)	2.06	(6.75)
				2.93	(9.61)	3.51	(11.51)
Four units maximum 30 days							
Units 1 and 2 max		145	(2300)				
Units 3 and 4 max	30 d	198	(3140)	5.96	(19.54)	7.13	(23.39)
		343	(5440)				
Four units maximum 2 days							
Units 1 and 2 max		145	(2300)				
Units 3 and 4 max	2 d	198	(3140)	2.70	(8.85)	3.87	(12.70)
		343	(5440)				

The normal operating groundwater demand for both existing and proposed units would be 93.5 L/s (1482 gpm) and the maximum operating groundwater demand would be 343 L/s (5440 gpm). Six cases of groundwater withdrawal are presented in Table 5-3. They quantify aquifer drawdown in the year 2025 and 2045 for normal operation, drawdown after 30 days for several maximum water withdrawal examples, and a drawdown after 2 days for the maximum withdrawal case.

To evaluate the potential offsite impacts of groundwater use by the proposed units, drawdown calculations have been completed using conservative analysis methods. The existing Cretaceous aquifer well closest to the VEGP site property boundary has been selected as a representative location for water withdrawal, and the shortest distance to the boundary has been chosen as the distance to the nearest future offsite groundwater user. Analyses by Southern employed a well 1740 m (5700 ft) from the facility boundary; however, Southern also identifies proposed locations for new wells and one is approximately 1070 m (3500 ft) from the boundary. The staff has analyzed both cases.

Conservative models are employed by Southern and the NRC staff to estimate drawdown in the confined Cretaceous aquifer as a result of groundwater withdrawal from the Cretaceous aquifer. A simplified form of the Theis equation for estimating drawdown in a confined aquifer (Theis 1935; Cooper and Jacob 1946) was used to estimate drawdown in the Cretaceous aquifer. This analysis assumes the aquifer is homogeneous, isotropic, has negligible recharge and gradient, as well as negligible boundary impacts. The water is assumed to be released from storage within the aquifer in response to declining hydraulic head. This is a conservative representation because not all of the water withdrawn by pumping comes from storage because there are recharge and gradients. The analysis is also conservative because it focuses the cumulative withdrawal from multiple wells at one point nearest to a hypothetical offsite groundwater user. Several groundwater wells completed in the Cretaceous aquifer would be used to withdraw groundwater. Groundwater users of the Cretaceous aquifer are several miles away.

Cretaceous Aquifer

Data on the hydraulic properties of the Cretaceous aquifer are published in the Final Safety Analysis Report for VEGP Units 1 and 2 (Southern 2003) and were gathered during the installation and testing of the deep production wells. The transmissivity of 0.0227 m^2/s (158,000 g/d/ft) is identified by Southern (2007a) as a mid-range value for use in analyses. The storativity value of 3.1×10^{-4} (dimensionless) is the arithmetic mean of values reported in the Final Safety Analysis Report.

Estimated drawdowns for the normal and maximum withdrawal rates are shown in Table 5-3. The normal withdrawal case with a well-to-boundary distance of 1740 m (5700 ft) for all units operating and a cumulative rate of 93.5 L/s (1482 gpm), yields approximately 3.44 m (11.3 ft) of drawdown through 2025 (approximately 39 years of operation for Units 1 and 2, approximately 11 years of operation for the proposed VEGP Units 3 and 4). The same rates yield approximately 3.67 m (12.1 ft) of drawdown through 2045 (approximately 59 years of operation for VEGP Units 1 and 2, approximately 31 years of operation for the proposed VEGP Units 3 and 4). From VEGP Units 1 and 2 operation alone, these represent differences of approximately 1.6 m (5.4 ft) and 1.8 m (5.9 ft) for the water withdrawal associated with proposed VEGP Units 3 and 4. If either Units 1 or 2 were to require maximum groundwater withdrawal, the difference in drawdown after 30 days would be approximately 0.86 m (2.8 ft). If either of the new units were to require maximum groundwater withdrawal, the difference in drawdown after 30 days would be approximately 1.3 m (4.3 ft). If all four units were to require maximum off-normal groundwater withdrawal, the difference in drawdown after 30 days would be less than 4.6 m (15 ft) at the property boundary.

In addition to confirming Southern's calculations of drawdown, the staff used the proposed well locations that are approximately 1070 m (3500 ft) from the property boundary to calculate drawdown. Estimates of drawdown increased roughly 10 percent for mulityear estimates for all normal pumping rates and roughly 20 percent for 30-day estimates involving maximum pumping rates.

The estimates above reflect the potential impact at the property boundary. The closest users of the Cretaceous aquifer are a municipal well 23.3 km (14.5 mi) away, an industrial well 13.7 km (8.5 mi) away and Savannah River Site wells located in D-Area 6.4 km (4 mi) away. At these distances the change in drawdown resulting from the production of water during operation of the proposed VEGP Units 3 and 4 through 2045 (approximately 30 years after startup of the proposed units) is estimated as less than 1.5 m (5 ft) for these users.

The original water level of the Cretaceous aquifer prior to Units 1 and 2 operations was approximately 56.1 m (184 ft) above mean sea level (MSL) in the vicinity of the VEGP site. The base of the upper confining strata for the Cretaceous aquifer is at an elevation of approximately -77.4 m (-254 ft) MSL; therefore, the original confining hydraulic head was approximately 133.5 m (438 ft) above the aquifer sediments. Based on recent submittals by Southern to the State of Georgia (Southern 2006a), since VEGP Units 1 and 2 operations began in 1987 and 1989, the hydraulic head of the Cretaceous aquifer has dropped approximately 4.6 m (15 ft) in the vicinity of well MU-1 and 7 m (23 ft) in the vicinity of MU-2A in 2004 (Southern 2003; Southern 2007a, b). Clearly, the pumping stress to support the proposed Units 3 and 4 would not dewater an aquifer with an excess of 120 m (400 ft) of confining hydraulic head, and does not substantially alter drawdown at offsite well locations.

Based on the USGS study of region and the water budget developed for that analysis (see Section 2.6.1.2), the 47.4 L/s (752 gpm) average long-term groundwater demand represents 1.1 percent of the regional groundwater (i.e., Cretaceous aquifer) discharge to the Savannah River. The average long-term demand also represents recharge to the regional groundwater system from an area approximately half the size of the VEGP site based on the 1.9 in./yr recharge rate estimated by the USGS.

Tertiary Aquifer

A review of hydraulic head contour plots for the Tertiary aquifer during 1971 and 1984 (Southern 2003), and June 2005 to June 2006 (Southern 2007a) reveal a gradual decline in the hydraulic head of the Tertiary aquifer during the period covering construction and operation of VEGP Units 1 and 2. In the vicinity of VEGP Units 1 and 2, where the record is longer, the decline is as much as 4.6 m (15 ft) since 1971 and 1.5 m (5 ft) since 1984, (i.e., hydraulic head of 35.1 m [115 ft] in 1971, 32.0 m [105 ft] in 1984, and 30.5 m [100 ft] in June of 2006). Most of this change occurred prior to Unit 1 coming online in 1987. Since 1971, the data set has undergone substantial change in spatial coverage and temporal continuity; and, consequently, there is not a long-term record of change in the immediate vicinity of the proposed VEGP

Units 3 and 4. However, the rate of pumping documented in 2005, 0.25 L/s (4 gpm), would result in a undetectable drawdown in the Tertiary aquifer at the VEGP site boundary as a result of groundwater withdrawals from the Tertiary aquifer.

The hydraulic heads of the Cretaceous aquifer and Tertiary aquifer in the vicinity of the VEGP site are approximately 49 m (160 ft) and 37 m (120 ft) above MSL, respectively. Thus, there is an upward gradient driving groundwater from the Cretaceous toward the Tertiary aquifer. Further, records submitted by Southern to the State of Georgia reveal that pumping the Cretaceous aquifer results in drawdowns less than 12 m (40 ft). Accordingly, an upward gradient is maintained during pumping of the Cretaceous and negligible impact on the Tertiary aquifer is anticipated.

Water Table Aquifer

The Water Table aquifer appears to be hydraulically isolated from the underlying confined Tertiary aquifer by the Blue Bluff Marl. The hydraulic head of the Water Table aquifer ranges from 50.3 to 43 m (165 to 140 ft) above MSL in the vicinity of the power block. The head in the Tertiary aquifer ranges from 38.1 to 32 m (125 to 105 ft) above MSL in the same vicinity. A downward gradient exists between these two aquifers, driving groundwater from the Water Table aquifer toward the Tertiary aquifer (Southern 2007a). In the vicinity of the VEGP site, the Blue Bluff Marl separating these two aquifers is believed to be a high-integrity confining unit; this is supported by the hydraulic head difference observed between the two aquifers at all but one location. Hydraulic isolation of the Water Table aquifer from the underlying confined aquifer systems implies no impact or a negligible impact to the Water Table aquifer from pumping the Tertiary or Cretaceous aquifers. If there is localized communication between the Water Table and Tertiary aquifers, flow would occur from the Water Table aquifer into the Tertiary aquifer, and hydraulic isolation of the Water Table aquifer would be maintained.

As a result of construction of the proposed VEGP Units 3 and 4 the Water Table aquifer in the vicinity of the VEGP site would experience a change in net infiltration (i.e., recharge from precipitation) during operation of the units because of the construction of buildings, paving parking lots, maintain large area vegetation free, and construction of a stormwater discharge system. However, data provided for wells in the immediate vicinity of VEGP Units 1 and 2 (Southern 2007a) illustrate water table change over the 20-year period since their construction is variable; some locations exhibit a rise, others a fall, but all changes appear to be less than 0.9 m (3 ft) in magnitude.

Summary

Groundwater supplies for normal and maximum operational scenarios have been evaluated using a conservative conceptual model. Drawdown levels forecast for normal withdrawals are less than 2.1 m (7 ft) after approximately 30 years of operation. Drawdown levels forecast for maximum withdrawal for a period of 30-days are short-term impacts for which the aquifer would recover. These short-term drawdowns are also less than 1.8 m (6 ft) for single unit maximum demand. These incremental drawdown levels are small in comparison to the 120 m (400 ft) of confining hydraulic head in the Cretaceous aquifer.

Southern would not use Tertiary aquifer wells to supply groundwater for proposed VEGP Units 3 and 4. Data provided by Southern (2007a) when supplemented with regional data in U.S. Geological Survey reports (Clarke and West 1997, 1998; Cherry 2006), indicates an upward gradient is maintained between the Cretaceous and Tertiary aquifers. Thus impacts to the Tertiary aquifer from groundwater withdrawals from the Cretaceous aquifer are small. Southern would also not use the Water Table aquifer to supply groundwater for proposed VEGP Units 3 and 4. The Water Table aquifer appears hydraulically isolated from both confined aquifers by the Blue Bluff Marl. Hydraulic head in the Water Table aquifer is higher than that of the Tertiary aquifer. During VEGP Unit 3 and 4 operation, recharge to the Water Table aquifer would be altered locally by the facility as constructed. However, alteration to hydraulic head in response to changed recharge rates would be localized.

Based on the foregoing, the staff concludes that groundwater use impacts of the proposed VEGP Units 3 and 4 would be SMALL, and mitigation is not warranted.

5.3.3 Water-Quality Impacts

This section discusses water-quality impacts to the environment from operation of the proposed VEGP Units 3 and 4. Surface-water impacts include thermal and chemical changes in the Savannah River resulting from effluents discharged by the plant. Groundwater impacts include changes in water quality of the surrounding environment because of plant withdrawals, primarily from the Cretaceous aquifers.

5.3.3.1 Savannah River

The GDNR classified the Savannah River at the VEGP site for fishing water use (GDNR 2007a). The water-quality standards for temperature are not to exceed 32.2°C (90°F), and at no time is the temperature of the receiving waters to be increased more than 2.8°C (5°F) above the intake temperature. A provision is included that allows for use of a reasonable and limited mixing zone, however evidence must be provided that such a zone would not create an objectionable or damaging pollution condition.

Southern states in its ER that the discharge outfall would enter the Savannah River 123.1 m (404 ft) downstream from the existing outfall (Southern 2007a) and on the same (Georgia) bank of the river (see Figure 5-1). The effluent from the proposed outfall would enter the river from a single submerged port angled 70 degrees (pointing toward the center of the channel and slightly downstream) (see Figures 3-6 and 3-7).

For purposes of determining the bounding water temperature impacts, staff examined the variable effluent and river discharge conditions. As noted by Southern in its ER, and corroborated by the staff's analysis, the extent of the 2.8°C (5°F) above ambient mixing zone would be largest when the following conditions simultaneously occur: river discharge is the lowest, the outfall discharge is the largest, and the maximum temperature difference exists between the ambient river and the effluent. The independent assessment performed by the staff assumed Drought Level 3 conditions were in effect, and the Savannah River discharge was 108 L/s (3800 cfs) with a corresponding stage elevation of 23.59 m (77.4 ft) above MSL. At the location of the discharge outfall, the Savannah River would be approximately 95.1 m (312 ft) wide with an average depth of 2.50 m (8.2 ft) and have a cross-sectional average velocity of 0.457 m/s (1.50 ft/s). The local water depth near the outfall, which is located near the deepest point in the cross-section, is 3.05 m (10.0 ft).

The distance between the existing outfall and the proposed outfall was a factor in Southern's analysis. A larger distance between the outfalls provides greater opportunity for the ambient river water to mix with effluent from VEGP Units 1 and 2 before encountering effluent from proposed VEGP Units 3 and 4. Likewise, a shorter distance between the two outfalls would raise the ambient river temperature, and a larger mixing zone for the downstream VEGP Units 3 and 4 would be produced.

Staff made a bounding assumption that discharge from VEGP Units 1, 2, 3, and 4 was combined into a single discharge pipe instead of specifying a set distance between the two outfalls. The diameter of the pipe governs the effluent velocity and mixing as the effluent leaves the discharge pipe. It is important under this assumption to alter the diameter of the pipe so that the exit velocity is equivalent when the effluents are combined. Southern states in its ER that at the outfall terminus, the discharge pipe would be 0.6 m (2 ft) in diameter (Southern 2007a), resulting in an effluent velocity of 6.64 m/s (21.8 ft/s) at the maximum design discharge of 1940 L/s (68.5 cfs) from VEGP Units 3 and 4 (Southern 2007a). The effluent discharge from VEGP Units 1 and 2 was 631.5 L/s (22.3 cfs or 10,000 gpm) based on an average value at 4 cycles of concentration (Southern 2007a). The combined effluent used in the analysis was 25.71 L/s (90.8 cfs), and the modified pipe diameter was increased to 0.70 m (2.3 ft) to maintain the VEGP Units 3 and 4 effluent velocity in the simulation. Although the CWS blowdown mixes with SWS blowdown, sanitary waste, and other effluents in the common sump before being discharged through the outfall, staff made an assumption that all waste issuing from the outfall was at the cooling water system maximum blowdown temperature of 32.8°C (91°F) (Southern 2007a).

The largest 2.8°C (5°F) above ambient mixing zone would occur when the temperature difference is the greatest between the ambient river and the discharging effluent, assuming fixed river and effluent discharge rates. Therefore, the maximum temperature difference would occur when the ambient river temperature was a minimum. Monthly water temperature data collected near Shell Bluff Landing were analyzed for the period between January 1973 and August 1996. Minimum river temperatures were approximately 5°C (41°F) on both February 1, 1977 and January 31, 1978. The temperature difference between the ambient river and the discharge effluent was therefore calculated to be 28°C (50°F).

The staff performed an independent assessment of the effluent plume extent using CORMIX version 5.0 (Jirka et al. 2004), and assumed the conservative river conditions described above (e.g., minimum river temperatures, maximum discharge temperatures, and combining total effluent from VEGP Units 1 through 4 into the proposed VEGP Units 3 and 4 discharge pipe). The extent of the 5°F above ambient isotherm is shown in Figure 5-1. The maximum downstream extent of the 5°F above ambient isotherm was 29.6 m (97 ft) downstream of the outfall pipe. As shown in the figure, the plume curves after leaving the pipe and turns downstream following the river flow. The maximum width of the curved isotherm was 4.6 m (15 ft).

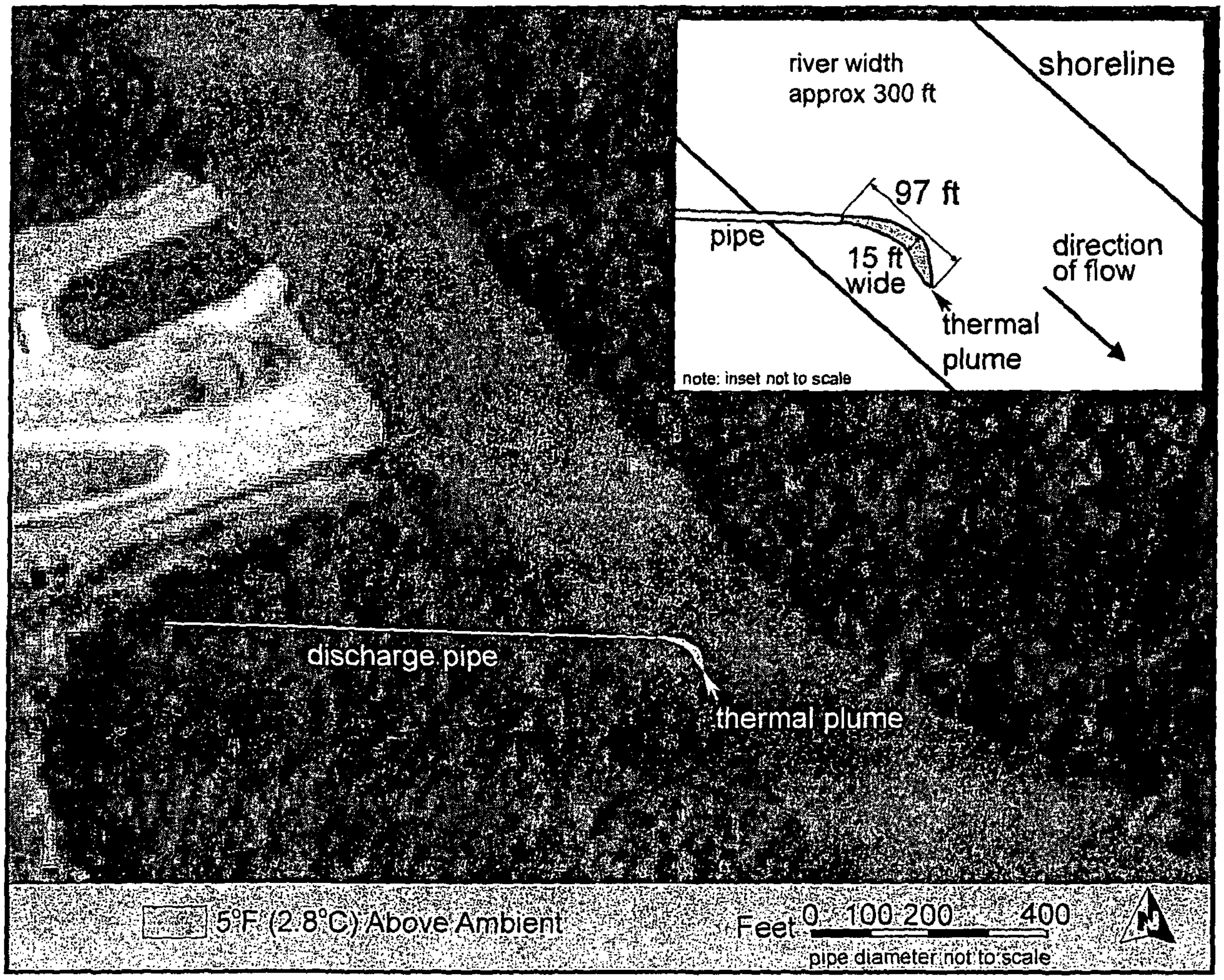

Figure 5-1. Extent of the 2.8°C (5°F) Above Ambient Isotherm Created by the Proposed VEGP Units 3 and 4 Discharge Pipe in the Combined Effluent Analysis

The staff performed a second analysis to identify the maximum downstream and lateral location of the 90°F isotherm, which is 1°F below the effluent release temperature. The same release conditions were assumed for this analysis (e.g., maximum discharge temperatures and combining total effluent from VEGP Units 1 through 4 into the proposed VEGP Units 3 and 4 discharge pipe). However, the maximum extent of the 90°F isotherm would occur whenever the ambient river temperature is as close to the release temperature as possible, and maximum river temperature near Shell Bluff Landing was approximately 81°F. As with the analysis above, the river discharge was assumed to be at Drought Level 3 (3800 cfs). Results generated by CORMIX indicate the maximum downstream extent of the 90°F isotherm would occur at a distance of 0.9 m (3 ft) downstream of the outfall pipe. Because of the proximity of the 90°F isotherm to the pipe terminus, the plume had not yet been significantly influenced by the river discharge, and the lateral extent of the isotherm was greater than the downstream extent. The maximum lateral extent of the 90°F isotherm from the outfall pipe terminus toward the river centerline was 2.21 m (7 ft).

The analysis performed by Southern and described in the ER (Southern 2007a) investigated two river discharge levels: 261 m^3/s (9229 cfs) (average discharge) and 112 m^3/s (3967 cfs) (low-flow discharge). The largest 5°F above ambient isotherm was computed for the scenario with the lowest river discharge, largest effluent discharge, and the greatest temperature difference between the effluent and the ambient river. However, unlike the staff's analysis, Southern assumed that the outfall pipe for the proposed VEGP Units 3 and 4 was located 123 m (404 ft) upstream of the existing VEGP Units 1 and 2 outfall pipe (note: the staff performed a similar analysis; however it is presented in Chapter 7, Cumulative Impacts, of this EIS). The distance between the outfall pipes influences the size of the plume resulting from operation of the proposed VEGP Units 3 and 4. To understand the change in ambient river conditions at the VEGP Units 1 and 2 outfall, Southern first developed a CORMIX model of the VEGP Units 1 and 2 plume. Along the centerline of the plume path the water temperatures are the greatest, and Southern applied the computed water temperatures 123 m (404 ft) downstream as the ambient river temperatures for the proposed VEGP Units 3 and 4 outfall analysis. The largest 5°F above ambient isotherm resulting from the proposed VEGP Units 3 and 4 outfall extended 17.4 m (57 ft) downstream and 6.7 m (22 ft) laterally across the river from the proposed outfall pipe terminus (Southern 2007a). The Savannah River would be approximated 95.1 m (312 ft) wide at drought level 3 flow rate.

The staff extended its thermal impact assessment using the CORMIX model to consider the potential impacts of chemical pollutants in the discharge to the Savannah River. Dilution was defined as the ratio between the initial concentration at discharge to the concentration at some given location away from the outfall. The calculations performed by Southern estimate dilution ratios range between 60 and 120 during periods of average Savannah River discharge. For the analysis performed by staff and at the edge of the 5°F above ambient isotherm described above, the dilution ratio was computed to be 10. For example, if the dilution ratio were 10 at the edge of the mixing zone and the discharge concentration was 20 ppm, then the concentration at the mixing zone edge would be 2 ppm. The dilution ratio was smaller under the more conservative conditions used by the staff.

Based on the computed size of the proposed VEGP Units 3 and 4 discharge plume, computed by both the staff and by Southern, and the relatively high levels of dilution at the mixing zone boundary, the NRC staff concludes that the impacts of the effluent plume on the Savannah River would be SMALL and localized. Discharge limits to the Savannah River for the proposed VEGP Units 3 and 4 would be limited by GDNR through the NPDES permitting process.

5.3.3.2 Groundwater

There are no potential impacts on groundwater quality from the operation of the proposed VEGP Units 3 and 4. However, cumulative impacts that may arise because of actions of others from salt water intrusion, tritium in the Water Table aquifer, and contaminants underlying the Savannah River Site are addressed in Chapter 7 of this EIS.

5.4 Ecological Impacts

This section describes the potential impacts to ecological resources from operation of two new units at the VEGP site, transmission line operation, and transmission line right-of-way maintenance. The impacts are discussed for terrestrial ecosystems, aquatic ecosystems, and threatened and endangered species.

5.4.1 Terrestrial Impacts

The proposed cooling system for the proposed VEGP Units 3 and 4 at the VEGP site is a closed-cycle system that would employ natural draft cooling towers. The heat would be transferred to the atmosphere in the form of water vapor and drift. Vapor plumes and drift may affect crops, ornamental vegetation, and native plants, and water losses could affect shoreline habitat. In addition, bird collisions and noise-related impacts are possible with natural draft cooling towers.

Electric transmission systems have the potential to affect terrestrial ecological resources through right-of-way maintenance, bird collisions with transmission lines, and electromagnetic fields (EMFs). Southern estimates that one additional 500-kV transmission line would be required to distribute the additional generation from proposed VEGP Units 3 and 4 (Southern 2007a). The proposed new transmission line right-of-way would likely connect the VEGP site with the Thomson-Vogtle substation west of Augusta. The transmission line would cross Burke, Jefferson, McDuffie, and Warren Counties. It is anticipated it would be a 46-m (150-ft)-wide right-of-way approximately 97 km (60 mi) long. Maintenance activities on the new transmission right-of-way would be the responsibility of GPC (Southern 2007a). Each of these topics is discussed in the following paragraphs.

5.4.1.1 Impacts on Vegetation

Impacts on crops, ornamental vegetation, and native plants may result from cooling tower drift, icing, fogging, or increased humidity. No row crop agricultural land exists on the VEGP site. However, forests and forested wetlands occur both onsite and offsite in the vicinity of the VEGP site.

Through the process of evaporation, the total dissolved solid concentration in the CWS increases. A small percentage of the water in the CWS is released into the atmosphere as fine droplets containing elevated levels of Total Dissolved Solids (TDS) that can be deposited on nearby vegetation. Operation of the CWS would be based on four-cycles of concentration, which means the TDS in the make-up water would be concentrated approximately 4 times before being released. CWS water losses from drift are minor in comparison to evaporation and blowdown discharge losses, and the maximum drift rate reported by Southern is 1.5 L/s (24 gpm) when both towers are operating (Southern 2007a).

Depending on the make-up source waterbody, the TDS concentration in the drift can contain high levels of salts which under certain conditions and for certain species can be damaging. Vegetation stress can be caused from drift with high levels of TDS deposition, either directly by deposition onto foliage or indirectly from the accumulation in the soils. Southern estimates a single cooling tower's plume to have a maximum deposition rate of 4.0 kg/ha/mo (3.6 lbs/ac/mo), and that maximum deposition would occur 490 m (1600 ft) from the tower. Regardless of the plume direction, maximum deposition would occur on the VEGP site. The drift from the proposed VEGP Units 3 and 4 towers would overlap because the towers are only 340 m (1100 ft) apart. Therefore, the maximum estimated cumulative deposition rate is 8 kg/ha/mo (7.2 lbs/ac/mo) at 490 m (1600 ft) north of the towers (4.0 kg/ha/mo [3.6 lbs/ac/mo] per tower). General guidelines for predicting effects of drift deposition on plants suggest that many species have thresholds for visible leaf damage in the range of 10 to 20 kg/ha/mo (9 to 18 lbs/ac/mo) on leaves during the growing season (NRC 1996). Since the maximum deposition for the proposed VEGP Units 3 and 4 is below the level which could cause leaf damage in many common species, the impacts would be negligible. The impact of drift on crops, ornamental vegetation, and native plants was evaluated for existing nuclear power plants in the "*Generic Environmental Impact Statement for License Renewal of Nuclear Plants*" NUREG-1437 (GEIS) and was found to be of minor significance (NRC 1996). This determination also included existing nuclear power plants with more than one cooling tower.

Southern expects the longest vapor plume associated with the new towers would be 10 km (6 mi), but would only occur 3.9 percent of the time (Southern 2007a). The longest plume length would occur in the winter months and the shortest in the summer months. Ground-level fogging and icing do not occur currently at the cooling towers for VEGP Units 1 and 2 and are not expected to occur at the new cooling towers associated with proposed VEGP Units 3 and 4. Therefore, impacts associated with fogging and icing would be negligible.

The potential impact on crops, ornamental vegetation, and native plants from the operation of cooling towers for the proposed VEGP Units 3 and 4 at the VEGP site would be minimal and mitigation would not be warranted.

5.4.1.2 Bird Collisions with Cooling Towers

The natural draft cooling towers associated with the proposed VEGP Units 3 and 4 would be 180 m (600 ft) high (Southern 2007a). The VEGP site is located adjacent to the Savannah River and though migratory birds pass through the vicinity of the VEGP site, it is not located on a major American flyway. No formal bird collision surveys have been conducted at the VEGP site. However, the Environmental Protection Plan for VEGP Units 1 and 2 stipulates that any excessive bird-impact events be reported to NRC within 24 hours (Southern 1989). No excessive bird-impact events have been reported onsite. Bird collision events that have been investigated by Southern have been determined to be of no significance due to their infrequent occurrence (Southern 2006b). The conclusion presented in the GEIS for license renewal is that bird collisions with natural draft cooling towers are of small significance at all operating nuclear power plants, including those with multiple cooling towers (NRC 1996). Consequently, the incremental number of bird collisions, if any, associated with the operation of the two new natural draft cooling towers for the proposed VEGP Units 3 and 4 at the VEGP site, would be minimal and mitigation would not be warranted.

5.4.1.3 Noise

The noise levels from cooling tower operation and diesel generators are anticipated to be 55 decibels (dBA) at 300 m (1000 ft) (Southern 2007a). This noise level is well below the 80-to-85-dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating natural draft cooling towers would not be likely to disturb wildlife beyond the VEGP site perimeter fence, which is over 300 m (1000 ft) from the source. Consequently, the potential impact on wildlife posed by the incremental noise resulting from the operation of the two new natural draft cooling towers for the proposed VEGP Units 3 and 4 and other facilities at the VEGP site would be minimal and mitigation would not be warranted.

5.4.1.4 Shoreline Habitat

Because of the small quantity of water withdrawn and discharged during operation relative to the flow in the Savannah River, adverse impacts on the river shoreline are unlikely. Based on NRC's own independent review (see Section 5.3.2.1), at the normal withdrawal rate of 2.35 m^3/s (83 cfs, 37,224 gpm), proposed VEGP Units 3 and 4 would withdraw up to 2.2 percent of the total river flow at Drought Level 3. At the maximum withdrawal rate of 3.65 m^3/s (129 cfs, 57,784 gpm), the Units 3 and 4 would withdraw between 1.4 and 3.4 percent of the total flow of the Savannah River as the river fluctuates between average and Drought Level 3.

A water surface elevation versus discharge relationship was developed by the USGS to monitor discharge near the VEGP site (USGS 2007). Using this relationship and the maximum withdrawal rate of 3.65 m^3/s (129 cfs), the resulting decrease in river stage as a result of operating the proposed VEGP Units 3 and 4 is approximately 5 cm (2 in.) at Drought Level 3 and approximately 2.5 cm (1 in.) under average discharge conditions.

No significant additional shoreline habitat would be exposed from the water removal, and evaporative loss for the proposed VEGP Units 3 and 4 would be undetectable and not likely to affect shoreline plants or wildlife. Consequently, the potential effects on terrestrial ecology from the drawdown of the Savannah River resulting from operation of two additional natural draft cooling towers for the proposed VEGP Units 3 and 4 at the VEGP site would be negligible and mitigation would not be warranted.

5.4.1.5 Transmission Line Right-of-Way Management (Cutting and Herbicide Application)

Southern stated that the same vegetation management practices currently employed by GPC for the existing VEGP Units 1 and 2 transmission line rights-of-way (such as hand-cutting on an as-needed basis) would be applied to the proposed new 500-kV transmission line right-of-way (Southern 2007a).

GPC performs aerial inspections five times each year to support routine maintenance activities. These surveys are normally conducted using a helicopter. The noise may startle and temporarily displace wildlife. However, these impacts are short term and occur in a very local area. Woody growth is cleared from transmission line rights-of-way on a 5-year maintenance cycle. This cycle may vary based on public concerns, local ordinances, line maintenance or environmental considerations. Vegetation management includes using herbicides, hand tools, and light equipment. Hand cutting or herbicides are used in areas that cannot be mowed either because it is impractical or because of environmental concerns. Herbicide use is conducted in accordance with manufacturer specifications and is applied by licensed applicators. Any spills of fuel and/or lubricants that occur as a result of equipment use in the transmission line right-of-way are immediately cleaned up and reported. GPC cooperates with the GDNR to manage known sites considered environmentally sensitive within the transmission line rights-of way (Southern 2007a). GPC has developed recommendations for maintenance practices for the protection of pitcher plants, caves, nests, rookeries, and habitat such as rock outcrops that occur within GPC rights-of-way (Southern 2007c).

Transmission line right-of-way maintenance was evaluated in the GEIS (NRC 1996), and the impact was found to be of small significance at operating nuclear power plants with associated transmission line rights-of-way of variable widths (NRC 1996). Consequently, the potential effects on terrestrial ecology from transmission line maintenance in the new transmission line rights-of-way would be negligible and mitigation would not be warranted.

5.4.1.6 Bird Collisions with Transmission Lines

Section 4.1 of the Environmental Protection Plan for VEGP Units 1 and 2 stipulates that any excessive bird-impact events be reported to NRC within 24 hours (Southern 1989). Transmission line and right-of-way maintenance personnel have not reported dead birds from collisions or contact with the Unit 1 and 2 transmission lines (Southern 2007a). GPC has an Avian Protection Plan in place to monitor and address the impacts of transmission lines on birds. Any impact events would be coordinated with GPC's Environmental Field Services and, if necessary, coordination would also involve the FWS (GPC 2006). The conclusion presented in the GEIS is that bird collisions with transmission lines are of small significance at operating nuclear power plants, including transmission line rights-of-way with variable numbers of transmission lines (NRC 1996). Thus, the addition of the proposed transmission line would likely present few new opportunities for bird collisions. The additional number of bird collisions, if any, would not be expected to cause a measurable reduction in local bird populations. Consequently, the incremental number of bird collisions posed by the operation of the new transmission line for the proposed VEGP Units 3 and 4 at the VEGP site would be negligible and mitigation would not be warranted.

5.4.1.7 Impact of EMFs on Flora and Fauna

EMFs are unlike other agents that have an adverse impact (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 1996). As discussed in the GEIS for license renewal (NRC 1996), a careful review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures. Thus, the conclusion presented in the GEIS for license renewal (NRC 1996) was that the impacts of EMFs on terrestrial flora and fauna were of small significance at operating nuclear power plants, including transmission systems with variable numbers of transmission lines. Since 1997, over a dozen studies have been published that looked at cancer in animals that were exposed to EMFs for all or most of their lives (Moulder 2005). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2005). Therefore, the staff concludes that the incremental EMF impact posed by the operation of the proposed transmission line at the VEGP site would be minimal and mitigation would not be warranted.

5.4.1.8 Floodplains and Wetlands on Transmission Line Rights-of-Way

The effects of transmission line right-of-way maintenance on floodplains and wetlands was evaluated in the GEIS for license renewal(NRC 1996). The impacts were found to be of small significance at operating nuclear power plants, and these included transmission line rights-of-way of variable widths. The incremental effects of transmission line right-of-way maintenance on floodplains and wetlands posed by the addition of the proposed transmission line for the proposed VEGP Units 3 and 4 at the VEGP site would be negligible and mitigation beyond use of BMP would not be warranted.

5.4.1.9 State-Listed Species

The Georgia State-listed threatened bay star-vine (*Schisandra glabra*) is the only State-listed plant species known to occur on the VEGP site. It was recorded on the wooded bluffs above the floodplain in the vicinity of the proposed cooling water intake structure during the 2005 threatened and endangered species survey. Its habitat preferences are such that it could occur in the floodplain forest as well. In addition, mounds indicative of the Southeastern pocket gopher have been recorded just north of the VEGP site (Southern 2007a). Southern would likely work with GDNR during operation to ensure State threatened and endangered species are protected. No other Georgia or South Carolina State-listed plant or animal species are known to occur within 3.2 km (2 mi) of the VEGP site (GDNR 2007b; SCDNR 2007). The potential impacts from VEGP Units 3 and 4 operation on State-listed species at the VEGP site are considered negligible.

Three State-listed species have been documented by the GDNR as occurring within the RDC: the bald eagle (*Haliaeetus leucocephalus*), silky camellia (*Stewartia malacodendron*), and sandhill rosemary (*Ceratiola ericoides*). A proposed 180-m (600- ft) buffer around the active eagle nest would minimize any potential impacts from transmission line construction and maintenance. The impact on State-listed wildlife within the proposed transmission line right-of-way, because of noise, EMFs, and bird collisions is expected to be negligible. The impact on State-listed species in the right-of-way due to of right-of-way maintenance activities is not known due to the uncertainty of the final routing of the transmission line. However, based on past performance and established maintenance practices and procedures, the staff has determined the impacts to State-listed species would likely be minimal.

5.4.1.10 Summary of Terrestrial Ecosystem Impacts

The potential impacts of operating the proposed VEGP Units 3 and 4 and two natural draft cooling towers at the VEGP site on vegetation, birds, shoreline habitat, and any related impacts on State-listed species are considered negligible. The potential impacts of transmission line right-of-way maintenance (cutting and herbicide application) and similar impacts on floodplains and wetlands, birds, and biota because of EMFs and any related impacts on State-listed species are considered negligible, assuming BMP are followed and State agencies are consulted, as appropriate.

The staff reviewed the potential terrestrial ecological impacts of operating new generation facilities at the VEGP site including the associated heat dissipation system, transmission lines, and associated right-of-way maintenance. The staff concludes the impacts from operation of the new facilities and associated transmission line right-of-way would be SMALL, and additional mitigation beyond that mentioned in the text would not be warranted.

5.4.2 Aquatic Impacts

This section discusses the potential impacts of the operation of the proposed VEGP Units 3 and 4 on the aquatic ecosystem in the Savannah River onsite streams, ponds, and water courses crossed by the Thomson-Vogtle transmission right-of-way.

5.4.2.1 Onsite Streams and Ponds

The only impacts to the onsite streams and ponds during the period of operation of the proposed VEGP Units 3 and 4 would result from stormwater drainage. Southern has an extensive stormwater drainage system and retention ponds for the VEGP site and this system would be used to manage stormwater discharges prior to discharge to the Savannah River (Southern 2007a). Southern would revise the existing VEGP Stormwater Pollution Prevention Plan to reflect the addition of new paved areas and facilities and changes in drainage patters (Southern 2007a). The staff concludes that based on the use of a stormwater system comparable to that currently used for the VEGP site, the impacts to onsite streams and ponds from operation of the proposed VEGP Units 3 and 4 would be minimal.

5.4.2.2 Savannah River

The potential impacts to the Savannah River from the operation of the proposed VEGP Units 3 and 4 would include the intake and consumption of water, the discharge of heated effluents, the discharge of chemicals, and the physical impact of bottom scouring from the discharge.

Water Intake and Consumption

For aquatic resources, the primary concerns related to water intake and consumption are the impacts related to the relative amount of water drawn from the cooling water source (the Savannah River) and the potential for organisms to be impinged on the intake screens or entrained into the cooling water system. Impingement occurs when organisms are trapped against the intake screens by the force of the water passing through the CWIS (66 FR 65256). Impingement can result in starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling (66 FR 65256). Entrainment occurs when organisms are drawn through the CWIS into the proposed VEGP Units 3 and 4 cooling system. Organisms that become entrained are normally relatively small benthic, planktonic and nektonic (organisms in the water column) forms, including early life stages of fish and shellfish, which often serve as prey for larger organisms (66 FR 65256). As entrained organisms pass through a plant's cooling system, they are subject to mechanical, thermal, and toxic stresses.

A number of factors, such as the type of cooling system, the design and location of the intake structure, and the amount of water withdrawn from the source waterbody greatly influences the degree to which impingement and entrainment affect the aquatic biota.

Southern stated in its ER that a closed-cycle wet cooling tower system would be used for the proposed VEGP Units 3 and 4. The proposed cooling system would be similar to the one employed by VEGP Units 1 and 2 (Southern 2007A). Closed-cycle recirculating cooling water systems can, depending on the quality of the makeup water, reduce water use by 96 to 98 percent of the amount that the facility would use if it employed a once-through cooling system (66 FR 65256). This significant reduction in water withdrawal rate results in a corresponding reduction in impingement and entrainment.

A second factor, the intake design through-screen velocity, greatly influences the rate of impingement of fish and shellfish at a facility. The higher the through-screen velocity the greater the number of fish impinged. EPA has established a national standard for the maximum design through-screen velocity of no more than 0.5 ft/sec (66 FR 65256). EPA determined that species and life stages evaluated in various studies could endure a velocity of 1.0 ft/sec and then applied a safety factor of two to derive the threshold of 0.5 ft/sec. Southern has stated that the proposed Unit 3 and 4 intake structure would have a design through-screen velocity of less than 15 cm/sec (0.5 ft/sec) at a minimum river water level of 23.8 m (78 ft) above MSL (Southern 2007A).

Another factor affecting impingement and entrainment losses is the percentage of the flow of the source waterbody past the site that is withdrawn by the station. EPA determined that limiting withdrawal to 5 percent of the source water body mean flow was technically achievable and economically practicable and that larger withdrawals may result in greaters level of entrainment. At a normal withdrawal rate of 2.35 m^3/s (83 cfs), proposed VEGP Units 3 and 4 would withdraw between 0.9 and 1.4 percent of the river flow during normal conditions. At the maximum withdrawal rate of 3.65 m^3/s (129 cfs) the two new units would withdraw between 1.4 and 3.4 percent of the total flow of the Savannah River depending on the drought level in the Savannah River. Thus, the planned design and operation of the proposed VEGP Units 3 and 4 CWIS meets the criteria of withdrawing no greater than 5 percent of the source water body mean annual flow.

A fourth factor is the use of design and construction technologies for minimizing impingement mortality and entrainment if specific conditions exist where the cooling water intake structure is located. EPA indicated (66 FR 65256) that the optimal design requirement for the intake location is to place the inlet of the CWIS in an area of the source water body where impingement and entrainment of organisms are minimized by locating intakes away from areas with the potential for high productivity. This area of the Savannah River is not considered to have higher than normal productivity. However, design features of the CWIS were incorporated to minimize its impact on aquatic biota.

As discussed in Section 4.4.2, Southern has stated in its ER (Southern 2007a) that the intake canal would be built so that the river flow is almost perpendicular to the intake canal flow. Southern has also stated that at the minimum river operating level (23.8 m [78 ft] above MSL) the flow velocity along the intake canal would be about 3 cm/s (0.1 fps), based on the site maximum make-up water demand of 3646 L/s (57,784 gpm, 129 cfs) (Southern 2007a). A canal weir extending upward from the bottom would be located approximately 15 m (50 ft) inside the canal, with a serrated weir wall. This would further serve to reduce entrainment mortality by reducing the fraction of the water column that could move into the intake canal. Because many fish eggs are demersal, and important fish larvae, such as sturgeon larvae, tend to stay near the river bottom, the presence of a wier wall would reduce the potential for entrainment.

Entrainment studies have not been conducted for the existing VEGP Units 1 and 2. However, in 1985 the NRC evaluated entrainment at these units in the Final Environmental Impact Statement (FES) (NRC 1985). The staff's evaluation at that time assumed a uniform distribution of drift organisms. The CWIS withdrawal was designed to range from approximately 1 to 4 percent of the Savannah River discharge, depending on CWIS operations and the range of Savannah River discharge. Assuming a uniform distribution of drift organisms, and 100 percent mortality of entrained biota, NRC determined that a 1 to 3.5 percent removal proportion would have an insignificant effect on the drift organisms, aquatic community, and resident fish in the vicinity of VEGP Units 1 and 2 (NRC 1985). A similar estimate could be applied to entrainment for the proposed VEGP Units 3 and 4 CWIS, because of the similarity in design for the CWISs. However, this estimate of entrainment rate is considerably higher than would be anticipated under actual conditions. Eggs of many freshwater riverine fish are adhesive, demersal or semi-buoyant. And early larval stages may tend to remain near the bottom of the river or otherwise not be susceptible to transport into the canal.

Although no entrainment studies were conducted after VEGP Units 1 and 2 began operation, there have been studies performed that looked at entrainment rates for reactor facilities at the DOE Savannah River Site. Between 1982 and 1985 ichthyoplankton studies occurred between rkm 47.2 and 301.1 (RM 29.3 and 187.1) and in intake canals and mouths of three creeks along the DOE Savannah River Site (Paller et al. 1986). During these four years, it was estimated that between 8.3 percent and 12.3 percent of the ichthyoplankton that drifted past the canals were entrained. However, there are significant differences between the DOE Savannah River Site intakes and the existing and proposed intakes at the VEGP site. First, the volume of water withdrawn is greater at the DOE Savannah River Site, 11.2 m^3/s (395 cfs) each for K-reactor and L-reactor intakes at full power (Paller 1992). This is about three times the anticipated water withdrawal rate of the proposed VEGP Units 3 and 4. Second, the structure of the DOE Savannah River Site intake canals is significantly longer. And third, the intake velocity at the DOE Savannah River Site intakes is calculated at 38 cm/s (1.25 ft/s) (McFarlane et al. 1978), which is 2.5 times as great as for the proposed VEGP Units 3 and 4.

Based on the percentage of water withdrawn, the planned low-through-screen intake velocity, the closed-cycle cooling system design, the typically high fecundity of most species inhabiting rivers, the existence of multiple spawning sites within the river basin, and the high natural mortality rates of eggs and larvae, the staff finds that the impacts to the fish of the Savannah River from entrainment would be minor.

Impingement studies have also not been conducted at the existing the VEGP site intake structure. However, the proposed design of the intake canal and structure and its placement relative to the Savannah River is similar to that of the existing VEGP Units 1 and 2, and thus the impacts resulting from impingement of fish would reasonably be expected to be similar. A site visit to the VEGP Units 1 and 2 on March 8, 2007 included an investigation of the VEGP intake and involved an examination of the traveling screens, the screen wash system, the debris trough that collects and channels debris washed from the screens and the collection debris basket as documented in a trip report (NRC 2007c). Southern staff indicated that the screen wash collection basket had been cleaned about 2-3 times each of the past two years and no fish were seen. Section 4.1, entitled Unusual or Important Environmental Events, of the VEGP Units 1 and 2 Environmental Protection Plan, Appendix B to VEGP Units 1 and 2 operating licenses NPF 68 and NPF 81, requires NRC notification of any unusual environmental events, citing specifically fish kills or impingement events at the plant. To date, no such report has been submitted for VEGP Units 1 and 2.

Based on the planned low-through-screen intake velocity, the use of closed-cycle cooling, the design of the intake canal, and the historic low impingement rates for the existing VEGP Units 1 and 2, the staff concludes that impacts from impingement of fish for the proposed VEGP Units 3 and 4 would be minor.

5.4.2.3 Aquatic Thermal Impacts

The effluent discharge from the proposed VEGP Units 3 and 4 would be directly into the Savannah River. Section 5.3.3.1 discusses the location and design of the discharge piping. It also discusses the results of the staff's thermal impact assessment using the CORMIX model to estimate the size and temperature of the thermal plume from the existing VEGP Units 1 and 2 as well as the proposed VEGP Units 3 and 4. Assuming conservative river conditions (e.g., minimum river temperatures, maximum discharge temperatures), the maximum width of the curved isotherm is 4.6 m (15 ft). The maximum distance the 2.8°C (5°F) above ambient isotherm was estimated to occur was 29.6 m (97 ft) downstream of the outfall pipe. Under average flow conditions the plume is significantly smaller. At the location of the discharge outfall, the river is approximately 95.1 m (312 ft) wide at Drought Level 3 flow rate. Based on the calculations, the staff has determined that the size of the thermal plume from the proposed effluent discharge is small in comparison to the width of the Savannah River at the VEGP site (see Figure 5-1). The location and design of the discharge would not impede fish passage up and down the river. Fish and other organisms in the river would likely avoid the elevated temperatures. They can move through this part of the river unencumbered by any structures or physical features that would retain them in the plume.

Another factor related to thermal discharges that may affect aquatic biota is cold shock. Cold shock occurs when aquatic organisms that have been acclimated to warm water, such as fish in a power plant's discharge canal, are exposed to a sudden temperature decrease. This sometimes occurs when single-unit power plants shut down suddenly in winter. Cold shock mortalities at U.S. nuclear power plants are "relatively rare" and typically involve small numbers of fish (NRC 1996). It is less likely to occur at a multiple-unit plant, because the temperature decrease from shutting down one unit is moderated by the heated discharge from the units that continue to operate. It is also less of a factor when the discharge is to a river where the volume of the discharge in comparison to the flow of the river are very small as is the case at the VEGP site.

No invasive nuisance organisms other than Asiatic clams (*Corbicula fluminea*) are found on the site. Neither Asiatic clams, nor any other invasive species have been observed to have increased in numbers as a result of the thermal plume operated by VEGP Units 1 and 2. Therefore, no large growths of invasive nuisance organisms is anticipated from the thermal plume for the proposed units.

Based on this analysis of the potential for thermal impacts to the aquatic ecosystem of the Savannah River, the staff has reviewed the impacts to the aquatic environment in the vicinity of the site. The staff concludes that the impacts from thermal discharges from the proposed VEGP Units 3 and 4 would be minor.

5.4.2.4 Chemical Impacts

Other discharge-related impacts include the chemical treatment of the cooling water. The ER indicates that chemicals, including biocides, would be added to the cooling tower basins to control scaling, corrosion and solids (Southern 2007a). Biocides would not be injected at the intake structure (NRC 2007d). Biofouling would be controlled using chlorination and/or other treatment methods in the cooling water system cooling tower, in order to ensure that the fill in the cooling tower remains free of organic deposits. This decision was based on the operational experience of the existing VEGP Units 1 and 2 intake structure. The biofouling control in the make-up water pipeline is handled by maintaining an appropriate velocity to prevent the attachment of the biofouling species of concern to the piping (Southern 2007b).

Operation of the cooling towers would be based on four cycles of concentration, which means that the total dissolved solids in the make-up water would be concentrated four times before being discharged. Thus, the levels of solids and organics in the cooling tower blowdown would be approximately four times higher than ambient or upstream concentrations. The CWS chemical treatment would be similar to that for the existing units. The final plant discharge from the proposed VEGP Units 3 and 4 would be composed of circulating and service water blowdown and other site wastewater streams, including sanitary waste, miscellaneous low-volume waste, and treated liquid radwaste (Southern 2007a). Blowdown from the cooling towers would be discharged to a common blowdown sump to provide retention time for settling of solids or to be treated, if required to remove biocide residuals before the water is discharged to the river (Southern 2007a). Calculations performed by Southern and confirmed by the staff (Section 5.3.3.1) give an estimated in river dilution factor of 60 to 120 during periods of average Savannah River discharge, depending on the time of the year and river flow rate. The dilution rate calculated by the staff under more conservative conditions for the edge of the 2.8°C (5°F) above ambient isotherm was 10, as discussed in Section 5.3.3.1.

Table 5-4 provides a list of the water treatment chemicals, their use, the concentration that is anticipated to be discharged from proposed VEGP Units 3 and 4 and the toxicity data from the Material Safety Data Sheets for each of the chemicals that will be discharged to the Savannah River. This list is the same as those present in the final discharge for VEGP Units 1 and 2. These chemicals include those that are used in the cooling towers, the heat exchangers, cooling systems, and sewage treatment. The concentrations in the discharge are significantly lower than the LC50 (the concentration that kills 50% of the sample population) obtained from the Material Safety Data Sheets (Moorer 2007). The water flow from the Savannah River would further dilute the concentration of these chemicals.

Table 5-4. Chemical discharges to the Savannah River from Proposed VEGP Units 3 and 4

Chemical	Use	Concentration at discharge point	Toxicity[a]
Nalco Sure-Cool 1336 (hazardous substance - sodium tolytriazole)	Corrosion control for yellow metals	2 ppm	23.7 ppm LC50[b]
Nalco 3DT177 (polymer) (hazardous substance - phosphoric acid)	Corrosion control for mild steel	10-11 ppm	> 5000 ppm LC50 for inland silverside (*Minidia beryllina*)
Nalco 3DT190 (polymer)	Dispersant	6-7 ppm	948 ppm LC50 for fathead minnow (*Pimephales promelas*) with similar product
Nalco 7905 (hazardous substance - ammonium bisulfite)	Dechlorination agent	25% excess to halogen radical, so max is (0.75 ppm x 0.25) = 0.1875 ppm	No toxicity studies have been conducted. This product is not a sensitizer or listed as a carcinogen.
Oxidizing biocide as either • Liquid sodium hypochlorite • Liquid sodium bromide activated with sodium hypochlorite • Stabilized bromine	Control algae and general biofouling (Asiatic clams) – Twice per week to achieve 0.2-0.75 ppm free available oxidant and continuously over a period of 120 hours at 0.5 ppm free available oxidant to control Asiatic clams	Neutralized prior to discharge,– Concentration effectively is zero.	Not applicable
Sodium hypochlorite (liquid)	Sanitary waste disinfection	Unknown (held in 325,0000 gallon wastewater retention basin prior to discharge so that no chlorine residual remains in the final effluent).	Not applicable

Source: Southern 2007d

[a] from Moorer 2007

[b] LC50 - Lethal Concentration 50 is the concentration of a chemical that kills 50% of the sample population.

The use of chemicals in the existing VEGP Units 1 and 2 is regulated by an NPDES permit, which is granted by the GDNR. The chemical concentrations at the outfall for the existing units meets the NPDES limits (Southern 2007a). No impacts to the aquatic ecology of the Savannah River from these chemicals have been observed. Other than the water treatment systems, no other Westinghouse AP1000 reactor systems have effluent streams that contain chemicals or biocides. Thus, the impacts from the chemical discharges to the Savannah River would be minimal.

5.4.2.5 Physical Impacts from Discharge

Some localized bottom scouring is anticipated in the immediate vicinity of the end of the discharge pipe (Southern 2007a). A bathymetric study (Southern 2007a) demonstrated that there was a 0.9- to 1.5-m- (3- to 5-ft)-deep trough immediately downstream of the existing VEGP Units 1 and 2 discharge structure, that is presumed to have been caused by the discharge scouring the river bottom. The bathymetric study shows no evidence of this depression 22.9 m (75 ft) further downstream; thus indicating that the scouring is restricted to a small area. Southern assumed that the extent of bottom scouring associated with the operation of the new discharge would be similar to that for the existing units, resulting in an area of several hundred square feet that is unsuitable for benthic organisms such as larval aquatic insects or mussels (Southern 2007a). Southern has committed to the placement of rip-rap around the discharge point to reduce potential erosion from the discharge jet pipe (Southern 2007a). This would result in a very small fraction of the entire benthic habitat of the Savannah River, thus there would be a minimal, if any, impact on benthic organisms.

Based on this analysis of the potential for physical impacts to the aquatic ecosystem from the discharge of cooling water to the Savannah River, the staff reviewed the impacts to the aquatic environment in the vicinity of the site. The staff concludes that the physical impacts from thermal discharges from the proposed VEGP Units 3 and 4 would be minor.

5.4.2.6 Transmission Line Right-of-Way Maintenance Activities

Maintenance activities along the Thomson-Vogtle 500-kV transmission project could lead to periodic temporary impacts on the waterways being crossed. However, it is assumed that the same vegetation management practices currently employed by GPC for the existing VEGP Units 1 and 2 facility transmission line rights-of-way would be applied to the proposed new 500-kV Thomson-Vogtle transmission line right-of-way (Southern 2007a). GPC practices and procedures were developed to prevent impacts to surface waters and wetlands, so that impacts to aquatic ecosystems from operation and maintenance of transmission lines would be small. GPC's Routine Line Maintenance Procedures require staff to check transmission line rights-of-way at least three times a year for encroachment, erosion problems or evidence of unauthorized logging or construction activity adjacent to the transmission lines. Identifying and correcting these problems would benefit aquatic communities in down-gradient streams and wetlands. GPC maintenance crews also are required to avoid environmentally sensitive areas including spawning areas and endangered species habitats (Southern 2007a). However, no Federal or State-listed aquatic organisms are anticipated to be in the transmission line rights-of-way, thus there are no impacts anticipated to important aquatic species. The staff concludes that the impacts of transmission line right-of-way maintenance activities on aquatic resources would not adversely impact aquatic ecosystems and that no mitigation beyond that described above is required.

5.4.2.7 Aquatic Monitoring During Operation

Southern does not plan to perform any formal monitoring of the aquatic ecosystems during operations. Its basis for this decision is that "...the operation of the new intake and discharge structures would have small impacts on the water quantity or quality" (Southern 2007b).

5.4.2.8 Summary of Aquatic Impacts

Given the information provided in Southern's ER (Southern 2007a), the response to requests for additional information (Southern 2007b), the operating experience at the existing units, and NRC's own independent review, impacts on aquatic ecosystems from operation of the intake system would likely be minor based on a number of factors given in Section 5.4.2.2, including the use of a closed-cycle cooling system and an intake with a design velocity through the screens of less than 15 cm/s (0.5 ft/s).

The staff concludes that the impacts to the aquatic ecosystem from the thermal discharge are also likely to be minor based on the size of the thermal plume in relationship to the size of the Savannah River. The staff concludes that the chemical impacts from the discharge would be negligible minor based on the dilution factors and experience with VEGP Units 1 and 2. The staff also concludes that the physical impacts of the discharge would be minor based on experience with the existing units and Southern's commitment to place rip-rap around the discharge point to reduce potential erosion from the discharge pipe. Impacts of transmission line right-of-way maintenance activities on aquatic ecosystems would be minor.

Therefore, the staff concludes that the overall impact on aquatic resources of operating the proposed VEGP Units 3 and 4 and the new transmission line would be SMALL and that no mitigation beyond that described above is required.

5.4.3 Federally Listed Species

5.4.3.1 Terrestrial Species

The VEGP Site

No Federally listed threatened and endangered species are known to occur at the VEGP site, with the exception of the American alligator (*Alligator mississippiensis*). There are no areas designated as critical habitat for threatened and endangered species in the vicinity of the VEGP site.

The American alligator is classified as "threatened based on the similarity of appearance" to the American crocodile (52 FR 21059). The alligator is no longer biologically imperiled in Georgia. Alligators appear to be relatively common in the Savannah River near the VEGP site and currently occur onsite. The alligator population near the VEGP site is not expected to be adversely affected by operation of VEGP Units 3 and 4.

The wood stork (*Mycteria americana*) has been seen within 3.2 km (2 mi) of the VEGP site in the Savannah River Swamp. However, the closest wood stork colony is about 45 km (27 mi) from the site. The wood stork may be occasionally using suitable habitat on the VEGP site for foraging or roosting. However, this species is highly mobile and any impacts associated with the operation of Units 3 and 4 on the VEGP site would be negligible.

The red-cockaded woodpecker (*Picoides borealis*), relict trillium (*Trillium reliquum*), and the flatwoods salamander (*Ambystoma cingulatum*) are not known to occur within 16 km (10 mi) of the VEGP site. Though suitable habitat may exist for these species on the VEGP site, this habitat is not likely to be affected by operation activities. It is unlikely there is suitable habitat for the smooth coneflower (*Echinacea laevigata*) and Canby's dropwort (*Oxypolis canbyi*) onsite. Therefore, there are no anticipated impacts on these species associated with operation of the proposed VEGP Units 3 and 4.

Operation of VEGP Units 3 and 4 would have minimal impacts on the red-cockaded woodpecker, wood stork, relict trillium, smooth coneflower, Canby's dropwort, American alligator, or the flatwoods salamander. Based on this review, the staff concluded the impacts on terrestrial Federally listed threatened and endangered species from operation of the proposed VEGP Units 3 and 4 would be SMALL, and no mitigation is required.

Proposed 500-kV Transmission Line

The exact route of the proposed 500-kV transmission line has not been determined at this time. However, the proposed transmission line would be located within the RDC. Routing alternatives within this right-of-way are currently being evaluated by GPC and Southern (GPC 2007). No Federally listed species have been documented to occur within the RDC. Populations of Canby's dropwort and Georgia aster are within 16 km (10 mi) of the RDC. The wood stork, red-cockaded woodpecker, relict trillium, smooth coneflower, and flatwoods salamander are not known to occur within 16 km (10 mi) of RDC, but have the potential to occur in counties that may be crossed by the transmission line. GPC maintenance practices include identifying all red-cockaded woodpecker colony areas within 3.2 km (2 mi) of maintenance work around the activity areas during non-breeding periods. GPC maintenance practices include identifying all active nesting wood stork colony locations in the State with a focus on the rookeries that are within 1.6 km (1 mi) of a transmission line. In areas within 230 m (750 ft) of an active rookery, GPC conducts mowing during the non-nesting season (Southern 2007b).

Based on past performance and established maintenance practices and procedures, the staff has determined the impacts to Federally listed species would be SMALL. Any additional mitigative actions or BMP would be dependent on the species, exact location and nature of the environmental impacts associated with operation of the transmission line right-of-way.

5.4.3.2 Aquatic Federally Listed Species

This section describes the potential impacts that operation of the proposed VEGP Units 3 and 4 could have on the shortnose sturgeon (*Acipenser brevirostrum*), the only Federally listed aquatic species occurring in the vicinity of the VEGP site. This species was identified through correspondence with the National Marine Fisheries Service (NMFS) (NMFS 2006). A Biological Assessment describing the staff's findings is being prepared and will be sent to NOAA under Section 7 of the Endangered Species Act. Impacts to shortnose sturgeon could occur as a result of entrainment, impingement, thermal discharges, or chemical discharges.

As discussed in Section 2.7.2.2, shortnose sturgeon are known to be in the Savannah River in the vicinity of the site. Suspected spawning grounds are located at rkm 179 to 190 (RM 111 to 120), rkm 275 to 278 (RM 171 to 173) (Hall et al. 1991), and rkmM 208 to 228 (RM 129 to 142) (Collins and Smith 1993). Twelve larval shortnose sturgeon were collected in the vicinity of SRS during ichthyoplankton surveys conducted between 1982 and 1985 (Paller et al. 1986).

Because sturgeon eggs are demersal (Dadswell et al. 1984), and adhere to hard substrate such as rocks or submerged logs, they are less likely to be entrained into the cooling water system than eggs of other species. In addition, as discussed in Section 2.7.2.2, larvae and early juveniles tend to initially stay near the bottom and seek cover. Collins et al. (2002) indicates the nursery habitat for juvenile shortnose sturgeon in the Savannah River is in the lower river approximately from rkm 31.5 to 47.5 (RM 19.57 to 29.52), well distant from the VEGP site.

The design and operation of the CWIS (as discussed in Section 5.4.2.2) including the low-through-screen intake velocity, are not likely to adversely impact shortnose sturgeon. The area affected by thermal discharge is small in comparison to the width of the Savannah River at the VEGP site, thus not providing a barrier to the up- or down-river migration of shortnose sturgeon. In addition, the quantities of chemicals to be discharged into the Savannah River from proposed VEGP Units 3 and 4 are of low enough concentration and would be significantly diluted to not cause an adverse impact to nearby sturgeon.

No impacts are anticipated to the shortnose sturgeon from maintenance of the transmission lines, because the lines do not cross the Savannah River. Consequently, operation of the proposed VEGP Units 3 and 4 is not likely to adversely affect the shortnose sturgeon. The impacts to the sturgeon would be considered SMALL and there is no need for additional mitigation.

5.5 Socioeconomic Impacts

The socioeconomic impacts from operating two new Westinghouse AP1000 reactors at the VEGP site and from the activities and demands of the operating workforce on the surrounding region include the potential impacts on individual communities, the surrounding region, and minority and low-income populations. Unless otherwise specified, the primary source for information in this section is provided by Southern's ER (Southern 2007a).

5.5.1 Physical Impacts

Potential physical impacts include noise, odors, exhausts, thermal emissions, and visual intrusions. The NRC staff believes these impacts would be mitigated through operations of the facility in accordance with all applicable Federal, State, and local environmental regulations and therefore would not significantly affect the region surrounding VEGP. The following sections assess the potential operations-related physical impacts of two new units on specific segments of the population, the plant, and nearby communities.

5.5.1.1 Workers and the Local Public

There are no residential areas located within the site boundary. The area within 16 km (10 mi) of the VEGP site is predominately rural and characterized by agricultural and forested land, with only 3500 residents (see Section 2.8.1 of this EIS). No significant industrial or commercial facilities other than VEGP exist or are planned for this area.

Burke County is part of the Augusta-Aiken Interstate Air Quality Control Region, which is classified as in attainment with all National Ambient Air Quality Standards (NAAQS)[a] (40 CFR 81.114). Once the two new reactors have begun operation, they would not produce any known air pollutant, except for (1) the periodic testing and operation of VEGP's standby diesel generators and auxiliary power systems, (2) commuter vehicle dust and exhaust, (3) odors from operations, and (4) operations-based noise. Certificates to operate the diesel generators require that air emissions comply with all applicable regulations and the staff expects the impact of the operations of the proposed VEGP Units 3 and 4 on air quality would be small. Access road maintenance and speed limit enforcement would reduce the amount of dust generated by the commuting workforce. Southern uses a staggered shift schedule for its operations workforce, which also helps mitigate the effects of vehicle exhaust (Southern 2007a). During normal plant operation, the new units would not use chemicals in amounts that would

(a) Areas of the United States having air quality as good as or better than the NAAQS are designated by the U.S. Environmental Protection Agency (EPA) as "attainment areas."

generate odors exceeding Federal and State limits. Southern plans to use BMP to control the odors emitted by chemicals and other sources during routine outages and therefore the staff believes the addition of two new reactors to the site would have only a SMALL impact and would not require additional mitigation. Air-quality impacts of plant operation are discussed in more detail in Section 5.2 of this EIS.

The proposed VEGP Units 3 and 4 would produce noise from the operation of pumps, transformers, turbines, generators, and switchyard equipment. The noise levels would be controlled in accordance with applicable local regulations. Most equipment would be located inside structures, reducing the outdoor noise level. Southern would use single natural draft cooling towers for each Westinghouse AP1000 reactor at the VEGP site to remove excess heat from the CWS. Natural and mechanical draft cooling towers emit broadband noise, which Southern expects to be greater than background levels. Noise levels below 60 to 65 dBA are not considered to be significant because these levels are not sufficient to cause hearing loss (NRC 1996). Ambient noise heard by recreational users on the Savannah River or nearby Yuchi Wildlife Management Area (WMA) under normal conditions includes some noise from the operation of VEGP Units 1 and 2. The maximum sound level generated by the operation of the proposed VEGP Units 3 and 4 at the site boundary would be approximately 30 to 40 dBA and would not affect the usage of nearby recreational areas and would not require mitigation. Therefore, the staff determined the noise-related effect on workers, residents, and recreational users of nearby areas would be SMALL and no mitigation would be required.

5.5.1.2 Buildings

Operations activities would not affect offsite buildings. Except for VEGP site structures, no other industrial, commercial, or residential structures would be affected by the operation of Vegp Units 3 and 4. Consequently, the staff determined the operations impacts to onsite and offsite buildings would be SMALL and not require mitigation.

5.5.1.3 Roads

Roads within the vicinity of the VEGP site would experience an increase in traffic at the beginning and the end of each operations shift and the beginning and end of each outage support shift. Commuter traffic would be controlled by speed limits. The access roads to the VEGP site would be paved. Maintaining good road conditions and enforcing appropriate speed limits would reduce the noise level and particulate matter generated by the workforce commuting to and from the VEGP site. Therefore, the staff determined the road-related impacts from noise and dust to workers, residents, and other users of the roads within the vicinity of the proposed site would be SMALL and would not require mitigation.

5.5.1.4 Aesthetics

The nearest residence is more than 1.6 km (1 mi) from the site of the proposed new units, separated by forested land such that the proposed units would not be clearly visible from its location. The proposed intake structure would be clearly visible from the Savannah River, and the new 180-m (600-ft) towers and the top of the new containment domes would be visible from some locations on the river, as well as their vapor plumes, which would resemble cumulus clouds. The plumes would be most noticeable in the winter months and may extend more than 8 km (5 mi) from the site. Section 5.2 of this EIS describes these impacts in more detail. Given the site has already been affected by the presence of two reactors and cooling towers, the staff believes the marginal aesthetic impact of the new reactors and cooling towers would be SMALL and would not require mitigation.

Once the new units are operational, the power would be transmitted via new 500-kV transmission lines. The new transmission line right-of-way would be routed northwest of the VEGP site to the Thomson-Vogtle Substation northwest of Augusta, Georgia. The new right-of-way would be approximately 46 m (150 ft) wide and 100 km (60 mi) long (Southern 2007b), and would require approximately 390 metal-lattice towers (Southern 2007a). MODERATE aesthetic impacts are expected due to the presence of this new transmission line and right-of-way.

5.5.1.5 Summary of Physical Impacts

Based on the information provided by Southern, staff interviews with local public officials, and NRC's own independent review, the staff concludes that the physical impacts of operation of the proposed new units would be SMALL and additional mitigation measures beyond those identified by Southern is not warranted.

5.5.2 Demography

Based on U.S. Census bureau estimates, approximately 670,000 people lived within an 80-km (50-mi) radius of the VEGP site in 2000 and this population is estimated to grow annually by an average rate of 2.1 percent between 2000 and 2090, increasing the population to approximately 4.5 million in 2090 (see Table G-3 in Appendix G).[a] Southern anticipates employing 660 operations workers at the new units. Although it is likely that some employees would already reside within a reasonable commuting distance to the plant, to estimate the maximum demographic impacts from operations, the staff assumed all of the new operations employees and their families would migrate into the region from other locations. The average household size in Georgia and South Carolina are 2.65 and 2.53, respectively. The staff used the average

(a) Further detail regarding the population projection methodology used for the sector population analysis is provided in Section 2.5 of Southern's ER (Southern 2007a).

Georgia household size (2.65 persons) to determine the increase in the operational workforce of 660 would increase the population in the 80-km (50-mi) region by approximately 1750 people.

The staff assumed the distribution of new operations workers would resemble the residential distribution of employees operating VEGP Units 1 and 2. Therefore, approximately 80 percent would likely reside in Burke (about 350 people), Columbia (590 people), and Richmond Counties (460 people) (see Table 2-15). For each of these counties, the increase in population would constitute less than 2 percent of the 2000 populations. The staff assumes the remaining 20 percent of operations employees and their families would be scattered throughout the other 23 counties within the 80-km (50-mi) radius of the VEGP site, and would represent a small fraction of each community's population. Table 5-5 displays the assumed distribution of new workers in tabular form.

Table 5-5. Potential Increase in Resident Population Resulting from Operating the Proposed VEGP Units 3 and 4

County	Percent of Current VEGP Site Workforce by Location	VEGP Units 3 and 4-Related Increase in Population	Year 2000 U.S. Census Population	Percentage Increase in Resident Population
Columbia	34	590	89,288	0.66
Richmond	26	460	199,775	0.23
Burke	20	350	22,243	1.57
Screven	7	120	15,374	0.78
Aiken	4	70	142,552	0.05
Jenkins	2	35	8,575	0.41
Jefferson	2	35	17,266	0.20
Emanuel	1	20	21,837	0.09
Bulloch	1	20	55,983	0.04
Other 19 Counties	3	50	97,107	0.05
Total	**100.0**	1750		

Source of resident locations: Southern 2007a
Source of Year 2000 U.S. Census Population: USCB 2007

Based on the information provided by Southern, NRC staff interviews with local public officials, and NRC's own independent review, the staff concludes that the demographic impacts of operation of the new unit or units at the VEGP site on most of the region would be SMALL.

5.5.3 Economic Impacts to the Community

The impacts of station operation on the local and regional economy are dependent on the region's current and projected economy and population. Although future impacts cannot be predicted with certainty, some insight can be obtained for the projected economy and population by consulting with county planners and population data. The economic impacts over a 40-year period of station operation are qualitatively discussed. The primary economic impacts from employing 660 new workers to operate the proposed VEGP Units 3 and 4 would be related to taxes, housing, and increased demand for goods and services, with the largest impact associated with plant property tax revenues (discussed in 5.5.3.2).

5.5.3.1 Economy

The staff estimated the potential social and economic impacts on the surrounding region as a result of operating the proposed two new reactors at the VEGP site, assuming a 40-year operating license. Social and economic impacts would occur from additional operation workforce jobs, tax revenue impacts, and increased population because of in-migrating workers and their families.

Section 2.8 of this EIS presents a detailed description of local and regional employment trends. The 80-km (50 mi) region of interest has a relatively diverse and stable economy, with a steady growth in the number of jobs for Burke, Columbia, and Richmond Counties in the last decade. The 660 new jobs at VEGP, would represent less than 1 percent of the total number of current workforce in the three county region (Burke-Columbia-Richmond). However, in Burke County, where the plant is located, the 660 additional jobs currently represents a 7 percent increase in the total number of jobs. Burke County would be the most impacted, as it would likely receive the largest population and workforce increase as a percentage of its base population and workforce, and it would also receive the substantial property tax benefits (discussed in 5.5.3.2 of this chapter). Outside of Burke County, the impacts become diffuse as a result of interacting with the larger economic base of the surrounding counties and the city of Augusta.

The operation of two new units at the VEGP site would also result in roughly doubling the workforce needed for scheduled outages. VEGP Units 1 and 2 undergo a scheduled refueling outage every 18 months. Once the proposed VEGP Units 3 and 4 are operational, the refueling outages would occur at least annually, and sometimes semiannually, which would require as many as 1000 (maximum estimate) additional short-term (3- to 5-week) contract employees to perform equipment maintenance, refueling, and special outage projects at the VEGP site. Most of the outage workers would stay in local hotels, rent rooms in local homes, or bring travel trailers so they can stay as close as possible to the VEGP site. In the town of Waynesboro, which is the closest town to the VEGP site, all available hotel rooms are filled to capacity during outages. This would now likely occur twice as often every 18 months, increasing hotel and restaurant revenues, as well as other retail establishments that provide services to these temporary workers. Outside of Burke County, the impacts become more diffuse because of each area's larger economic base with more available hotel rooms and temporary housing.

The overall impact on the economy of the region from operating two new units at the VEGP site would be positive. The most pronounced economic impacts would occur in Burke County, where impacts could be MODERATE, while SMALL positive economic impacts may occur in other nearby counties within commuting distance of the plant.

5.5.3.2 Taxes

Sales, Use, Income, and Corporate Taxes

To the extent the new operations employees would move into the area surrounding the proposed site from other states, the counties within the 80-km (50-mi) radius of the plant in Georgia and South Carolina would experience an increase in sales and use tax, and income tax revenues; however, these tax payments go to general State funds, and the marginal tax revenue impact at the regional level would be negligible.

GPC would also pay the State of Georgia a corporate income tax on the profits received from the sale of electricity generated by the new units, and the tax revenue impact on the region from increased sales, use, income, and corporate taxes would not be noticeable at a regional level.

Property Taxes

One of the primary sources of economic impact related to the operation of new units would be property taxes assessed on the facility. Currently Southern's tax payments represent 80 to 82 percent of the total property taxes received by Burke County (see Table 2-16). Property taxes that would be paid by the co-owners for the two new units during operations depend on many factors, most of which are unknown at this time, including future millage rates. Southern made simplifying assumptions to develop an estimate of tax payments based on the estimated value of the reactors. An estimated cost of each Westinghouse AP 1000 installed ranges from $1.20 to $2.60 billion based on a net electrical output of 1117 MW(e).[a] Table 5-6 provides an estimate of the tax payments for the proposed VEGP Units 3 and 4 throughout the life of the plant.

Table 5-6. Range of Estimated Annual Property Taxes Paid to Burke County Generated by the Proposed VEGP Units 3 and 4

	Estimated Range	
Years of Operation	**Lower Range ($)**	**Upper Range ($)**
2015-2024	20,000,000	29,000,000
2025-2034	16,000,000	23,000,000
2035-2044	10,000,000	14,000,000
2045-2054	3,500,000	5,000,000

Source: Southern 2007a

(a) These assumptions used to calculate future property taxes on VEGP Units 3 and 4 are detailed in Southern's ER, Section 5.8.2.2.2. The taxable value is assumed to depreciate throughout the life of the plant (Southern 2007a)

In addition to the property taxes paid on the value of the plant itself, Burke, Columbia, and Richmond Counties could experience an increase in property tax revenues on new homes, if the influx of workers results in any new residential construction and/or increases in existing home prices; however, this overall impact would likely be small, since the operations workforce and their families would only make up a small percentage of the existing population in the region (see Section 5.5.4.3 of this EIS).

Summary of Tax Impacts

The NRC staff expects tax revenue increases in the form of sales, use, income, and corporate taxes, because of the operation of the proposed VEGP Units 3 and 4 and the influx of operations workforce into the region. This impact, however, is likely to be SMALL at a regional level. Burke County would experience a LARGE beneficial property tax revenue increase.

5.5.3.3 Summary of Economic Impacts

Based on the information provided by Southern, NRC staff interviews with local public officials, and NRC's own independent review of data on the regional economy and taxes, the staff concludes that the impacts on the regional economy of operating the proposed units at the VEGP site would be SMALL and beneficial for all counties except Burke County, which would experience a LARGE beneficial impact under current Georgia tax law.

5.5.4 Infrastructure and Community Services

Infrastructure and community services include transportation, recreation, housing, public services, and education. The operation of two new units at the VEGP site would impact the transportation network as additional workforce use the local roads to commute to and from work and possibly additional truck deliveries are made to support operation of the new units. These same commuters could also potentially impact recreation in the area. As the workforce in-migrates and settles in the region, there may be impacts on housing, education, and public sector services.

5.5.4.1 Transportation

Similar to the impacts discussed in Section 4.5.4, the impacts of the two new units' operations on transportation and traffic would be greatest on the roads of Burke County, particularly River Road, a two-lane highway that provides the only access to the VEGP site. Beyond River Road, traffic is disbursed in several directions and capacity increases as the roads approach Richmond and Columbia Counties; thus, the focus of the impact analysis is on River Road. To enter the plant, the workforce would use the current access road that has a left turn lane from River Road.

As discussed in Section 4.5.3 of this EIS, the staff assumed current peak traffic on River Road is 1200 cars per hour, both directions. The current capacity of River Road is 3200 cars per hour and there is enough capacity for an additional 2000 passenger cars per hour. The existing workforce of 890 for VEGP Units 1 and 2 also access the VEGP site via River Road. Traffic congestion would be most noticeable during shift-change, which would occur three times a day. The number of new operations workers per shift is assumed to be similar, in percentage, to the current operations workforce. Therefore, during the afternoon shift change, approximately 60 percent of the 660 operations workers would leave the VEGP site while 30 percent would arrive. Including both existing workforce (operating VEGP Units 1 and 2), and the additional workforce employed to operate the proposed VEGP Units 3 and 4, the peak level number of vehicles per hour would be 1800 vehicles in both directions (assuming baseline of 1200 cars per hour), which is still well within the 3200-vehicles-per-hour capacity.

During outages, there could also be as many as 1000 outage workers per unit (divided between two shifts) for approximately 1 month annually or semiannually, increasing the vehicles on River Road by approximately 600. During outages, traffic on River Road could be as high as 2800 vehicles per hour.[a]

To reduce congestion on River Road, Southern would implement several permanent transportation mitigation measures that would minimize most bottlenecks, and because the current road network has sufficient capacity to accommodate the expected increase in traffic, the estimated workforce of 660 persons is expected to have a SMALL effect on the transportation network in the vicinity.

5.5.4.2 Recreation

A detailed description of local tourism and recreation is provided in Section 2.8. The primary impacts on recreation would be similar to those impacts described for the construction of two new units in Section 4.5.3.4. The impacts on recreation within 80 km (50 mi) of the VEGP Site are expected to be SMALL.

5.5.4.3 Housing

Section 2.8.2 states there were 4466 vacant rental units and 1997 vacant housing units for sale in Burke, Richmond, and Columbia Counties in 2000. There is currently enough available housing to support the maximum influx of workers and their families (1750 total people) into the region, particularly in Burke, Richmond, and Columbia Counties where most of the workers are expected to reside. Burke County, which would likely receive the highest percentage of

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(a) For Units 1 and 2, VEGP has a scheduled outage every 18 months. This would increase to 2 outages every 18 months with the operation of two new units at the plant. During outages plant operation staff *and* outage workforce are on 12-hour shifts, 24 hours per day and 7 days per week. The outage shifts are staggered with start/end times between 6-7:00 am and 6-7:00 pm.

in-migrating workers relative to the available housing stock, may experience a noticeable increase in housing demand as well as a possible shift in demand toward relatively higher-value houses.[a] A number of new housing developments currently in the works, however, could alleviate some of this short-term pressure on housing demand. The overall impact on housing demand and prices from plant operations over the expected 40-year operation of the plant in the region would likely be SMALL.

The VEGP site would need as many as 1000 additional outage workers every 18 months for a period of 30 to 40 days per outage to maintain the two new reactors. The outages for the new units would be staggered with the other units. The temporary outage workers for the existing VEGP reactors typically stay in area hotels or recreational vehicles dispersed throughout the region; therefore, no single community would be overburdened by the influx of temporary workers. In the town of Waynesboro, however, all available hotel rooms are filled to capacity during the current outages and once the proposed VEGP Units 3 and 4 become operational, this would occur twice as often. This influx of temporary workers would not be expected to impact the permanent housing stock or housing market in the region.

5.5.4.4 Public Services

Water Supply Facilities

The VEGP site does not use water from a municipal system. Instead, the VEGP site relies upon a series of onsite wells to provide potable water to support the operational workforce and operations of its existing two units. The VEGP site has permits to extract up to 20.8 million L/d (5.5 MGD) from these wells, but has typically drawn an average of 3.7 million L/d (1.05 MGD). As discussed in its ER, Southern expects those wells to provide the additional potable water demand for operation of the two proposed units, as well (Southern 2007a). Section 5.4.2 of this EIS provides more detail on plant water usage.

The average per capita water usage in the United States is 340 L/d (90 gal/d) per person, 98 L (26 gal) for personal use and the rest for bathing, laundry, and other household uses (EPA 2003). Therefore, the new operations workforce and their families would require an additional 596,200 L/d (157,500 gal/d) of potable water. Section 2.8 describes the public water supply systems in the analytical area, their permitted capacities, and current demands. Municipal water suppliers in the region have excess capacity (see Table 2-20; 2-21) with the excess public water capacity in Burke County at approximately 11 million L/d (3 MGD). Therefore, the expected impact on potable water demand in the analytical area from the in-migration of operations workers and their families would be SMALL and not require mitigation.

(a) General housing outlook based on an interview with Ms. Cathy Hawkins of Cox Real Estate, 259 S. Liberty Street, Waynesboro, Georgia, where the housing market in Burke County was described as "tight," especially for newer, higher-value homes (October 19, 2006).

Waste Water Treatment Facilities

The VEGP site has a private wastewater treatment facility for the two existing units. As part of the new units' construction project, the facility would be expanded to support the increased capacity of the additional units. Therefore, operations would not impact the VEGP site wastewater treatment facility.

Section 2.8 describes the public wastewater treatment systems in the three counties, their permitted capacities, and current demands. Wastewater treatment facilities in the three counties have excess capacity (see Table 2-21). Assuming 100 percent of the water consumed would be disposed of through the wastewater treatment facilities, the proposed VEGP Units 3 and 4 plant operations-related population increase of 1750 people would require 596,200 L/d (157,500 gpd) of additional wastewater treatment capacity in an area where the excess treatment capacity is approximately 72 million L/d (19 mgd). Therefore, the staff determined the impact on wastewater treatment from the in-migration of operations workers and their families would be SMALL and not require mitigation.

Police and Fire Services

Given the staff expects the increase in population for any given county to be less than 2 percent (see Section 5.5.2), the impact of new operations workers and their families on police and fire services would fall well within the expected population growth planned by their local governments. Therefore, the in-migration of operations workers would have a SMALL impact and not need mitigation.

Medical, Health and Human Services

Section 4.5.4.4 describes the level of medical and human services within the region of interest, which the staff determined is sufficient to absorb the operations-related influx of workers. New jobs created to operate and maintain the proposed new reactors would benefit the disadvantaged population served by the state health and human resources offices by adding some additional jobs to the region which may go to people who are currently under employed or unemployed, removing them from social services client lists. While the influx of new workers and their families may also create additional pressure on those same social services, the NRC staff believes the net effect of the new permanent operations workforce on local and state welfare and social services would be SMALL and beneficial.

5.5.4.5 Education

Section 5.5.2 discusses the staff's underlying assumptions about the distribution of workers' families within the 80-km (50-mile) radius area around the proposed site. These assumptions indicate the expected increase in population for any given county within the analytical area would be less than 2 percent. This rate is well within the planned growth rate for each county government and would, therefore, have a SMALL impact that the NRC staff does not believe would require mitigation.

For the counties expected to have the largest increase in population, the Burke County School District currently operates with an excess capacity that could support up to an additional 800 students.[a] Although the Richmond and Columbia County school districts do not operate with excess capacity, the number of potential new students from the proposed VEGP site expansion, relative to the total enrollment in their districts is relatively small. Columbia County school capacity is driven by the rapid residential growth in the area. For the past two school years, enrollment has increased by more than 800 students each year. Therefore, all of the school-aged children that might move to the area as a result of the proposed VEGP Units 3 and 4 operations at the VEGP site would be absorbed as part of Columbia County's rapid growth rate. The Richmond School District is the largest of the three districts and the increase in the total number of students expected to enroll due to VEGP operations would be insignificant relative to total enrollment levels.

5.5.4.6 Summary of Infrastructure and Community Services

Based on information supplied by Southern, staff interviews conducted with and information solicited from public officials in Burke, Screven, Columbia and Richmond Counties, and staff review of data concerning the current availability of services and current State and community planning efforts, the staff concludes that the operation impacts on the regional infrastructure and community services would be SMALL in most of the region. The estimated workforce of 660 persons would have a SMALL effect on the local transportation network. The site is relatively isolated, industrial in nature, and well masked by forest in most directions so the impacts on aesthetics would be SMALL, as would the impacts on recreation. The impacts on public services and infrastructure would be SMALL.

5.5.5 Summary of Socioeconomic Impacts

Based on information supplied by Southern, staff interviews conducted with public officials in Burke, Screven, and Richmond Counties concerning the current availability of services, and additional taxes that would likely compensate the need for additional services, the staff concludes that the operations impacts on the local economy would be beneficial and SMALL in most of the region and probably MODERATE and beneficial in Burke. The estimated workforce of 660 would have a SMALL effect on the transportation network in the vicinity and region because permanent transportation mitigation measures proposed for the construction of the new unit or units would also result in much reduced transportation-related impacts during operation of the new unit or units. The effect on tax revenues would be beneficial and SMALL

(a) Information provided by Wilbert Roberts, Burke County School District Assistant Superintendent, in e-mail message, March 6, 2007.

except for property tax receipts in Burke County, which could be beneficial and LARGE. The impacts on public services and infrastructure would be SMALL throughout the region.

5.6 Historic and Cultural Resource Impacts from Operations

The National Environmental Policy Act of 1969, as amended (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966, as amended through 2000 (NHPA), also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (such resources are referred to as "Historic Properties" in NHPA). As outlined in 36 CFR 800.8(c), "Coordination with the National Environmental Policy Act of 1969," the NRC coordinated Section 106 compliance with NEPA compliance.

The NRC has determined that evaluating suitability of the existing VEGP site for construction, operation, and decommissioning of two new units is an undertaking that could possibly affect either known or potential historic properties that may be located at the site. Therefore, in accordance with the provisions of NHPA and NEPA, the NRC is required to make a reasonable and good faith effort to identify historic properties in the areas of potential effect and, if present, determine if any significant impacts are likely to occur. Identification is to occur in consultation with the State Historic Preservation Officer (SHPO), American Indian tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, if no historic properties (i.e., places eligible for listing on the National Register of Historic Places) are present or affected, the NRC is required to notify the SHPO before proceeding. If it is determined that historic properties are present, the NRC is required to assess and resolve adverse effects of the undertaking.

For specific historic and cultural information on the VEGP site, see Section 2.9.2.

The staff does not expect any significant impacts on historic and cultural resources during operation of the new units. Any new ground-disturbing activities that might occur during operation would follow Southern procedures, which would require further evaluation to determine if additional archaeological review is necessary (Southern 2007a). Therefore, the staff concludes that the impacts from operations would be SMALL. Mitigation might be warranted in the event of an unexpected discovery.

5.7 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Section 2.10 discusses the locations of minority and low-income populations around the VEGP site and within the 80-km (50-mi) radius.

The scope of the review as defined in NRC guidance (NRC 2001, 2004a; 69 FR 52040) should include an analysis of the impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation. The descriptions to be provided by this review should state whether the impacts are likely to be disproportionately high and adverse. The review should also evaluate the significance of such impacts.

The staff evaluated whether the health or welfare of minority and low-income populations at those census blocks identified in Section 2.10 of this EIS could be disproportionately affected by the potential impacts of operating two new reactors at the proposed site. To perform this assessment, the staff used the same process employed in Section 4.7.

5.7.1 Health and Environmental Impacts

The results of the normal operation dose assessments indicate that the maximum individual dose for these pathways was found to be insignificant, well below the regulatory guidelines in Appendix I of 10 CFR Part 50 and the regulatory standards of 10 CFR Part 20.

The evaluation of postulated accidents is provided in Section 5.10 and demonstrates that radiological consequences of these accidents would meet the site acceptance criteria of 10 CFR 50.34 and 10 CFR Part 100 for the exclusion area boundary and low population zone boundary. In demonstrating compliance with these criteria, an adequate level of protection would be provided. There would be no significant adverse health impacts on members of the public, and, therefore, there would be only minimal negative and disproportionate health impacts on minority and low-income members of the public.

Environmental Impacts

Soil: As discussed in Section 5.8 the staff does not believe there would be any operations-related environmental effects to soils at the VEGP site that would impact nearby residents. Therefore, the staff believes there can be no disproportionate impact on any minority or low-income population. Similarly, while the proposed new units would generate low-level radioactive and non-radioactive wastes, these are currently generated and there are existing facilities located throughout the country permitted for disposing of these materials. Consequently, the staff determined the marginal impact to soils from the proposed new units would be SMALL and not require mitigation.

Water: As discussed in Sections 5.3.3 and 5.4.2, the staff determined the two proposed units at the VEGP site would operate with a very small thermal plume in the Savannah River and that concentrations of biocides, anti-scaling compounds and dispersants would be very small and greatly diluted by the volume of flow in the Savannah River. Consequently, the concentration of these chemicals in the river should quickly return to near-background levels (Southern 2007a). Therefore, the impact to aquatic biota would be negligible.

Consumptive losses from a portion of the proposed VEGP Units 3 and 4 would account for less than 2 percent of the daily flow of the Savannah River (see Table 5-2) and are too small to affect recreational activities on the river.

The VEGP site has three groundwater wells drawing from the Cretaceous aquifer, each of which are capable of producing 63 to 126 L/s (1000 to 2000 gpm), and under normal operating conditions for the two existing units and the two proposed units, the total pumping rate would be about 95.5 L/s (1482 gpm). This volume would drawdown the level of the Cretaceous aquifer by slightly more than 1.8 m (6 ft) during the expected life of the proposed two new reactors (Southern 2007a). There are an additional six wells completed in the Tertiary aquifer, that currently provide a small amount of water for ground site support purposes.

The staff determined that given the relatively small impact on water quantity and quality in the Savannah River, and the small consumptive water use and the drawdown on the Cretaceous aquifer, there would be no operations-related environmental effects that need to be mitigated and, therefore, there cannot be any disproportionate adverse impacts on minority and low-income populations.

Air: The total liquid and gaseous effluent doses from all four units (the two existing units plus the two proposed units) would be well within the regulatory limits of 40 CFR 190. As described in Section 5.5.2, the staff concurs with Southern's findings that the potential impacts from all potential air medium sources would be small. Furthermore, the staff believes that because these impacts would be small, there would be no disproportionate and adverse impacts felt by minority or low-income populations within the analytical area.

5.7.2 Socioeconomic Impacts

The staff determined that once the proposed new units are operational at the VEGP site, any adverse socioeconomic impacts felt by any group within the region of interest would either stop or significantly diminish when the construction workforce leaves the region. However, offsetting the departure of the construction workforce would be the in-migration of the permanent operations workforce that would operate and maintain the two new reactors. While the addition of these new employees would place pressure on local infrastructures (schools, hospitals, etc.), the staff believes any adverse impact the in-migration might create would be overwhelmed by the positive contributions of that workforce to their new local communities through income and taxes. Furthermore, the staff's interviews of surrounding communities revealed a high level of preparedness with regard to any potential influx of temporary construction or permanent operations workers.

5.7.3 Subsistence and Special Conditions

This segment of the staff's environmental justice analysis was performed under the same authority and requirements as that performed in Section 4.7 of this EIS.

Subsistence

Fish advisories from the States of Georgia and South Carolina indicate consumption of some species, especially predatory species, can carry levels of radioactive contamination that could be harmful if ingested. However, an extensive investigation by the Institute for Energy and Environmental Research indicates only a small amount of the radiological contamination (primarily tritium) in the Savannah River and its organisms can be attributed to the existing VEGP (Makhijani et al. 2004). The addition of the proposed VEGP Units 3 and 4 is not expected to significantly increase the level of radioactive contamination in the Savannah River. Therefore, while subsistence consumption of fish species from the Savannah River may be a health problem for minority and low-income populations, it is not attributable to the existing reactors and cannot be reasonably projected to be exacerbated by the addition of two more reactors at the site. The staff determined there were no operations-related disproportionate and adverse impacts on minority or low-income populations related to subsistence.

High Density Communities

There are no Native American communities within the region of interest, and while some existing communities within the area exhibit disproportionately high percentages of minority (primarily Black races) and low-income populations, most of the higher percentages of minority and low-income populations can be attributed to the sparseness of the rural population in general. This was reinforced for the staff through a series of interviews with minority leaders and social service agency representatives in the affected counties, all of whom described the minority and low-income communities as "scattered" throughout the counties with no heavy concentrations in any one particular area.[a] Therefore, the staff determined there were no environmental justice effects to consider with respect to densely populated minority or low-income communities.

(a) Personal communication (phone interview) on October 9, 2006, with Reverend Robert Lynch, pastor of Bethel Apostolic Church, Waynesboro, Georgia, and head of the Burke County Citizens Hunger Action Committee (affiliated with the Golden Harvest Food Bank). Also confirmed in interviews with Screven County Family Services (with Mr. Bill Hillis), October 18, 2006, and Burke County Family Services (with Ms. Alane Hickman), October 19, 2006.

5.7.4 Summary of Environmental Justice Impacts

Based upon the underlying assumptions of the analysis discussed in Section 2.10, the impacts of plant operations on environmental justice would be SMALL because no environmental pathways or health and other preconditions of the minority and low-income population were found that would lead to adverse and disproportionate impacts.

5.8 Nonradiological Health Impacts

This section addresses the health impacts of operating the proposed new units at the VEGP site from nonradiological parameters. Health impacts to the public from the cooling system, noise generated by operations, EMFs, and transporting operations and outage workers are discussed. Health impacts from the same sources are also evaluated for workers at the new units. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Thermophilic Microorganisms

Operation of VEGP Units 3 and 4 would result in a thermal discharge to the Savannah River (Southern 2007a). Such discharges have the potential to increase the growth of thermophilic microorganisms, including etiological agents, both in the circulating water system and the river. Thermophilic microorganisms include enteric pathogens such as *Salmonella* spp., *Pseudomonas aeruginosa*, thermophilic fungi, bacteria such as *Legionella* spp., and free-living amoeba such as *Naegleria fowleri* and *Acanthamoeba* spp. These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels.

As described in the NUREG-1437 (NRC 1996), nuclear power plants that use cooling ponds, lakes, or canals and those that discharge to "small rivers" have the greatest chance of affecting the public from increases in thermophilic microbial populations. A small river is defined as one with an average flow rate of less than 2800 m^3/s (100,000 ft^3/s). The monthly average flow rates of the Savannah River between the years 1985 and 2005 ranged from about 200 to 400 m^3/s (7000 to 14,000 ft^3/s), which meets the criterion of a small river (Southern 2007a). The maximum projected cooling tower blowdown from operating two new units is about 1.81 m^3/s (64 ft^3/s), which is less than 1 percent of the minimum monthly average flow rate of the Savannah River (Southern 2007a). Modeling performed by Southern (2007a) using the CORMIX mixing zone model predicted a maximum blowdown temperature of 33.1°C (91.5°F) and a negligible impact on Savannah River temperature below the discharge outfall.

Available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 1996 to 2005 (CDC 1997, 1998, 1999, 2001, 2002a, 2003a, 2004, 2005, 2006, 2007), and from the States of Georgia and South Carolina for the years 2001 to 2006 (GDHR 2002, 2006; SCDHEC 2007), report a single occurrence of a waterborne disease in August 2002 resulting from exposure to *N. fowleri* of an 11-year old boy who had swum in a river in southern

Georgia along with 9 other individuals (CDC 2004). In early September 2002, the Georgia Division of Public Health and CDC were notified that this exposure had resulted in a fatal case of primary amebic meningoencephalitis (PAM) (CDC 2003b). The environmental investigation revealed a high ambient air temperature (>32°C [>90°F]) and water temperature (33°C [91°F]) in the river at the time of the exposure and that because no recent rainfall had occurred in the region, the river level was low, and the river was flowing slowly (CDC 2003b). Bacteriologic testing of the river water demonstrated that fecal coliform levels were within acceptable limits. *Naegleria fowleri* was isolated from two of three river water samples tested and from a control sample taken from a local lake (CDC 2003b). During 1989 to 2000, the CDC waterborne-disease outbreak surveillance system documented 24 fatal cases of PAM in the United States, this being the first case in Georgia since 1987 (CDC 2002b). Outbreaks of Legionellosis, Samonellosis, or Shigellosis that occurred in Georgia or South Carolina were within the range of national trends (CDC 1997, 1998, 1999, 2001, 2002a, 2003a, 2004, 2005, 2006, 2007) in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes.

Epidemiological reports from the States of Georgia and South Carolina indicate a very low risk of outbreaks from thermophilic microorganisms associated with thermal discharges (GDHR 2002, 2006; SCDHEC 2007). Notably, there have been up to 40 cases per year of Legionellosis reported statewide in Georgia during the last 10 years and only one case of exposure to *N. fowleri* reported statewide during the last 5 years. During the period 2004 to 2006, counties in Georgia within the vicinity of VEGP reported Legionellosis in Jefferson County (6 cases) and Chatham County (9 cases), with no cases reported in Burke, Columbia, Emanuel, Effingham, Jenkins, McDuffie, Richmond, or Screven Counties. In South Carolina, up to 22 cases per year of Legionellosis have been reported statewide since 1995. For South Carolina counties in the vicinity of VEGP, Aiken County reported one case in 2004, and Barnwell County reported one case in 2006, with no cases reported in Allendale, Edgefield, Hampton or Jasper Counties during 2003 to 2006. No reported cases of exposure to *N. fowleri* in South Carolina were identified during the last 5 years.

The small temperature increase expected as a result of operating the new nuclear units would not significantly increase the abundance of these organisms and the staff concludes that the impacts on human health would be SMALL and that no mitigation would be warranted.

5.8.2 Noise

In the GEIS (NRC 1996), the staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from plant operation include cooling towers, and transformers, with intermittent contributions from loud speakers and auxiliary equipment such as diesel generators. These noise sources are discussed in this section.

The existing units at the VEGP site use natural draft cooling towers. According to the ER (Southern 2007a), there have been no complaints. According to the ER (Southern 2007a) and

Westinghouse (2005a), noise levels from cooling towers and diesel generators at new units could have noise levels as high as 55 dBA at a distance of 300 m (1000 ft). The nearest site boundary is more than 460 m (1500 ft) from the planned cooling tower location (Southern 2007a). At this distance, cooling tower and generator noise would be expected to about 51 dBA, not considering attenuation because of vegetation and topography. Similarly, the 55 dBA at 300 m (1000 ft) translates to about 41 dBA at about 1.6 km (1 mi), the approximate distance to the nearest residence (Southern 2007a).

According to the GEIS (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (NUREG-0586, Supplement 1) (NRC 2002a). The criterion for assessing the level of significance was not expressed in terms of sound levels but based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG-0586, Supplement 1, is stated as follows:

> The noise impacts ... are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts ... are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

These noise sources are sufficiently distant from the plant boundaries that the noise generated by the plant is attenuated to near-ambient levels before reaching critical receptors outside the plant boundary.

Given the postulated noise levels for cooling towers and diesel generators, the staff concludes that the noise impacts would be SMALL and that mitigation would not be warranted.

5.8.3 Acute Effects of EMFs

In its ER, Southern states that two 500-kV transmission lines would service new generation at the VEGP site (Southern 2007a). The applicant then evaluates electric shock potential of a template 500-kV line built to present National Electric Safety Code (NESC) standards as a surrogate design for all spans. On this basis, the applicant concludes that an induced current for a vehicle parked beneath a single 500-kV transmission line could be as high as 3.8 milliamp. The induced current for a vehicle parked beneath two 500-kV transmission lines could be higher or lower, depending on the configuration of the lines. Finally, the applicant commits to design any new transmission lines to ensure that two lines combined would be in compliance with the 5-milliamp standard in the present NESC. The staff assumes that transmission lines constructed to serve new generation at the VEGP site would be constructed to meet NESC criteria for construction and operation of transmission lines at the time of construction.

For the template span, the present NESC requirements for preventing electric shock from induced current were met. With the applicant's commitment to design new transmission lines to ensure that the present NESC criteria are met when two transmission lines are combined and the staff's assumption that transmission lines constructed to serve new generation at the VEGP site would be constructed to NESC standards in effect at the time of construction, the staff concludes that the impact to the public from acute effects of EMFs would be SMALL, and additional mitigation would not be warranted.

5.8.4 Chronic Effects of EMFs

Research on the potential for chronic effects from 60-Hz EMFs from energized transmission lines was reviewed and addressed elsewhere by the NRC in the NUREG-1437 (NRC 1996). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. An NIEHS report (1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency-electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the staff to consider the potential impact as significant to the public. The staff will continue to follow developments in this area.

5.8.5 Occupational Health

In general, occupational health risks for new units are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) to workers engaged in activities such as maintenance, testing, and plant modifications. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. Further, Southern (2007a) reports that the incidence rate of total recordable cases at the VEGP site from 2000 to 2004 was 1.8 percent, which was less than the corresponding incidence rates for the State of Georgia and the United States for electrical power production workers (4.5 and 3.5 percent). Occupational injury and fatality risks are reduced by strict adherence to NRC and Occupational Safety and Health Administration (OSHA) safety standards (29 CFR Part 1910), practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks for new nuclear unit operation. The staff assumes adherence to NRC, OSHA, and State safety standards, practices, and procedures during new nuclear unit operations.

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. Southern (2007a) reports that it maintains a health and safety program to protect workers from industrial safety risks at the operating units and would implement the program for the proposed new units. Health impacts to workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be SMALL.

5.8.6 Impacts of Transporting Operations Personnel to the VEGP Site

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used to calculate the impacts of transporting operations and outage personnel to and from the VEGP site. However, preliminary estimates are the only data available to estimate these impacts. The assumptions made to fill in reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

- The number of workers needed for operations was given in the ER (Southern 2007a) as 660 (two units), so each Westinghouse AP1000 reactor at the VEGP site requires about 330 operating personnel. An additional 1000 temporary workers are estimated to be needed for refueling outages. It was assumed that outages for the two units would not occur simultaneously.

- The average commute distance for operations and outage workers was assumed to be 32 km (20 mi) one way.

- To develop representative commuter traffic impacts, a source was located that provided a Georgia-specific fatality rate for all traffic for the years 2001 to 2005 (DOT 2005). The average fatality rate for the 2001 to 2005 period in Georgia was used as the basis for estimating Georgia-specific injury and accident rates. Adjustment factors were developed using national-level traffic accident statistics in the U.S. Department of Transportation publication *National Transportation Statistics 2007* (DOT 2007). The adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the Georgia-specific fatality rate to approximate the injury and accident rates for commuters in the State of Georgia.

The estimated impacts of transporting operations and outage workers to/from the VEGP site are shown in Table 5-7. The total annual traffic fatalities during operations, including both operations and outage personnel, represents about a 0.04 percent increase above the 12 traffic fatalities that occurred in Burke County, Georgia, in 2005 (DOT 2005). This represents a small increase relative to the current traffic fatality risk in the area surrounding the proposed VEGP site.

Table 5-7. Nonradiological Impacts of Transporting Workers to/from the VEGP Site

	Accidents per Year	Injuries per Year	Fatalities per Year
Permanent Workers	3.9×10^0	1.8×10^0	2.7×10^{-2}
Outage Workers	2.9×10^0	1.3×10^0	2.0×10^{-2}

5.8.7 Summary of Nonradiological Health Impacts

The staff evaluated health impacts to the public and the workers from the cooling systems, noise generated by unit operations, and acute and chronic impacts of EMFs at the higher power levels, and transporting operations and outage workers to/from the two additional units. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from thermophilic microorganisms, noise generated by unit operations, and acute impacts of EMFs would be minimal. Based on the information provided by Southern and NRC's own independent review, the staff concludes that the potential impacts of nonradiological effects resulting from the operation of two additional units would be SMALL, and mitigation is not warranted. The staff has not come to conclusions on the chronic impacts of EMFs.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of the proposed new units on the VEGP site, including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the VEGP site. Estimated doses to workers at the proposed units are also discussed. Radiological impacts were determined using the Westinghouse AP1000 reactor design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation (see discussion in Section 3.2.3).

5.9.1 Exposure Pathways

The public and biota would be exposed to increased ambient background radiation from a nuclear unit via the liquid effluent, gaseous effluent, and direct radiation pathways. Southern estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding a nuclear unit at the VEGP site. They considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around the site (Southern 2007a). For example, factors such as the location of homes in the area, consumption of meat from the area, and consumption of vegetables grown in area gardens were considered.

For the liquid effluent release pathway, the ER considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): ingestion of aquatic food (i.e., fish), ingestion of drinking water, and direct radiation exposure from shoreline activities (see Figure 5-2). The analysis for population dose considered the following exposure pathways: ingestion of aquatic food and direct radiation exposure from shoreline, swimming, and boating activities. Drinking water was not evaluated because the current land-use census showed no drinking water use of the river within 160 km (100 mi) downstream of the site. Liquid effluents were assumed to be released into Savannah River at the end of a newly constructed discharge structure.

For the gaseous effluent release pathway, Southern considered the following exposure pathways in evaluating the dose to the individual: immersion in the radioactive plume, direct radiation exposure from deposited radioactivity, inhalation, ingestion of garden fruit and vegetables, and ingestion of beef. Southern (2007a) did not calculate a dose from milk ingestion because the most recent land-use census indicated that no milk cows existed within 8 km (5 mi) of the site.

Southern (2007a) calculated population doses using the same exposure pathways as used for the individual dose assessment, but with the addition of the cow milk ingestion pathway (see Figure 5-2).

Southern (2007a) states that direct radiation from the reactor buildings and planned ISFSI would be the primary sources of direct radiation exposure to the public from the VEGP site. However, Southern assumes that contained sources of radiation at the proposed VEGP Units 3 and 4 would be shielded and would not contribute to the external dose of the MEI individual or the population.

Exposure pathways considered in evaluating dose to the biota are shown in Figure 5-3 and included

- Ingestion of aquatic foods
- Ingestion of water
- External exposure from water immersion or surface effect
- Inhalation of airborne radionuclides
- External exposure to immersion in gaseous effluent plumes, and
- Surface exposure from deposition of iodine and particulates from gaseous effluents (NRC 1977).

The staff reviewed the exposure pathways for the public and biota identified by Southern (2007a) and found them to be appropriate, based on a documentation review, a tour of environs, and interviews with Southern staff and contractors during the site visit in October 2006.

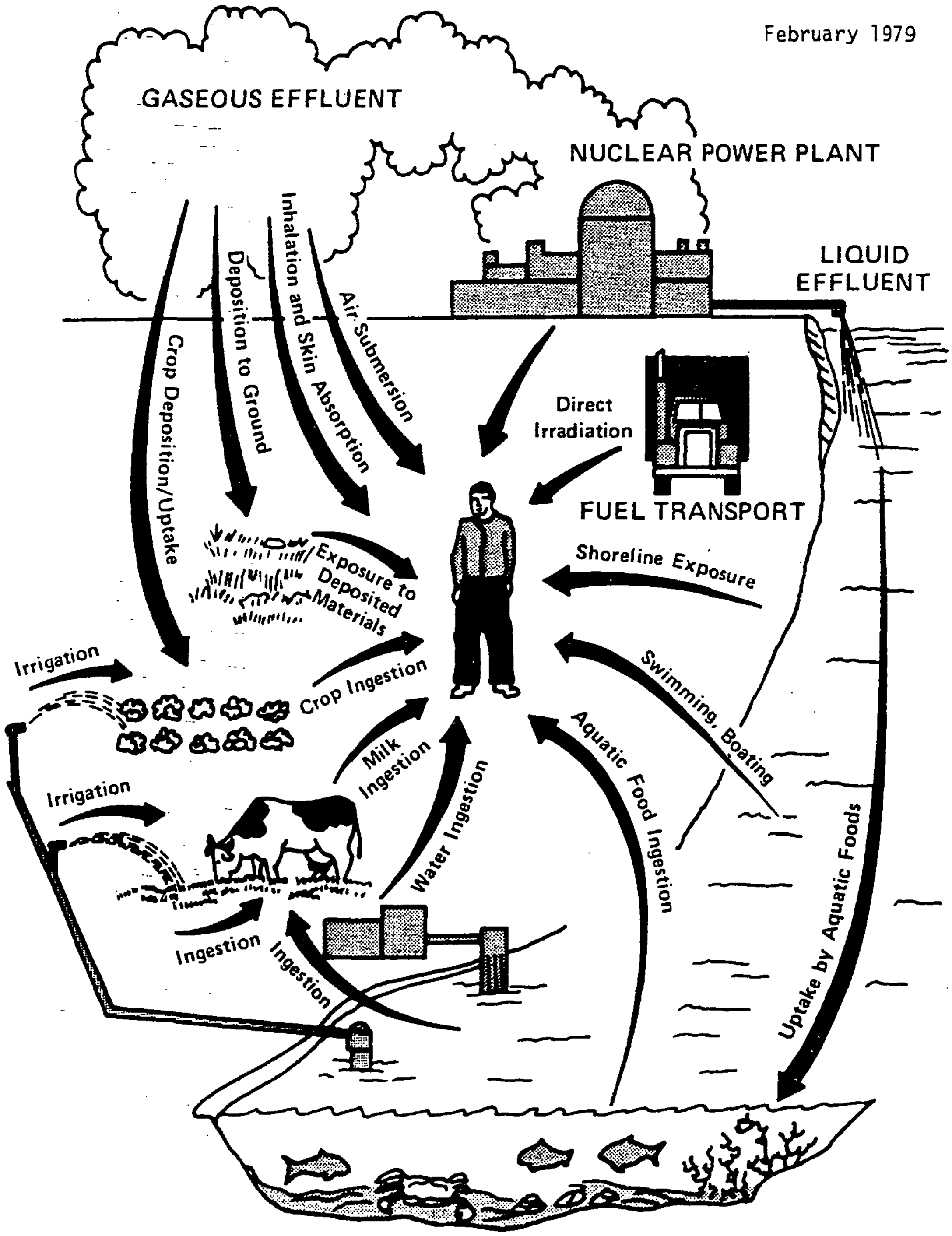

Figure 5-2. Exposure Pathways to Man (Soldat et al. 1974)

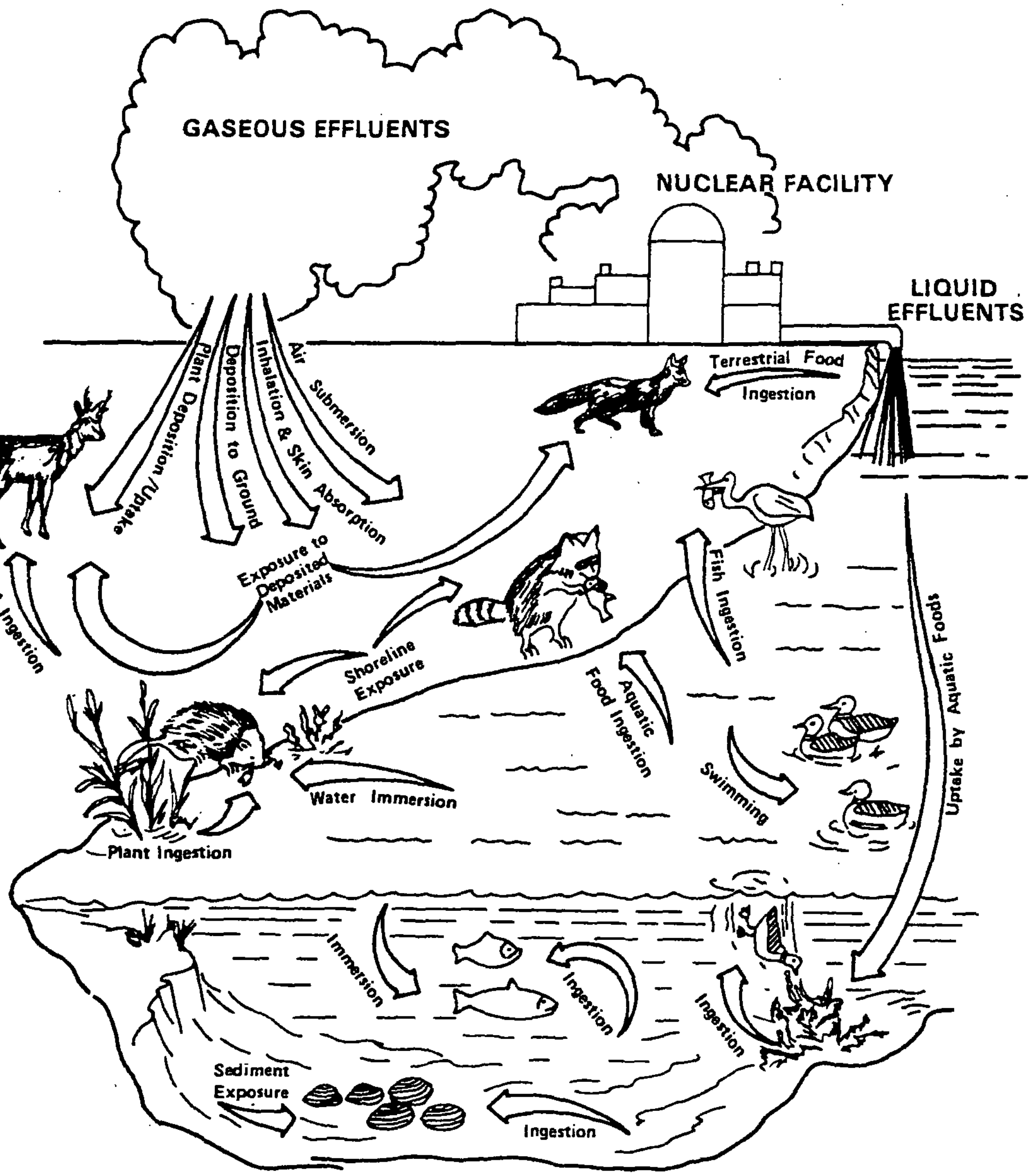

Figure 5-3. Exposure Pathways to Biota Other than Man (Soldat et al. 1974)

5.9.2 Radiation Doses to Members of the Public

Southern calculated the dose to the MEI individual and the population living within an 80-km (50-mi) radius of the site from both the liquid and gaseous effluent release pathways (2007a). As discussed in the previous sections, direct radiation exposure to the MEI individual from sources of radiation at the proposed VEGP Units 3 and 4 would be negligible.

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses were calculated using the LADTAP II computer program (Strenge et al. 1986). The liquid effluent releases used in the estimates of dose are found in Table 3.5-1 of the ER (Southern 2007a). Other parameters used as inputs to the LADTAP II program include effluent discharge rate, dilution factor for discharge, transit time to receptor, and liquid pathway consumption and usage factors (i.e., fish consumption and drinking water consumption), and are found in Table 5.4-1 of the ER (Southern 2007a).

Southern calculated liquid pathway doses to the MEI and population. The maximum annual dose to the total body for two new units was 0.00034 mSv (0.034 mrem) for an adult. The maximum annual dose to the thyroid for two new units was 0.0003 mSv (0.03 mrem) for an infant. The maximum annual dose to the liver for two new units was 0.00042 mSv (0.042 mrem) for a child. Southern calculated the dose to the population living within an 80-km (50-mi) radius of the site to be 0.37 person-mSv/yr (37 person-mrem/yr) for two new units.

The staff recognizes the LADTAP II computer program as an appropriate method for calculating dose to the MEI for liquid effluent releases. The staff performed an independent evaluation of liquid pathway doses using input parameters from the ER and found similar results. All input parameters used in Southern calculations were judged by the staff to be appropriate. Results of the staff's independent evaluation are found in Appendix G.

5.9.2.2 Gaseous Effluent Pathway

Gaseous pathway doses to the MEI were calculated by Southern using the GASPAR II computer program (Strenge et al. 1987) at the nearest residence and the exclusion area boundary. The GASPAR II computer program was also used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground, (2) inhalation of gases and particulates, (3) ingestion of meat from animals eating contaminated grass, and (4) ingestion of garden vegetables contaminated by gases and particulates. Southern (2007a) states that no milk cows or milk goats are located within 8 km (5 mi) of the proposed site. However, Southern did provide individual dose results for the milk pathway in its ER for information purposes, but those results are not included in the total doses reported here and in the ER (Southern 2007a). Southern did include the milk pathway in the calculation of population dose. The gaseous effluent releases used in the estimate of dose to the MEI and population are found in Table 3.5-2 of the ER (Southern 2007a). Other parameters used as inputs to the GASPAR II program, including population data, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found in Tables 5.4-2 and 5.4-4 of the ER (Southern 2007a). Gaseous pathway doses to the MEI calculated by Southern are found in Table 5-8.

Table 5-8. Doses to the Maximally Exposed Individual from Gaseous Effluent Pathway for Two Units[(a)]

Location	Pathway	Total Body Dose (mSv/yr)[(b)]	Thyroid Dose (mSv/yr)[(b)]	Skin Dose (mSv/yr)[(b)]
Exclusion area boundary (0.8 km [0.5 mi] NE)	Plume	1.12×10^{-2}	-	4.60×10^{-2}
Nearest residence (1.1 km [0.67 mi] NE)	Plume	5.11×10^{-3}	-	2.56×10^{-2}
Nearest residence (1.1 km [0.67 mi] NE)	Ground	1.75×10^{-1}	-	2.05×10^{-1}
Nearest residence (1.1 km [0.67 mi] NE)	<u>Inhalation</u>			
	Adult	5.59×10^{-4}	5.19×10^{-3}	-
	Teen	5.65×10^{-4}	6.48×10^{-3}	-
	Child	5.00×10^{-4}	7.56×10^{-3}	-
	Infant	2.89×10^{-4}	6.78×10^{-3}	-
Nearest garden (1.1 km [0.67 mi] NE)	<u>Vegetable</u>			
	Adult	4.09×10^{-3}	4.00×10^{-2}	-
	Teen	6.08×10^{-3}	5.38×10^{-2}	-
	Child	1.33×10^{-2}	1.05×10^{-1}	-
Nearest meat animal (1.1 km [0.67 mi] NE)	<u>Meat</u>			
	Adult	1.25×10^{-3}	-	-
	Teen	1.00×10^{-3}	-	-
	Child	1.81×10^{-3}	-	-
Nearest milk cow (1.1 km [0.67 mi] NE)[(c)]	<u>Cow Milk</u>			
	Adult	1.84×10^{-3}	5.46×10^{-2}	-
	Teen	2.97×10^{-3}	8.67×10^{-2}	-
	Child	6.42×10^{-3}	1.73×10^{-1}	-
	Infant	1.27×10^{-2}	4.18×10^{-1}	-

(a) Source was the ER (Southern 2007a), Tables 5.4-6 and 5.4-7. No infant doses were calculated for the vegetable or meat pathway because the doses that infants receive from this diet would be bounded by the dose calculated for the child.
(b) Multiply mSv/yr times 100 to obtain mrem/yr.
(c) This distance and direction from the VEGP site represents nearest residence. No milk-producing animals are known to be located within 8 km (5 mi) of the proposed site and these results for milk cow are provided for informational purposes only.

The staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The staff performed an independent evaluation of gaseous pathway doses and obtained similar results for the MEI.

The staff performed an independent evaluation of population dose and calculated a population dose 20 percent higher than that calculated by Southern (2007a). Section 5.4.1 of the Environmental Standard Review Plan (ESRP) requires use of "...projected population for 5 years from the time of licensing action under consideration" (NRC 2000a). Assuming the ESP action occurs in year 2008 and adding 5 years yields 2013. The staff calculated the population dose for the population predicted to exist in the year 2013, while Southern (2007a) used the year 2000 census value. See Appendix G for details.

5.9.3 Impacts to Members of the Public

This section describes the staff's evaluation of the estimated impacts from radiological releases and direct radiation of two new units at the VEGP site. The evaluation addresses dose from operations to the MEI located at the VEGP site and the population dose (collective dose to the population within 80 km [50 mi]) around the VEGP site.

5.9.3.1 Maximally Exposed Individual

Southern (2007a) states that total body and organ dose estimates to the MEI from liquid and gaseous effluents for two new units would be within the design objectives of 10 CFR Part 50, Appendix I. Doses to total body and maximum organ at the Savannah River from liquid effluents were well within the respective 0.03-mSv/yr (3-mrem/yr) and 0.1-mSv/yr (10-mrem/yr) Appendix I design objectives. Doses at the exclusion area boundary from gaseous effluents were well within the Appendix I design objectives of 0.1 mGy/yr (10 mrad/yr) air dose from gamma radiation, 0.2 mGy/yr (20 mrad/yr) air dose from beta radiation, 0.05 mSv/yr (5 mrem/yr) to the total body, and 0.15 mSv/yr (15 mrem/yr) to the skin. In addition, dose to the thyroid was within the 0.15 mSv/yr (15 mrem/yr) Appendix I design objective. A comparison of dose estimates for each of two new units to the Appendix I design objectives is found in Table 5-9.

Gaseous and liquid effluents from the VEGP site are below the Appendix I design objectives (Southern 2007a). The cumulative effects of both the current operating units and two new units also are within Appendix I design objectives.

Southern (2007a) states that dose estimates from combined liquid and gaseous effluents to the MEI at the nearest residence from the new units are well within the regulatory standards of 40 CFR Part 190. As stated earlier, exposure at the site boundary from direct radiation sources at the new units would be negligible. Table 5-10 compares Southern's calculated doses from the two existing and proposed units to the dose standards from 40 CFR Part 190, i.e., 0.25 mSv/yr (25 mrem/yr) to the total body, 0.75 mSv/yr (75 mrem/yr) to the thyroid, and 0.25 mSv/yr (25 mrem/yr) to any other organ.

Table 5-9. Comparison of Maximally Exposed Individual Dose Estimates for a Single New Nuclear Unit from Liquid and Gaseous Effluents to 10 CFR Part 50, Appendix I, Design Objectives

Pathway/Type of Dose	Southern (2007a)[(a)]	Appendix I Design Objectives[(a)]
Liquid Effluents		
Total body dose	0.00017 mSv/yr (adult)	0.03 mSv/yr
Maximum organ dose	0.00021 mSv/yr (child liver)	0.1 mSv/yr
Gaseous Effluents (Noble gases only)		
Gamma air dose	0.0068 mGy/yr	0.1 mGy/yr
Beta air dose	0.0284 mGy/yr	0.2 mGy/yr
Total body dose	0.0056 mSv/yr	0.05 mSv/yr
Skin dose	0.0230 mSv/yr	0.15 mSv/yr
Gaseous Effluents (Radioiodines and particulates)		
Organ dose	0.0591 mSv/yr (child thyroid)	0.15 mSv/yr

(a) Multiply mSv/yr or mGy/yr times 100 to obtain mrem/yr or mrad/yr.
Source: Southern 2007a, 10 CFR Part 50 Appendix I.

Table 5-10. Comparison of Maximally Exposed Individual Dose Estimates from Liquid and Gaseous Effluents to 40 CFR Part 190 Standards

Dose	Southern (2007a) Estimate (mSv/yr)[(a)(b)]	40 CFR Part 190 Standards (mSv/yr)[(b)]
Whole body dose equivalent	0.0236	0.25
Thyroid dose	0.1239	0.75
Dose to another organ	0.0888 (child liver)	0.25

(a) Sum of dose from liquid and gaseous effluent releases for existing and proposed units.
(b) Multiply mSv/yr times 100 to obtain mrem/yr.
Source: Southern 2007a, 40 CFR Part 190

Doses to the MEI from the existing VEGP units are smaller than the dose estimates for the new units. Section 2.5 states that the maximum annual dose to a member of the public from gaseous and liquid effluents at the VEGP site is typically less than 0.001 mSv (less than 0.1 mrem). Section 4.9 states that direct exposures from the existing VEGP site do not vary significantly from background radiation levels at the site boundary. Therefore, the combined dose to the MEI from the existing VEGP units and the proposed new units would be well within the 40 CFR Part 190 standards, 10 CFR Part 20 standards, and 10 CFR Part 50, Appendix I, design objectives.

5.9.3.2 Population Dose

Southern estimates the collective total body dose within an 80-km (50-mi) radius of the VEGP site to be 0.01837 person Sv/yr (1.837 person-rem/yr) (Southern 2007a). The estimated collective dose to the same population from natural background radiation is estimated to be 2.43×10^3 person-Sv/yr (2.43×10^5 person-rem/yr) (Southern 2007a). The dose from natural background radiation was calculated by multiplying the 80-km (50-mi) population estimate for 2000 of approximately 674,101 people by the annual background dose rate of 3.6 mSv/yr (360 mrem/yr) (Southern 2007a).

Collective dose was estimated using the GASPAR II computer code and was attributed to the gaseous and liquid effluent pathway. The staff performed an independent evaluation of population doses and obtained results 20 percent higher (see Appendix G).

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses below about 100 mSv (10,000 mrem) and at low dose rates. However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures.

Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), BEIR VII report, supports the linear, no-threshold dose response model. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks. Based on this model, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiological Protection (ICRP) Publication 60 (ICRP 1991). This coefficient was multiplied by the estimated collective whole body population dose of 0.01837 person-Sv/yr (1.837 person-rem/yr) to calculate that the population living within 80 km (50 mi) of the VEGP site would incur less than one fatal cancer, nonfatal cancer, or severe hereditary effect annually. The risks from the cumulative radiation exposure from the existing VEGP units and the proposed VEGP units would be only slightly higher. This risk is very small compared to the estimated 177 fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation. Because the population doses from the liquid effluents are very small compared to the gaseous effluents, the addition of this dose would not change the resulting risk estimates.

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, "Cancer in Populations Living Near Nuclear Facilities," in 1990 (NCI 1990).

This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from the new units at the VEGP site. Based on the information provided by Southern and NRC's own independent evaluation, the staff concludes there would be no observable health impacts to the public from normal operation of the new units, and the health impacts would be SMALL.

5.9.4 Occupational Doses to Workers

Southern (2007a) reported annual occupational dose estimates of about 1.5 person-Sv (150 person-rem) for existing VEGP Units 1 and 2 during 2005. On the basis of information contained in NUREG-0713 (NRC 2002b), the average annual collective dose per operating reactor in the United States was 1.72 person-Sv/yr (172 person-rem/yr) for the time period of 1992-2001. The estimated occupational doses for advanced reactor designs, including the Westinghouse AP1000 reactors at the VEGP site, were slightly less than the annual occupational doses for current light-water reactors (LWRs).

Southern (2007a) concluded that occupational exposures for the new units would likely be bounded by occupational exposures from currently operating LWRs because advanced LWR designs, including the Westinghouse AP1000 reactors at the VEGP site, have or would incorporate radiation protection features that are improved over the designs provided in currently operating LWRs.

The licensee of a new plant would need to maintain individual doses to workers within 0.05 Sv (5 rem) annually as specified in 10 CFR 20.1201 and incorporate ALARA provisions to maintain doses below this limit.

The staff concludes that the health impacts from occupational radiation exposure would be SMALL based on individual worker doses being maintained within 10 CFR 20.1201 limits and collective occupational doses being typical of doses found in current operating LWR reactors.

5.9.5 Impacts to Biota Other than Members of the Public

Southern estimated doses to representative biota species, including fish, muskrat, raccoon, heron, and duck. Additional results are reported for algae and invertebrates. Fish, invertebrates, and algae are referred to as aquatic species. Muskrats, raccoons, herons, and ducks are referred to as terrestrial species. Important biota species for the VEGP site and the corresponding surrogate species are as follows: (1) various mussel and mollusc species – invertebrates, (2) darter, shiner, catfish, sunfish, perch, eels, largemouth bass, striped bass – fish, (3) white-tailed deer, raccoon, gray squirrel, Eastern cottontail, coyotes, gray fox, and pocket gopher – raccoon and muskrat, (4) wood duck – duck, and (5) wood stork – heron. Surrogate species are well-defined and provide an acceptable method for judging doses to the biota. Exposure pathways considered in evaluating dose to the biota were discussed in Section 5.9.1 and shown in Figure 5-3. The NRC independent evaluation included consideration of surrogate species that included invertebrates and algae; and found similar results to those reported by Southern (2007a) (see Appendix G).

5.9.5.1 Liquid Effluent Pathway

Southern (2007a) used the LADTAP II computer code to calculate doses to the biota from the liquid effluent pathway. In estimating the concentration of radioactive effluents in Savannah River, Southern (2007a) used a transit dilution model. Liquid pathway doses were higher for biota compared to man because of considerations for bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in water and shoreline compared to man. The liquid effluent releases used in estimating biota dose are found in Table 3.5-1 of the ER (Southern 2007a). Total body dose estimates to the surrogate species from the liquid and gaseous pathways are shown in Table 5-11.

Table 5-11. Comparison of Biota Doses from the VEGP Site to 40 CFR Part 190[a]

Biota	Liquid Effluents Dose (mGy/yr)[b]	Gaseous Effluents Dose (mGy/yr)[b]	Total Body Biota Dose All Pathways (mGy/yr)[b]	40 CFR Part 190 Total Body Dose Limit (mSv/yr)[b]
Fish	1.6×10^{-3}	-	1.6×10^{-3}	2.5×10^{-1}
Invertebrate	[c]	-	4.5×10^{-3}	2.5×10^{-1}
Algae	[c]	-	1.3×10^{-2}	2.5×10^{-1}
Muskrat	4.7×10^{-3}	1.5×10^{-2}	2.0×10^{-2}	2.5×10^{-1}
Raccoon	1.9×10^{-3}	2.2×10^{-2}	2.4×10^{-2}	2.5×10^{-1}
Heron	2.15×10^{-2}	1.5×10^{-2}	3.7×10^{-2}	2.5×10^{-1}
Duck	4.5×10^{-3}	2.2×10^{-2}	2.6×10^{-2}	2.5×10^{-1}

(a) Data taken from Table 5.4-10 of Southern (2007a).
(b) Multiply mGy/yr or mSv/yr times 100 to obtain mrad/yr or mrem/yr.
(c) Southern did not report results for these biota.

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure because of immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. The dose calculated to the MEI from gaseous effluent releases in Table 5-8 would also be applicable to terrestrial surrogate species with two modifications. One modification defined in Southern (2007a) was increasing the ground deposition factors by a factor of two as terrestrial animals would be closer to the ground than the MEI. The second modification was to disable the vegetation intake pathway for muskrat and heron that are not known to consume vegetation. The gaseous effluent releases used in estimating dose are found in Table 3.5-2 of the ER (Southern 2007a). The ER used doses at the exclusion area boundary (0.8 km [0.5mi]) NE of the VEGP site) in estimating terrestrial species doses. Total body dose estimates to the surrogate species from the gaseous pathway are shown in Table 5-11.

5.9.5.3 Impact of Estimated Biota Doses

Table 5-9 also compares the annual total body dose estimates to surrogate biota species from each of the two new nuclear units to the annual whole body dose standard in 40 CFR Part 190. Although the 40 CFR Part 190 standards apply to members of the public in unrestricted areas and not to biota, they are provided here for comparative purposes. Radiation doses to the biota are expressed in units of absorbed dose (mGy [mrad]) because dose equivalent (mSv [mrem]) only applies to human radiation doses. Southern assumed that mSv (mrem) and mGy (mrad) are approximately equivalent for comparison of biota doses to the 40 CFR Part 190 standards. Annual dose for no surrogate species exceeded the dose standard in 40 CFR Part 190. The biota dose estimates of the new units are conservative because they do not consider dilution or decay of liquid effluents during transit. Actual doses to the biota are likely to be much less.

The International Commission on Radiological Protection (ICRP 1977; ICRP 1991) states that if humans are adequately protected, other living things are also likely to be sufficiently protected. The International Atomic Energy Agency (IAEA 1992) and the National Council on Radiation Protection and Measurements (NCRP 1991) reported that a chronic dose rate of no greater than 10 mGy/d (1000 mrad/d) to the MEI in a population of aquatic organisms would ensure protection of the population. IAEA (1992) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations. Table 5-12 compares the estimated total body dose to the biota from the proposed VEGP Units 3 and 4 to the IAEA chronic dose rate values for aquatic organisms and terrestrial animals. The cumulative effects of the existing VEGP units and the new units result in dose rates far less than those of the NCRP and IAEA studies.

The staff performed an independent evaluation of doses to biota and found similar results. Results of the staff's independent evaluation are found in Appendix G.

Table 5-12. Comparison of Biota Doses from the Proposed VEGP Units 3 and 4 at the VEGP Site to Relevant Guidelines for Biota Protection[(a)]

Biota	Total Body Dose - Southern ESP Units (mGy/d)[(b)]	IAEA/NCRP Guidelines for Protection of Biota Populations (mGy/d)[(b)]
Fish	4.4×10^{-6}	10
Invertebrate	1.2×10^{-5}	10
Algae	3.6×10^{-5}	10
Muskrat	5.5×10^{-5}	1
Raccoon	6.6×10^{-5}	1
Heron	1.0×10^{-4}	1
Duck	7.1×10^{-5}	1

(a) Total dose from liquid and gaseous effluents in Table 5-9.
(b) Multiply mGy/d times 100 to obtain mrad/d.
IAEA = International Atomic Energy Agency.
NCRP = National Council on Radiation Protection and Measurements.

Based on the information provided by Southern and NRC's own independent evaluation, the staff concludes that the radiological impact on biota from the routine operation of the proposed Units 3 and 4 at the VEGP site would be SMALL, and mitigation is not warranted.

5.9.6 Radiological Monitoring

A radiological environmental monitoring program (REMP) has been in place for the VEGP site since operations began in 1987, with preoperational sample collection activities beginning in 1981 (Southern 2002). The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway from the Savannah River, and the ingestion exposure pathway in a 8-km (5-mi) radius of the station, with indicator locations near the plant perimeter and control locations at distances greater than 16 km (10 mi). Milk is not currently sampled because there is no known production within 8 km (5 mi) of the site. An annual survey is conducted for the area surrounding the site to verify the accuracy of assumptions used in the analyses, including the occurrence of milk production. The pre-operational REMP sampled various media in the environment to determine a baseline from which to observe the magnitude and fluctuation of radioactivity in the environment once the unit began operation. The pre-operational program included collection and analysis of samples of air particulates, precipitation, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation. After operation of VEGP Unit 1 began in 1987, the monitoring program continued to assess the radiological impacts on workers, the public, and the environment. Radiological releases are summarized in the two annual reports: the *Annual Radiological Environmental Operating Report* (e.g., Southern 2002) and *Annual Radioactive Effluent Release Report* (e.g., Southern 2005). The limits for all radiological releases are specified in the *Vogtle Offsite Dose Calculation Manual* (Southern 2004). No additional monitoring program has been established for the new units. To the greatest extent practical, the REMP for the ESP program would utilize the procedures and sampling locations used by the existing VEGP site. The staff reviewed the documentation for the existing REMP, the *Vogtle Offsite Dose Calculation Manual*, and recent monitoring reports from VEGP and the Savannah River Site (Savannah River Site 2006), and determined that the current operational monitoring program is adequate to establish the radiological baseline for comparison with the expected impacts on the environment related to the construction and operation of the proposed new units at the VEGP site.

5.10 Environmental Impacts of Postulated Accidents

The staff considered the radiological consequences on the environment of potential accidents at new units at the VEGP site. Consequence estimates are based on the Westinghouse AP1000 reactor certified design (Westinghouse 2005b) as set forth in 10 CFR 52, Appendix B. The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Numerous features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which comprise the first line of defense, are intended to prevent the release of radioactive materials from the plant. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas as low as reasonable achievable are specified in 10 CFR Part 50, Appendix I. There are additional measures that are designed to mitigate the consequences of failures in the first line of defense. These include the NRC's reactor site criteria in 10 CFR Part 100, which require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident, and emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47, 10 CFR Part 50, Appendix E, and NUREG-0654/FEMA-REP-1 (NRC 1980). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

This section discusses (1) the types of radioactive materials, (2) the paths to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both design-basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. The majority of the material in the fuel is in the form of nonvolatile solids. However, there is a significant amount of material that is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and, therefore, have lower tendencies to escape from the fuel than the noble gases and iodines.

Radiation exposure to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water, (2) inhalation of radioactive material, and (3) ingestion of food or water containing material initially deposited on the ground and in water.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses below about 100 mSv (10,000 mrem) and at low dose rates. However, radiation protection experts conservatively assume that any amount of radiation exposure may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold response model is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, supports the linear, no-threshold dose response theory. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Physiological effects are clinically detectable should individuals receive radiation exposure resulting in a dose greater than about 0.25 Sv (25 rem) over a short period of time (hours). Doses of about 2.5 to 5.0 Sv (250 to 500 rem) received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.10.1 Design-Basis Accidents

Southern evaluated the potential consequences of postulated accidents to demonstrate that a Westinghouse AP1000 reactor could be constructed and operated at the VEGP site without undue risk to the health and safety of the public (Southern 2007a). These evaluations used a set of surrogate DBAs that are representative for the reactor design being considered for the VEGP site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The DBA review focuses on the certified Westinghouse AP1000 reactor at the VEGP site. The bases for analyses of postulated accidents for this design are well established because they have been considered as part of the NRC's advanced reactor design certification process. Potential consequences of DBAs are evaluated following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the Westinghouse AP1000 reactor and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183 (NRC 2000b).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as χ/Q. Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983).

Table 5-13 lists χ/Q values pertinent to the environmental review of DBAs for the VEGP site. The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the exclusion area boundary, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term, i.e., 2 hours, and for the low population zone, they are calculated for the course of the accident, i.e., 30 days (720 hours) composed of four time periods. The second column lists the χ/Q values presented in Southern's ER Section 2.7.5.2 using the site meteorological information discussed in ER Section 2.7.4 and the exclusion area boundary and low population zone distances (Southern 2007a). No credit was taken for building wake. Southern calculated the χ/Q values listed in Table 5-13 using a set of five years of meteorological data (1998-2002) for the VEGP site assuming the release point was located midway between the two proposed Westinghouse AP1000 reactors. Small χ/Q values are associated with greater dilution capability.

Table 5-13. Atmospheric Dispersion Factors for VEGP Site DBA Calculations

Time Period and Boundary	χ/Q (s/m^3)
0 to 2 hr, Exclusion Area Boundary	7.38×10^{-5}
0 to 8 hr, Low Population Zone	1.40×10^{-5}
8 to 24 hr, Low Population Zone	1.22×10^{-5}
1 to 4 d, Low Population Zone	9.15×10^{-6}
4 to 30 d, Low Population Zone	6.04×10^{-6}

Source: Southern 2007a

The staff reviewed the meteorological data used by Southern and the method used to calculate the atmospheric dispersion factors, thereby confirming that the atmospheric dispersion factors values are correct. On these bases, the staff concludes that the atmospheric dispersion factors for the VEGP site are acceptable for use in evaluating potential environmental consequences of postulated DBAs for the Westinghouse AP1000 reactor design at the VEGP site.

Table 5-14 lists the set of DBAs considered by Southern and presents Southern's estimate of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE). TEDE is the sum of the committed effective dose equivalent from inhalation and the deep dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993) were used to calculate the deep dose equivalent.

The staff reviewed Southern's selection of DBAs by comparing the accidents listed in the application with the DBAs considered in the design certification process (Westinghouse 2005b NRC 2004b). The DBAs in the ER are the same as those considered in the design certification, therefore the staff concludes that the set of DBAs is appropriate. In addition, the staff reviewed the calculation of the site-specific consequences of the DBAs and found the calculations to be correct.

There are no environmental criteria related to the potential consequences of DBAs. Consequently, the review criteria used in the staff's review of DBA doses are included in Table 5-14 to illustrate the magnitude of the calculated environmental consequences (TEDE

Table 5-14. DBA Doses for a Westinghouse AP1000 Reactor

		TEDE in rem(a)		
Accident	**Standard Review Plan Section(b)**	**EAB(c)**	**LPZ(d)**	**Review Criterion**
Main steam line break	15.1.5			
Pre-existing iodine spike		7.38×10^{-2}	2.58×10^{-2}	$2.5 \times 10^{+1}$(e)
Accident-initiated iodine spike		8.30×10^{-2}	7.67×10^{-2}	$2.5 \times 10^{+0}$(f)
Steam generator rupture	15.6.3			
Pre-existing iodine spike		1.66×10^{-1}	3.55×10^{-2}	$2.5 \times 10^{+1}$(e)
Accident-initiated iodine spike		8.30×10^{-2}	2.44×10^{-2}	$2.5 \times 10^{+0}$(f)
Loss-of-coolant accident	15.6.5	$3.52 \times 10^{+0}$	$1.54 \times 10^{+0}$	$2.5 \times 10^{+1}$(e)
Rod ejection	15.4.8	2.68×10^{-1}	1.66×10^{-1}	$6.25 \times 10^{+0}$(f)
Reactor coolant pump rotor seizure (locked rotor)	15.3.3			
No feedwater		6.46×10^{-2}	1.09×10^{-2}	$2.5 \times 10^{+0}$(f)
Feedwater available		4.61×10^{-2}	2.22×10^{-2}	$2.5 \times 10^{+0}$(f)
Failure of small lines carrying primary coolant outside containment	15.6.2	1.57×10^{-1}	2.86×10^{-2}	$2.5 \times 10^{+0}$(f)
Fuel handling	15.7.4	5.17×10^{-1}	9.63×10^{-2}	$6.25 \times 10^{+0}$(f)

(a) To convert rem to Sv, divide by 100.
(b) NUREG-0800 (NRC 1987).
(c) Exclusion area boundary.
(d) Low population zone.
(e) 10 CFR 50.34(a)(1) and 10 CFR 100.21 criteria.
(f) Standard Review Plan criterion.
Source: Southern 2007a; NRC 1987

doses). In all cases, the calculated TEDE values are considerably smaller than the TEDE doses used as safety review criteria. Therefore, the staff concludes that, with respect to DBAs, the VEGP site is environmentally suitable for operation of two new Westinghouse AP1000 reactors.

Summary of DBA Impacts

The NRC staff reviewed the DBA analysis in the ER, which is based on analyses performed for design certification of the Westinghouse AP1000 reactor design with adjustment for VEGP site-specific characteristics. The results of the Southern analyses indicate that the environmental risks associated with DBAs, if two new Westinghouse AP1000 reactors were to be located at the VEGP site, would be small. On this basis, the staff concludes that the environmental consequences of DBAs at the VEGP site would be of SMALL significance for two new Westinghouse AP1000 reactors.

5.10.2 Severe Accidents

In its ER, Southern considers the potential consequences of severe accidents for a Westinghouse AP1000 reactor at the VEGP site. Three pathways are considered: (1) the atmospheric pathway, in which radioactive material is released to the air, (2) the surface-water pathway, in which airborne radioactive material falls out on open bodies of water, and (3) the groundwater pathway, in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

Southern bases its evaluation of the potential environmental consequences for the atmospheric and surface-water pathways on the results of the MACCS2 computer code (Chanin et al. 1990; Jow et al. 1990) run using Westinghouse AP1000 reactor source term information and site-specific meteorological, population, and land-use data. In response to an NRC request for additional information, dated December 29, 2006 (NRC 2006a), Southern provided the NRC with copies of the input and output files for the MACCS2 computer runs (Southern 2007e). The NRC staff has reviewed the input and output files, has run confirmatory calculations, and concurs with Southern's results.

Environmental consequences of some potential surface-water pathways (e.g., swimming and fishing) are not evaluated by MACCS2. Southern relied on generic analyses in the GEIS, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG 1437 (NRC 1996) for these pathways. Similarly, the MACCS2 code does not address the potential environmental consequences of the groundwater pathway. Southern relied on generic analyses in the GEIS and earlier analyses to evaluate the potential consequences of releases to groundwater.

The MACCS computer code was developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150 (NRC 1990). MACCS2 (Chanin and

Young 1997) is the current version of MACCS. The MACCS and MACCS2 codes evaluate the consequences of atmospheric releases of material following a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of contaminated food and surface water. The primary enhancements in MACCS2 are that MACCS2 has (1) a flexible emergency-response model, (2) an expanded library of radionuclides, and (3) a semidynamic food-chain model (Chanin and Young 1997).

Three types of severe accident consequences were assessed: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early cancer fatalities and latent fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990). Latent fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within an 80-km (50-mi) radius of the site. Economic costs of a severe accident include the costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident. Farm land decontamination is an estimate of the area that has an average whole body dose rate for the 4-year period following the release that would be greater than 0.005 Sv/yr (0.5 rem/yr) if not reduced by decontamination and that would have a dose rate following decontamination of less than 0.005 Sv/yr (0.5 rem/yr). Decontaminated land is not necessarily suitable for farming.

Risk is the product of the frequency and the consequences of an accident. For example, the probability of a severe accident without loss of containment for a Westinghouse AP1000 reactor at the VEGP site is estimated to be 2.2×10^{-7} per reactor year (Ryr^{-1}), and the cumulative population dose associated with a severe accident without loss of containment at the VEGP site is calculated to be 1.34×10^{1} person-Sv (1.34×10^{3} person-rem). The population dose risk for this class of accidents is the product of 2.2×10^{-7} Ryr^{-1} and 1.34×10^{1} person-Sv (1.34×10^{3} person-rem), or 2.9×10^{-6} person-Sv Ryr^{-1} (2.9×10^{-4} person-rem Ryr^{-1}). The following sections discuss the estimated risks associated with each pathway.

The risks presented in the tables that follow are risks per year of reactor operation. Southern has indicated that the VEGP site could hold two reactors of the Westinghouse AP1000 reactor design. The consequences of a severe accident would be the same regardless of whether one or two additional Westinghouse AP1000 reactors were built at the VEGP site. However, if two new Westinghouse AP1000 reactors were built, the risks would apply to each reactor, and the total risk for new reactors at the site would be twice the risk for a single reactor. Even if the risk values were doubled, the risks would still be significantly smaller than the risks associated with current-generation reactors.

Air Pathway. The MACCS2 code directly estimates consequences associated with releases to the air pathway. The results of the MACCS2 runs are presented in Table 5-15. The core damage frequencies given in these tables are for internally initiated accident sequences while the plant is at power. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. Estimates of the core damage frequencies for externally initiated events and during shutdown are discussed later.

Table 5-15 shows that the probabilistically weighted consequences, i.e., risks, of severe accidents for a Westinghouse AP1000 reactor located on the VEGP site are small for all risk categories considered. For perspective, Tables 5-16 and 5-17 compare the health risks from severe accidents for a Westinghouse AP1000 reactor at the VEGP site with the risks for current-generation reactors at various sites and with the AP1000 reactor at the North Anna, Clinton, and Grand Gulf ESP sites.

In Table 5-16, the health risks estimated for a Westinghouse AP1000 reactors at the VEGP site are compared with health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only risks associated with internally initiated events are presented in Table 5-16. The health risks shown for the Westinghouse AP1000 reactor at the VEGP site are significantly lower than the risks associated with current-generation reactors presented in NUREG-1150. Table 5-16 also compares health risks of a Westinghouse AP1000 reactor at the VEGP site with health risks for a Westinghouse AP1000 reactor at three other ESP sites (NRC 2006b, c, d).

The last two columns of Table 5-16 provide average individual fatality risk estimates. To put these estimated into context for the environmental analysis, the staff compares these estimates to the safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the safety Goal Policy Statement (NRC 1996). These goals are presented here solely to provide a point of reference for the environmental analysis and does not serve the purpose of a safety analysis. The Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health

- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

Table 5-15. Mean Environmental Risks from a Westinghouse AP1000 Reactor Severe Accident at the VEGP Site

			Environmental Risk					
				Fatalities (Ryr^{-1})				
Release Category Description (Accident Class)		Core Damage Frequency (Ryr^{-1})	Population Dose (person-Sv Ryr^{-1})(a)	Early(b)	Latent(c)	Cost(d) ($ Ryr^{-1})	Farm Land Decontamination(e) (ha Ryr^{-1})	Population Dose from Water Ingestion (person Sv Ryr^{-1})(a)
IC	Intact containment	2.2×10^{-7}	2.9×10^{-6}	$0.0 \times 10^{+0}$	1.8×10^{-7}	7.6×10^{-2}	7.5×10^{-8}	2.7×10^{-8}
BP	Containment bypass, fission products released directly to environment	1.1×10^{-8}	2.2×10^{-4}	1.8×10^{-10}	1.4×10^{-5}	$3.8 \times 10^{+1}$	2.8×10^{-4}	1.4×10^{-5}
CI	Containment isolation failure occurs prior to onset of core damage	1.3×10^{-9}	9.9×10^{-6}	6.7×10^{-12}	6.6×10^{-7}	$1.3 \times 10^{+0}$	1.8×10^{-5}	2.8×10^{-7}
CFE	Early containment failure, after onset of core damage but before core relocation	7.5×10^{-9}	5.4×10^{-5}	6.6×10^{-13}	3.3×10^{-6}	$8.3 \times 10^{+0}$	6.8×10^{-5}	2.0×10^{-6}
CFI	Intermediate containment failure, after core relocation but before 24 hr	1.9×10^{-10}	2.1×10^{-6}	4.0×10^{-14}	1.3×10^{-7}	2.3×10^{-1}	2.8×10^{-6}	2.7×10^{-8}
CFL	Late containment failure occurring after 24 hr	3.5×10^{-13}	5.6×10^{-9}	$0.0 \times 10^{+0}$	3.7×10^{-10}	1.1×10^{-3}	1.3×10^{-8}	6.0×10^{-12}
Total		2.4×10^{-7}	2.8×10^{-4}	1.9×10^{-10}	1.9×10^{-5}	$4.8 \times 10^{+1}$	3.6×10^{-4}	1.7×10^{-5}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).
(e) Land risk is area where the average whole body dose rate for the 4-year period following the accident exceeds 0.005 Sv/yr but can be reduced to less than 0.005 Sv/yr by decontamination.

Table 5-16. Comparison of Environmental Risks for a Westinghouse AP1000 Reactor at the VEGP Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG-1150[(a)] and with Risks for the Westinghouse AP1000 Reactor at Three Other ESP Sites.

	Core Damage Frequency (Ryr^{-1})	50-mi (80-km) Population Dose Risk (person-Sv Ryr^{-1})[(b)]	Fatalities Ryr^{-1}		Average Individual Fatality Risk Ryr^{-1}	
			Early	Latent	Early	Latent Cancer
Grand Gulf[(c)]	4.0×10^{-6}	5×10^{-1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[(c)]	4.5×10^{-6}	$7 \times 10^{+0}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[(c)]	5.7×10^{-5}	$1 \times 10^{+1}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[(c)]	4.0×10^{-5}	$5 \times 10^{+0}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[(c)]	3.4×10^{-4}	$5 \times 10^{+1}$	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
Westinghouse AP1000[(d)] Reactor at the VEGP site	2.4×10^{-7}	2.8×10^{-4}	1.9×10^{-10}	1.9×10^{-5}	1.6×10^{-12}	1.1×10^{-11}
Westinghouse AP1000[(e)] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-4}	1.2×10^{-10}	4.0×10^{-5}	2.6×10^{-13}	4.9×10^{-11}
Westinghouse AP1000[(f)] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-4}	1.4×10^{-8}	1.2×10^{-5}	6.4×10^{-13}	5.5×10^{-11}
Westinghouse AP1000[(g)] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-4}	$< 1.0 \times 10^{-12}$	6.9×10^{-6}	$<1.0 \times 10^{-14}$	2.0×10^{-11}

(a) NRC 1990
(b) To convert person-Sv to person-rem, multiply by 100.
(c) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990).
(d) Calculated with MACCS2 code using VEGP site-specific input.
(e) NUREG-1811 (NRC 2006b)
(f) NUREG-1815 (NRC 2006c)
(g) NUREG-1817 (NRC 2006d)

Table 5-17. Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for a Westinghouse AP1000 Reactor at the VEGP Site with Risks Initiated by Internal Events for Current Plants, Including VEGP Units 1 and 2, Undergoing Operating License Renewal Review and Environmental Risks of the Westinghouse AP1000 Reactor at Other ESP Sites

	Core Damage Frequency (yr^{-1})	80-km (50-mi) Population Dose Risk (person-Sv Ryr^{-1})[(a)]
Current Reactor Maximum[(b)]	2.4×10^{-4}	6.9×10^{-1}
Current Reactor Mean[(b)]	3.1×10^{-5}	1.5×10^{-1}
Current Reactor Median[(b)]	2.5×10^{-5}	1.3×10^{-1}
VEGP Unit 1 or 2[(c)]	1.6×10^{-5}	3.4×10^{-3}
Current Reactor Minimum[(b)]	1.9×10^{-6}	3.4×10^{-3}
Westinghouse AP1000[(d)] Reactor at the VEGP site	2.4×10^{-7}	2.8×10^{-4}
Westinghouse AP1000[(e)] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-4}
Westinghouse AP1000[(f)] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-4}
Westinghouse AP1000[(g)] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-4}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Based on MACCS and MACCS2 calculations for 60 current plants at 36 sites.
(c) License Renewal ER for VEGP Units 1 and 2 (Southern 2007g)
(d) Calculated with MACCS2 code using VEGP site-specific input.
(e) NUREG-1811 (NRC 2006b)
(f) NUREG-1815 (NRC 2006c)
(g) NUREG-1817 (NRC 2006d)

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.

- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed," is about 3.8×10^{-4} per year (NSC 2006), including a 1.5×10^{-4} per year risk associated with transportation accidents (BTS 2005). One-tenth of 1 percent of these figures imply that the individual risk of prompt fatality from a reactor accident should be less than 4×10^{-7} per Ryr^{-1}.

- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the U.S. which is about 1 in 500 or 2×10^{-3} per year (Reed 2007). One-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to 2×10^{-6} per Ryr^{-1}.

MACCS2 calculates average individual early and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1.6 km (1 mi) of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 16 km (10 mi) of the plant. For the plants considered in NUREG-1150, these risks were well below the Commission's safety goals. Risks calculated for the Westinghouse AP1000 reactor design at the VEGP site are lower than the risks associated with the current-generation reactors considered in NUREG-1150 and are well below the Commission's safety goals.

The staff compared the core damage frequency (CDF) and population dose risk estimate for a Westinghouse AP1000 reactor at the VEGP site with statistics summarizing the results of contemporary severe accident analyses performed for 60 reactors at 36 sites. The results of these analyses are included in the final site-specific Supplements 1 through 30 to the GEIS for License Renewal, NUREG-1437 (NRC 1996), and in the ERs included with license renewal applications for those plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990), and the analyses for

56 of the reactors used MACCS2, which was released in 1997. Table 5-15 shows that the CDF estimated for the Westinghouse AP1000 reactor is significantly lower than those of current-generation reactors. Similarly, the population doses estimated for a Westinghouse AP1000 reactor at the VEGP site are well below the mean and median values for current-generation reactors undergoing license renewal including VEGP Units 1 and 2.

Finally, the population dose risk from a severe accident for a Westinghouse AP1000 reactor at the VEGP site (2.8×10^{-4} person-Sv/Ryr) may be compared with the dose risk for normal operation of a single Westinghouse AP1000 reactor at the VEGP site (9.2×10^{-3} person-Sv/Ryr) (see Section 5.9.3.2). The risk associated with a severe accident is more than an order of magnitude lower than the risk associated with normal operations.

The analyses described above are specifically for internally initiated events. The ER does not address potential consequences from externally initiated events (Southern 2007a). However, the Westinghouse AP1000 reactor vendor and the staff have addressed three externally initiated events during design certification of the Westinghouse AP1000 reactor. Those events are seismic, internal fire, and internal flooding events. The analyses are described Section 19.1.5 of the Final Safety Evaluation Report (FSER) for the Westinghouse AP1000 reactor (NRC 2004a). Analyses of the capability of the Westinghouse AP1000 reactor design to withstand external flooding, tornadoes, hurricanes, and site-specific external events were not performed. These analyses are required of the COL applicant (COL Action Item 19.1.5-1) (NRC 2004a). In addition, the COL applicant is required to update the PRA used to support the Westinghouse AP1000 reactor design certification, as necessary, when site-specific and plant-specific (as-built) data become available (COL Action Item 19.1.1.1-1; NRC 2004a).

With respect to seismic events, the Westinghouse AP1000 reactor vendor performed a PRA-based seismic margin analysis. This analysis indicates that there is a high confidence (95 percent) that safety systems and components would survive a 0.5g peak acceleration during a seismic event. The safe-shutdown earthquake for the Westinghouse AP1000 reactor design is 0.3g. Consequently, the staff concluded in the FSER that the Westinghouse AP1000 reactor design is acceptable.

With respect to internal fires, the Westinghouse AP1000 reactor vendor estimated the fire-induced CDFs to be about 5.6×10^{-8} per year, during power operation and about 8×10^{-8} per year during shutdown and considers these estimates to be conservative. While the staff believes that such a conclusion is not possible without a detailed PRA, the staff did conclude that the Westinghouse AP1000 reactor design is capable of withstanding severe accident challenges from internal fires in a manner superior to most, if not all, operating plant designs. In addition, because detailed PRA-based internal fires analyses at some operating plants have shown that fire-induced sequences can be leading contributors to CDF, COL applicants should provide an updated internal fires PRA that takes into account design details, (e.g., cable routing, door and equipment locations, and fire detection and suppression system locations) to search for internal fire vulnerabilities (COL Action Item 19.1.5.2.1-1; NRC 2004a).

With respect to internal flooding, the Westinghouse AP1000 reactor vendor did not perform a detailed PRA to assess the risk from internal flooding. Instead, the vendor performed an internal flooding PRA commensurate with the level of detail available and made conservative assumptions, where detailed information was not available, to bound the flooding analysis. The staff found that this analysis was adequate to identify potential vulnerabilities and to lend insight into the design which could be used to support design certification requirements. Quantification of potential scenarios with the plant at power resulted in a total CDF from internal floods of about 1×10^{-9} per year. The CDF from internal floods when the plant is shutdown is estimated to be about 3.2×10^{-9} per year. The vendor considers these estimates to be conservative. While the staff believes that such a conclusion is not possible without a detailed PRA, the staff did conclude that the Westinghouse AP1000 reactor design is capable of withstanding severe accident challenges from internal floods in a manner superior to operating plants and that the conclusions from the vendor's internal flood risk analysis complement this belief. In addition, because detailed PRA-based internal floods analyses at some operating plants have shown that flood-induced sequences can be leading contributors to CDF, COL applicants should provide an updated internal flood PRA that takes into account design details, (e.g., pipe routing, door locations, and flood barriers) to search for internal flooding vulnerabilities (COL Action Item 19.1.5.3-1; NRC 2004a).

Surface-Water Pathways. Surface-water pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water. The surface-water pathways of interest include external radiation from submersion in water and activities near the water, ingestion of water, and ingestion of fish and other aquatic creatures. Of these pathways, the MACCS2 code evaluates only the ingestion of contaminated water. The risks associated with this surface-water pathway calculated for the VEGP site are included in the last columns of Table 5-15.

Doses from surface-water pathways are not modeled in MACCS or MACCS2. Typical population exposure risk for the aquatic food pathway for plants located on small rivers were considered in the GEIS (NRC 1996). For these plants, the population dose from the food pathway was well below the population dose from the air pathway. The existing VEGP, which is co-located with the ESP site, is classified as being on a small river. The Savannah River is used for recreational activities including swimming and fishing. Analysis of water-related exposure pathways at the Fermi reactor (NRC 1981) suggests that population exposures from swimming are significantly lower than exposures from the aquatic ingestion pathway.

Should a severe accident occur at a Westinghouse AP1000 reactor located at the VEGP site, it is likely that Federal, State, and local officials would restrict access to the river below the site and in contaminated areas above the site. These actions would further reduce surface water pathway exposures.

Groundwater Pathway. MACCS2 does not evaluate the environmental risks associated with severe accident releases of radioactive material to groundwater. However, this pathway has been addressed in NUREG-1437 in the context of renewal of licenses for current-generation reactors (NRC 1996). In NUREG-1437 the staff assumes a 1×10^{-4} Ryr^{-1} probability of occurrence of a severe accident with a basemat melt-through leading to potential groundwater contamination, and the staff concluded that groundwater contribution to risk is generally a small fraction of the risk attributable to the atmospheric pathway.

The staff has re-evaluated its assumption of a 1×10^{-4} Ryr^{-1} probability of a basemat melt-through. The staff believes that the 1×10^{-4} probability is too large for new plants. The probability of core melt with basemat melt-through should be no larger than the total core damage frequency estimate for the reactor. Table 5-13 gives a total core damage frequency estimates of 2.4×10^{-7} Ryr^{-1} for the Westinghouse AP1000 reactor. NUREG-1150 indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. New designs include features to reduce the probability of basemat melt-through in the event of a core melt accident. On this basis, the staff believes that a basemat melt-through probability of 1×10^{-7} Ryr^{-1} is reasonable and still conservative.

Although the staff assumed that the probability of occurrence of a release via the groundwater pathway is significantly larger than a release via the atmospheric pathway for the Westinghouse AP1000 reactor, the groundwater pathway is more tortuous and affords more time for implementing protective actions and, therefore, results in a lower risk to the public. As a result, the staff concludes that the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on determination of suitability of the VEGP site.

Summary of Severe Accident Impacts. The NRC staff has reviewed the analysis in the ER and conducted its own confirmatory analysis using the MACCS2 code. The results of both the Southern analysis and the NRC analysis indicate that the environmental risks associated with severe accidents if a Westinghouse AP1000 reactor were to be located at the VEGP site would be small compared to risks associated with operation of the current-generation reactors at the VEGP site and other sites. These risks are well below the NRC safety goals. On these bases, the staff concludes that the probability-weighted consequences of severe accidents at the VEGP site would be of SMALL significance for a Westinghouse AP1000 reactor.

5.10.3 Severe Accident Mitigation Alternatives

Southern elected to reference the Westinghouse AP1000 reactor design in its ESP application. The Westinghouse AP1000 reactor design (see Appendix D to Part 52–Design Certification Rule for the AP1000 Design) incorporates many features intended to reduce severe accident core damage frequencies (CDFs) and the risks associated with severe accidents. The effectiveness of the Westinghouse AP1000 reactor design features is evident in Tables 5-14 and 5-15, which compare CDFs and severe accident risks for the Westinghouse AP1000 reactor with CDFs and risks for current-generation reactors including VEGP Units 1 and 2. Core damage frequencies and risks have generally been reduced by a factor of 100 or more when compared to the existing units.

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to determine whether there are SAMDAs or procedural modifications or training activities that can be justified to further reduce the risks of severe accidents (NRC 2000b). Consistent with the direction from the Commission to consider the severe accident mitigation design alternatives (SAMDAs) at the time of certification, the Westinghouse AP1000 reactor vendor (Westinghouse 2005b) and the staff, in its environmental assessment (EA) accompanying the rule (NRC 2004a, 2005), have considered a number of design alternatives for a Westinghouse AP1000 reactor at a generic site. On these bases, the staff concluded (NRC 2005):

> Because the AP1000 design already has numerous plant features designed to reduce CDF and risk, the benefits and risk reduction potential of any additional plant improvements is significantly reduced. This reduction is true for both internally and externally initiated events. Moreover, with the features already incorporated in the AP1000 design, the ability to estimate CDF and risk approaches the limits of probabilistic techniques. Specifically, when CDFs are estimated to be on the order of 1 in 1,000,000 years, it is possible that areas of the PRA where modeling is least complete, or supporting data are sparse or even nonexistent, may actually be the more important contributors to risk. Areas not modeled or incompletely modeled included human reliability, sabotage, rare initiating events, construction and design errors, and system interactions. Although improvements in these areas may introduce additional contributors to CDF and risk, the NRC does not expect that additional contributions would change the conclusions in absolute terms.

In its ER (Southern 2007a), Southern assessed 15 SAMDAs that were considered in the AP1000 DCD (Westinghouse 2005b) using the VEGP site-specific information. Using procedures set forth in NUREG/BR-0184 (NRC 1997), the applicant determined that the maximum averted cost risk for a single Westinghouse AP1000 reactor at the VEGP site is so low that none of the SAMDAs is cost beneficial. A more realistic assessment would show that the potential reductions in cost risk are substantially less than the maximum averted cost risk because no SAMDA can reduce the remaining risk to zero. Based on a review of the its previous evaluation of generic SAMDAs for the Westinghouse AP1000 reactor and the applicant's analysis, the staff concludes that there are no cost beneficial SAMDAs and that the SAMDA issue is resolved.

The SAMDA issue is a subset of the SAMA review. The other attributes of the SAMA review, namely procedural modifications and training activities, have not been addressed by the applicant. However, the applicant has stated (Southern 2007a) that "appropriate administrative controls on plant operations would be incorporated into the plants' management systems as part of its baseline."

5.10.4 Summary of Postulated Accident Impacts

The staff evaluated the environmental impacts from DBAs and severe accidents for a Westinghouse AP1000 reactor at the VEGP site. Based on the information provided by

Southern and NRC's own independent review, the staff concludes that the potential environmental impacts from a postulated accident from the operation of the proposed VEGP Units 3 and 4 would be SMALL.

5.11 Measures and Controls to Limit Adverse Impacts During Operation

The following general measures and controls on which the staff relied in its evaluation of environmental impacts during operation of two new units at the VEGP site include those for which Southern would be required (at the Federal, State, and local levels) by applicable permits and authorizations (contained in Tables 1.3-1, 1.3-2, and 1.3-4 of the ER) as well as the feasible measures and controls contained in Section 5.10 of the ER (Southern 2007a):

- Compliance with the applicable Federal, State, and local laws, ordinances, and regulations that prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emission control, noise control, stormwater management, spill response and cleanup, and hazardous material management)

- Compliance with applicable requirements of permits and licenses required for operation (e.g., NPDES and GDNR permits and operating license requirements)

- Compliance with Southern or GPC procedures applicable to environmental control and management.

Some of these permits or approvals include:

- NPDES permit requirements imposed on water discharges from the new units (ER Sections 5.2 and 5.3)

- The Georgia Environmental Protection Agency permit limits and regulations for installing and operating air emission sources

Southern evaluated the measures and controls shown in Section 5.10 of the ER (Southern 2007a) and considered them feasible from both a technical and economic standpoint. In addition, Southern expects these measures and controls to be adequate for avoiding or mitigating potential adverse impacts associated with operation of the new units. The staff considered these measures and controls in its evaluation of station operation impacts.

Table 5-18 lists a summary of measures and controls to limit adverse impacts during operation proposed by Southern. Table 5-19 is reproduced from sections of Southern's Table 5.10-1 of the ER (Southern 2007a).

Table 5-18. Summary of Measures and Controls Proposed by Southern to Limit Adverse Impacts During Operation of Proposed VEGP Units 3 and 4 at the VEGP Site (Southern 2007a).

Impact Category	Specific Measures and Control
Land-Use Impacts	
The Site and Vicinity	Southern did not propose any additional measures or controls.
Transmission Line Rights-of-Way and Offsite Areas	• Maintenance practices would protect sensitive habitats and protected species, including wetlands and water crossings. • Routing decisions would consider protected species and critical habitats.
Historic Properties and Cultural Resources	Southern did not propose any additional measures or controls.
Water-Related Impacts	
Hydrologic Alterations and Plant Water Supply	Southern did not propose any additional measures or controls.
Water-Use Impacts	Southern did not propose any additional measures or controls.
Water-Quality Impacts	Southern did not propose any additional measures or controls.
Future Water Use	Southern did not propose any additional measures or controls.
Cooling System Impacts	
Intake System	Southern did not propose any additional measures or controls.
Hydrodynamic Descriptions and Physical Impacts	Southern did not propose any additional measures or controls.
Aquatic Ecosystems	Southern did not propose any additional measures or controls.
Discharge System	Southern did not propose any additional measures or controls.
Thermal Description and Other Physical Impacts	Southern did not propose any additional measures or controls.
Aquatic Ecosystems	Southern did not propose any additional measures or controls.

Table 5-18. (contd)

Impact Category	Specific Measures and Control
Terrestrial Ecosystems	Southern did not propose any additional measures or controls.
Impacts to Members of the Public	Southern did not propose any additional measures or controls.
Radiological Impacts of Normal Operation	
Exposure Pathways	Releases of radiation would be within all regulatory limits.
Radiation Doses to Members of the Public	Southern did not propose any additional measures or controls.
Impacts to Members of the Public	Southern did not propose any additional measures or controls.
Impacts to Biota Other than Members of the Public	Southern did not propose any additional measures or controls.
Environmental Impact of Waste	
Nonradioactive Waste System Impacts	• All discharges would comply with Georgia NPDES permit and applicable water-quality standards. • Revise the existing VEGP Stormwater Pollution Prevention Plan or prepare and implement a new one to avoid/minimize releases of contaminated stormwater. • Revise the existing Spill Prevention Countermeasures and Control Plan or prepare and implement a new one to avoid/minimize contamination from spills. • Use approved transporters and offsite landfills for disposal of solid wastes. • Continue the existing program of waste minimization reuse and recycling. • Operate minor air emission sources in accordance with applicable regulations and certificates. • If necessary, modify the existing sanitary waste treatment system to accommodate increased volume.
Mixed Waste Impacts	• Limit mixed waste generation through source reduction, recycling, and treatment options. • Develop a Waste Minimization Program to address mixed waste inventory management, equipment maintenance, recycling and reuse, segregation, treatment (decay in storage), work planning, waste tracking, and awareness training. • Revise the existing Spill Prevention Countermeasures and Control Plan or prepare and implement a new one to avoid/minimize contamination from spills.

Table 5-18. (contd)

Impact Category	Specific Measures and Control
Waste Minimization	Develop a Waste Minimization Program to address mixed waste inventory management, equipment maintenance, recycling and reuse, segregation, treatment (decay in storage), work planning, waste tracking, and awareness training.
Radioactive Waste	Develop a Waste Minimization Program to address mixed waste inventory management, equipment maintenance, recycling and reuse, segregation, treatment (decay in storage), work planning, waste tracking, and awareness training.
Transmission System Impacts	
Terrestrial Ecosystems	Maintenance practices would protect sensitive habitats and protected species, including wetland and water crossings.
Aquatic Ecosystems	Southern did not propose any additional measures or controls.
Impacts to Members of the Public	Southern did not propose any additional measures or controls.
Uranium Fuel Cycle Impacts	
Uranium Fuel Cycle Impacts Relative to Westinghouse AP1000 Reactor	• Select mining techniques that minimize potential impacts. • Consider use of new technology that requires less uranium hexafluoride. • Consider use of centrifuge process over gaseous diffusion process, which could significantly reduce energy requirements and environmental impacts. • Consider use of new technologies with less fuel loading to reduce energy, emissions and water usage.
Socioeconomic Impacts	
Physical Impacts of Proposed Units	• Comply with permit limits and regulations for installing and operating air emission sources. • Perform view scape study for new structures onsite, including cooling towers, as part of final design. • Consider staggering outage shifts to reduce plant-associated traffic on local roads during shift changes.
Social and Economic Impacts of Proposed Units	Lead time would allow developers to construct new homes.
Environmental Justice	Southern did not propose any additional measures or controls; traffic volume would not exceed road capacities.

Table 5-18. (contd)

Impact Category	Specific Measures and Control
Decommissioning	
Decommissioning	Southern did not propose any additional measures or controls.
Transportation of Radioactive Waste	
Transportation of Radioactive Waste	Southern did not propose any additional measures or controls.
Nonradiological Health Impacts	
Nonradiological Health Impacts	Southern did not propose any additional measures or controls.

5.12 Summary of Operational Impacts

Impact level categories are denoted in Table 5-19 as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts, if any. With the socioeconomic issues for which the impacts are likely to be beneficially MODERATE or LARGE, this is noted in the Comments column. The Impact Level column designates beneficial impacts as SMALL.

Table 5-19. Characterization of Operational Impacts at the VEGP Site

Category	Comments	Impact Level
Land-Use Impacts		
The Site and Vicinity	Operation of 2 new units within existing site. Possible new housing and retail space added in vicinity because of potential growth.	SMALL
Transmission Line Rights-of-Way	Most land-use impacts occur during construction.	SMALL
Air-Quality Impacts	Cooling tower, meteorological, and transmission line impacts are expected to be negligible. Pollutants emitted during operations considered insignificant and limits could be incorporated under existing permits.	SMALL
Water-Related Impacts		
Water Use	During normal and drought years, the impact would be SMALL.	SMALL
Water Quality	Water effluents would be regulated by the GDNR and the NPDES permit.	SMALL

Table 5-19. (contd)

Category	Comments	Impact Level
Ecological Impacts		
Terrestrial Ecosystems	Impacts from operation of a new nuclear unit, including the associated heat dissipation system, transmission lines, and right-of-way maintenance would be negligible.	SMALL
Aquatic Ecosystems	Southern's adherence to the NPDES permit and EPA's intake structure design requirements would likely result in the maintenance of balanced aquatic populations.	SMALL
Threatened and Endangered Species	The American alligator is the only animal species known to inhabit the area.	SMALL
Socioeconomic Impacts		
Physical Impacts		
Workers/Public	Workers would use protective equipment and receive training to mitigate any possible impact. The VEGP site location is relatively remote, so the public would not be affected.	SMALL
Buildings	No anticipated impact to onsite or offsite buildings.	SMALL
Roads	Upgrades before or during construction would cover the lesser impact of operational workforces.	SMALL
Aesthetics	Visual impact would be minimal because of remote location and sparse population. Visual impacts of operation at the VEGP site would be SMALL and similar to existing conditions. Aesthetic Impact along new transmission line right-of-way would be MODERATE.	SMALL to MODERATE
Demography	Number of new employees would be small in proportion to population base in the region if in-migrating population settles according to current patterns for VEGP Units 1 and 2.	SMALL
Impacts to Community - Social and Economic		
Economy	Increased jobs would benefit the area economically, up to a moderate beneficial impact (Burke County) is possible.	SMALL to MODERATE Beneficial
Taxes	Degree of impact depends on distribution of revenues to county or state; generally impact is beneficial, especially for property taxes. Under current tax law, the beneficial impact of additional taxes would be LARGE for Burke County, and SMALL elsewhere.	SMALL to LARGE Beneficial

Table 5-19. (contd)

Category	Comments	Impact Level
Infrastructure and Community Services		
Transportation	Improvements made for construction would be sufficient to cover any adverse impact from additional operational workers.	SMALL
Recreation	Overall impacts on recreation near the VEGP site would be minimal because of the remote location and fact that the facility would be operating in an area with an existing nuclear power facility.	SMALL
Housing	Adequate housing is available in the region to handle operational workers.	SMALL
Public Services	Adequate in all counties for any population increase because of the operation workforce.	SMALL
Education	Current schools and planned additions would handle additional students.	SMALL
Historic and Cultural Resources	A cultural resource procedure is in place for minimizing impacts from routine land disturbances.	SMALL
Environmental Justice	Physical impacts would be SMALL. Economic impacts would be beneficial under existing tax law.	SMALL
Nonradiological Health Impacts	Small estimated river temperature increase would not significantly increase abundance of thermophilic microorganisms. Health impacts of noise, EMFs, and occupational injuries would be monitored and controlled in accordance with OSHA regulations.	SMALL
Radiological Health Impacts	Doses to the public and occupational workers would be monitored and controlled in accordance with NRC limits.[a]	SMALL
Impacts of Postulated Accidents		
Design-Basis Accidents	Doses for a Westinghouse AP1000 reactor are expected to be a small fraction of the regulatory dose limits.	SMALL
Severe Accidents	Risks would be small, compared with current generation nuclear power facilities.	SMALL

(a) The ICRP (ICRP 1977; ICRP 1991) states that if humans are adequately protected, other living things are also likely to be sufficiently protected.

5.13 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51.' Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits; Standard Design Certifications, and Combined Licenses for Nuclear Power Plants."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

29 CFR Part 1910. Code of Federal Regulations, Title 29, *Labor*, Part 1910, "Occupational Safety and Health Standards."

36 CFR Part 800. Code of Federal Regulations, Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 125. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation."

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6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of two new nuclear units at the Vogtle Electric Generating Plant (VEGP) site.

In its evaluation of uranium fuel cycle impacts from new units at the VEGP site, Southern Nuclear Operating Company, Inc. (Southern) used the Westinghouse AP1000 advanced light-water reactor (LWR) design, assuming a capacity factor of 93 percent. The capacity factor reported by Westinghouse Electric Company, LLC (2005) for the Westinghouse AP1000 reactor design is 95 percent. The results reported here assume two units with a capacity factor of 95 percent. Southern would have to perform a new evaluation if a different design is proposed at the construction permit (CP) or combined license (COL) stage.

6.1 Fuel Cycle Impacts and Solid Waste Management

This section discusses the environmental impacts from the uranium fuel cycle and solid waste management for the Westinghouse AP1000 reactor design. The environmental impacts of this design are evaluated against specific criteria for LWR designs at Title 10 of the Code of Federal Regulations (CFR) 51.51.

The regulations in 10 CFR 51.51(a) state that

> Every environmental report prepared for the construction permit stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S–3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S–3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The Westinghouse AP1000 reactors proposed for the VEGP site will use uranium dioxide fuel; therefore, Table S–3 (10 CFR 51.51(b)) can be used to assess environmental impacts. Table S–3 values are normalized for a reference 1000 megawatt electrical (MW[e]) LWR at an 80-percent capacity factor. The 10 CFR 51.51(a) Table S–3 values are reproduced in Table 6-1. The power rating for the VEGP site is 6800 megawatts thermal (MW[t]), assuming that two Westinghouse AP1000 reactors would be located on the VEGP site (Southern 2007). With a capacity factor of 95 percent, this corresponds to 2185 MW(e).

Specific categories of natural resource use are included in Table S–3 (see Table 6-1). These categories relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high-level and low-level wastes, and radiation doses from transportation and occupational exposures. In developing Table S–3, the staff considered two fuel cycle options that differed in the treatment of spent fuel removed from a reactor. The "no-recycle" option treats all spent fuel as waste to be stored at a Federal waste repository, whereas, the "uranium only recycle" option involves reprocessing spent fuel to recover unused uranium and return it to the system. Neither cycle involves the recovery of plutonium. The contributions in Table S–3 resulting from reprocessing, waste management, and transportation of wastes are maximized for both of the two fuel cycles (uranium only and no-recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The uranium fuel cycle is defined as the total of those operations and processes associated with provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

Table 6-1. Table S–3 from 10 CFR 51.51(b), Table of Uranium Fuel Cycle Environmental Data[a]

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Natural Resource Use		
Land (acres):		
Temporarily committed[b]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 100-MW(e) coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to a 95-MW(e) coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	= 2 percent of model 1000-MW(e) LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1000 MW(e) with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hr)	323	<5 percent of model 1000 MW(e) LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45-MW(e) coal-fired power plant.

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Natural gas (millions of standard cubic feet)	135	<0.4 percent of model 1000 MW(e) energy output.
Effluents--Chemical (MT)		
Gases (including entrainment):[c]		
SO_x^{-1}	4400	
$NO_x^{-1(d)}$	1190	Equivalent to emissions from 45 MW(e) coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1154	
Other gases:		
F	0.67	Principally from uranium hexafluoride (UF_6) production, enrichment, and reprocessing. The concentration is within the range of state standards–below level that has effects on human health.
HCl	0.014	
Liquids:		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs, NO_3—20 cfs, Fluoride—70 cfs.
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10	
Fe	0.4	
Tailings solutions (thousands of MT)	240	From mills only–no significant effluents to environment.
Solids	91,000	Principally from mills–no significant effluents to environment.
Effluents–Radiological (curies)		
Gases (including entrainment):		
Rn-222	....	Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	0.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	0.83	
Tc-99	....	Presently under consideration by the Commission.
Fission products and transuranics	0.203	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Liquids:		
Uranium and daughters	2.1	Principally from milling–included tailings liquor and returned to ground–no effluents; therefore, no effect on environment.
Ra-226	0.0034	From UF_6 production.
Th-230	0.0015	
Th-234	0.01	From fuel fabrication plants–concentration 10 percent of 10 CFR Part 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried onsite):		
Other than high level (shallow)	11,300	9100 Ci comes from low-level reactor wastes and 1500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4063	<5 percent of model1000-MW(e) LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

(a) In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the table. Table S–3 does not include health effects from the effluents described in the table, or estimates of releases of radon-222 from the uranium fuel cycle or estimates of technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248 (AEC 1974); the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp.1 to WASH-1248) (NRC 1976); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248) (NRC 1977b); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor, which are considered in Table S–4 of Sec. 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S–3A of WASH-1248.

(b) The contributions to temporarily committed land from reprocessing are not prorated over 30 years, because the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

(c) Estimated effluents based upon combustion of equivalent coal for power generation.

(d) 1.2 percent from natural gas use and process.

In 1978, the Nuclear Nonproliferation Act of 1978 (22 USC 3201, et seq.) was enacted. This law significantly impacted the disposition of spent nuclear fuel by deferring indefinitely the commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power program. While the ban on the reprocessing of spent fuel was lifted during the Reagan administration, economic circumstances changed, reserves of uranium ore increased, and the stagnation of the nuclear power industry provided little incentive for industry to resume reprocessing. During the 109th Congress, the Energy Policy Act of 2005 (119 Statute 594) was enacted. It authorized the U.S. Department of Energy (DOE) to conduct an advanced fuel recycling technology research and development program to evaluate proliferation-resistant fuel recycling and transmutation technologies that minimize environmental or public health and safety impacts. Consequently, while Federal policy does not prohibit reprocessing, additional DOE efforts would be required before commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power plants could commence.

The no-recycle option is presented schematically in Figure 6-1. Natural uranium is mined in either open-pit or underground mines or by an *in situ* leach solution mining process. *In situ* leach mining, presently the primary form of mining in the United States, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or *in situ* leach solution is transferred to mills where it is processed to produce "yellowcake" (U_3O_8). A conversion facility prepares the uranium oxide by converting it to uranium hexafluoride, which is then processed by an enrichment facility to increase the percentage of the more fissile isotope uranium-235 and decrease the percentage of the non-fissile isotope uranium-238. At a fuel fabrication facility, the enriched uranium, which is approximately 5 percent uranium-235, is then converted to UO_2. The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies, which are placed in a reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reactor has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor. After onsite storage for sufficient time to allow for short-lived fission product decay and to reduce the heat generation rate, the fuel assemblies would be transferred to a waste repository for internment. Disposal of spent fuel elements in a repository constitutes the final step in the no-recycle option.

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S–3 (Table 6-1) and the staff's analysis of the radiological impact from radon-222 and technetium-99. In NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, 1999),[a] the staff provides a detailed analysis of the environmental impacts from the uranium fuel cycle. Although NUREG-1437 is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR design considered here uses the same type of fuel; the staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and set forth here.

(a) NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to NUREG-1437 include NUREG-1437 and its Addendum 1.

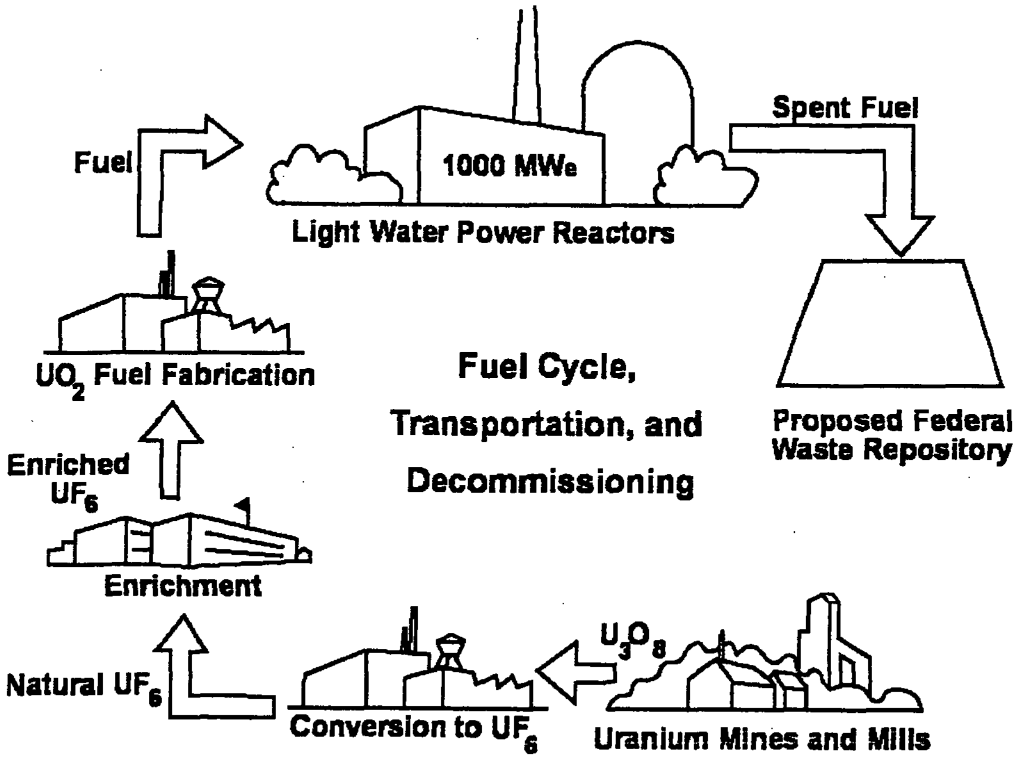

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (derived from NRC 1999)

The fuel cycle impacts in Table S–3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). In the following review and evaluation of the environmental impacts of the fuel cycle, the staff considered the capacity factor of 95 percent with a total net electric output of 2185 MW(e) for the proposed two new units at the VEGP site (Southern 2007); this is about three times (i.e., 2185 MW(e) divided by 800 MW(e) yields 2.73) the impact values in Table S–3 (see Table 6-1). Throughout this chapter, this will be referred to as the 1000-MW(e) LWR-scaled model, reflecting 2185 MW(e) for the site and, for simplicity the Table S–3 results are scaled by a factor of 3 rather than 2.73.

Recent changes in the fuel cycle may have some bearing on environmental impacts; however, as discussed below, the staff is confident that the contemporary fuel cycle impacts are below those identified in Table S–3.

The values in Table S–3 were calculated from industry averages for the performance of each type of facility or operation within the fuel cycle. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the staff followed the policy of choosing the assumptions or factors to be applied so that the calculated values would not be underestimated. This approach was intended to ensure that the actual environmental impacts would be less than the quantities shown in Table S–3 for all LWR nuclear power plants within the widest range of operating conditions. Many subtle fuel cycle parameters and interactions were recognized by the staff as being less precise than the estimates and were not considered or were considered but had no effect on the Table S–3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in Table S–3, the staff defined the model reactor as a 1000-MW(e) LWR reactor operating at 80-percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a "reactor reference year" or "reference reactor year" depending on the source (either Table S–3 or the NUREG-1437), but it has the same meaning. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the now more likely 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain an average annual fuel requirement. This was done in NUREG-1437 for both boiling water reactors and pressurized water reactors; the higher annual requirement, 35 metric tonnes (MT) of uranium made into fuel for a boiling water reactor, was chosen in NUREG-1437 as the basis for the reference reactor year (NRC 1996). A number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. Since Table S–3 was promulgated, these improvements have reduced the annual fuel requirement.

Another change is the elimination of the U.S. restrictions on the importation of foreign uranium. Until recently, the economic conditions of the uranium market favored utilization of foreign uranium at the expense of the domestic uranium industry. These market conditions forced the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from these activities. However, more recently the spot price of uranium has increased dramatically from $24 per pound in April 2005 to $135 per pound in July 2007. As a result, there is a renewed interest in uranium mining and milling in the United States and the NRC anticipates receiving multiple license applications for uranium mining and milling in the next several years. The majority of these applications are expected to be for *in situ* leach solution mining that does not produce tailings. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and tail millings could drop to levels below those given in Table S–3; however, Table S–3 estimates have not been reduced for these analyses.

Section 6.2 of NUREG-1437 discusses the sensitivity to recent changes in the fuel cycle on the environmental impacts in greater detail.

6.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR-scaled model is about 137.2 ha (339 ac). Approximately 15.8 ha (39 ac) are permanently committed land, and 120 ha (300 ac) are temporarily committed. A "temporary" land commitment is a commitment for the life of the specific fuel cycle plant (e.g., a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use. "Permanent" commitments represent land that may not be released for use after plant shutdown and decommissioning because decommissioning activities do not result in removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E, for release of that area for unrestricted use. Of the 120 ha (300 ac) of temporarily committed land, 95.9 ha (237 ac) are undisturbed and 26.7 ha (66 ac) are disturbed. In comparison, a coal-fired power plant using the same MW(e) output as the LWR-scaled model and using strip-mined coal requires the disturbance of about 240 ha (600 ac) per year for fuel alone. The staff concludes that the impacts on land use to support the 1000-MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the fuel cycle supporting a 1000-MW(e) LWR-scaled model is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Scaling from Table S–3, of the total annual water use of 1.29×10^8 m^3 (3.41×10^{10} gal), about 1.26×10^8 m^3 (3.33×10^{10} gal) are required for the removal of waste heat, assuming that a new unit uses once-through cooling. Other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 1.82×10^6 m^3/yr (4.80×10^8 gal/yr) and water discharged to the ground (e.g., mine drainage) of about 1.44×10^6 m^3/yr (3.81×10^8 gal/yr).

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4 percent of the 1000-MW(e) LWR-scaled model using once-through cooling. The consumptive water use of 1.82×10^6 m^3/yr (4.80×10^8 gal/yr) is about 2 percent of the 1000-MW(e) LWR-scaled model using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel cycle use cooling towers) would be about 6 percent of the 1000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. The staff concludes that the impacts on water use for these combinations of thermal loadings and water consumption would be SMALL.

6.1.3 Fossil Fuel Impacts

Electric energy and process heat are required during various phases of the fuel cycle process. The electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the fuel cycle represents about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the model plant. The staff concludes that the fossil fuel impacts from the direct and indirect consumption of electric energy for fuel cycle operations would be SMALL relative to the net power production of the proposed project.

6.1.4 Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents with fuel cycle processes are given in Table S–3 (Table 6-1) for the reference 1000-MW(e) LWR. The quantities of effluents would be about three times greater for the reference 1000-MW(e) LWR-scaled model. The principal effluents are SO_x, NO_x, and particulates. Based on data in the *Seventh Annual Report of the Council on Environmental Quality* (CEQ 1976), these emissions constitute a small additional atmospheric loading in comparison with emissions from the stationary fuel combustion and transportation sectors in the United States, which is about 0.06 percent of the annual national releases for each of these effluents.

Liquid chemical effluents produced in fuel cycle processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table S–3 (Table 6-1) specifies the amount of dilution water required for specific constituents. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel cycle operations would be subject to requirements and limitations set by an appropriate Federal, State, Tribal, and local agencies.

Tailings solutions and solids are generated during the milling process and are not released in quantities sufficient to have a significant impact on the environment.

The staff determined that the impacts of these chemical effluents would be SMALL.

6.1.5 Radiological Effluents

Radioactive effluents estimated to be released to the environment from waste management activities and certain other phases of the fuel cycle process are set forth in Table S–3 (Table 6-1). Using these effluents in NUREG-1437 (NRC 1996), the staff calculated the 100-year environmental dose commitment to the U.S. population from the fuel cycle of 1 year of operation of the model 1000-MW(e) LWR. The total overall whole body gaseous dose commitment and whole body liquid dose commitment from the fuel cycle (excluding reactor releases and dose commitments because of exposure to radon-222 and technetium-99) were calculated to be approximately 4 person-Sv (400 person-rem) and 2 person-Sv (200 person-rem), respectively. Scaling these dose commitments by a factor of about three for the 1000-MW(e) LWR-scaled model results in whole body dose commitment estimates of 12 person-Sv (1200 person-rem) for gaseous releases and 6 person-Sv (600 person-rem) for liquid releases. For both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 18 person-Sv (1800 person-rem) for the 1000-MW(e) LWR-scaled model.

Currently, the radiological impacts associated with radon-222 and technetium-99 releases are not addressed in Table S–3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. Southern provided an assessment of radon-222 and technetium-99 in its Environmental Report (ER) (Southern 2007). This evaluation relied on the information discussed in NUREG-1437 (NRC 1996).

In Section 6.2 of NUREG-1437 (NRC 1996), the staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operations of the reference 1000-MW(e) LWR. The estimated releases of radon-222 for the reference reactor year for the 1000-MW(e) LWR-scaled model, or for the total electric power rating for the site for a year, are approximately 577.2 terre becquerels (TBq) (15,600 Ci). Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tails before stabilization. For radon releases from stabilized tailings, the staff assumed that the LWR-scaled model would result in an emission of 110 GBq (3 Ci) per site year, (i.e., about three times the NUREG-1437 [NRC 1996] estimate for the reference reactor year). The major risks from radon-222 are from exposure to the bone and the lung, although there is a small risk from exposure to the whole body. The organ-specific dose-weighting factors from 10 CFR Part 20 were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment from mining, milling, and tailings before stabilization for each site year (assuming the 1000-MW(e) LWR-scaled model) would be approximately 28 person-Sv (2800 person-rem) to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 0.52 person-Sv (52 person-rem) to the whole body. Additional insights regarding Federal policy/resource perspectives concerning institutional controls comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in NUREG-1437 (NRC 1996).

Also as discussed in NUREG-1437, the staff considered the potential health effects associated with the releases of technetium-99. The estimated releases of technetium-99 for the reference reactor year for the 1000-MW(e) LWR-scaled model are 700 million becquerels (MBq) (0.02 Ci) from chemical processing of recycled uranium hexafluoride before it enters the isotope enrichment cascade and 560 MBq (0.015 Ci) into the groundwater from a repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from exposure to the whole body. Applying the organ-specific dose-weighting factors from 10 CFR Part 20 to the gastrointestinal tract and kidney doses, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 3 person-Sv (300 person-rem) for the 1000-MW(e) LWR-scaled model.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses below about 100 mSv (10,000 mrem) and at low dose rates. However, radiation protection experts conservatively assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, supports the linear, no-threshold dose response model. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the U.S. Nuclear Regulatory Commission (NRC) as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from International Commission on Radiological Protection (ICRP) Publication 60 (ICRP 1991). This coefficient was multiplied by the sum of the estimated whole body population doses from gaseous effluents, liquid effluents, radon-222, and technetium-99 discussed above (approximately 49 person-Sv/yr [4900 person-rem/yr]) to calculate that the U.S. population would incur a total of approximately 3.6 fatal cancers, nonfatal cancers, and severe hereditary effects annually. This risk is quite small compared to the number of fatal cancers, nonfatal cancers, and severe hereditary effects that would be estimated to the U.S. population annually from exposure to natural sources of radiation using the same risk estimation method.

Radon releases from tailings are indistinguishable from background radiation levels at a few kilometers from the tailings pile (at less than 1 km [0.6 mi] in some cases) (NRC 1996). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR Part 190, is 0.25 mSv/yr (25 mrem/yr) to the whole body from the entire fuel cycle, but most NRC licensees have airborne effluents resulting in doses of less than 0.01 mSv/yr (1 mrem/yr) (61 FR 65120).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (NCI 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (NCI 1990). The contribution to the annual average dose received by an individual from fuel-cycle-related radiation and other sources as reported in a report published by the National Council on Radiation Protection and Measurements (NCRP 1987a) is listed in Table 6-2. The nuclear fuel cycle contribution to an individual's annual average radiation dose is extremely small (less than 0.01 mSv [1 mrem] per year).

Based on the analyses presented above, the staff concludes that the environmental impacts of radioactive effluents from the fuel cycle are SMALL.

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources

Source		Dose (mSv/yr)[a]	Percent of Total
Natural			
	Radon	2	55
	Cosmic	0.27	8
	Terrestrial	0.28	8
	Internal (body)	0.39	11
	Total natural sources	3	82
Artificial			
	Medical x-ray	0.39	11
	Nuclear medicine	0.14	4
	Consumer products	0.10	3
	Total artificial sources	0.63	18
Other			
	Occupational	0.009	<0.30
	Nuclear fuel cycle	<0.01	<0.03
	Fallout	<0.01	<0.03
	Miscellaneous sources	<0.01	<0.03

(a) To convert mSv/yr to mrem/yr, multiply by 100.
Source: NCRP Report 93, *Ionizing Radiation Exposure of the Population of the United States* (NCRP 1987a)

6.1.6 Radiological Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in Table S–3 (Table 6-1). For low-level waste disposal at land burial facilities, the Commission notes in Table S–3 that there would be no significant radioactive releases to the environment. For high-level and transuranic wastes, the Commission notes that these are to be buried at a repository, such as the candidate repository at Yucca Mountain, Nevada, and that no release to the environment is expected to be associated with such disposal because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976), which provides background and context for the Table S–3 values for high-level and transuranic wastes established by the Commission, the staff indicates that these high-level and transuranic wastes would be buried and would not be released to the environment.

On February 15, 2002, subsequent to receipt of a recommendation by the Secretary of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste (White House Press Release 2002).

The EPA developed Yucca Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000-year period (U.S. Court of Appeals 2004). The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63. In response to the Court's decision, EPA issued its proposed revised standards on August 22, 2005, that would revise the radiation protection standards for the candidate repository (70 FR 49014). In order to be consistent with EPA's revised standards, NRC proposed revisions to 10 CFR Part 63 on September 8, 2005 (70 FR 53313). The 10 CFR Part 63 rulemaking, RIN 3150-AH68, is titled "Implementation of a Dose Standard after 10,000 years," and the comment period was extended to December 7, 2005. The proposed standards are 0.15 mSv (15 mrem) per year for 10,000 years following disposal and 3.5 mSv (350 mrem) per year for 10,000 years through 1 million years after disposal. RIN 3150 will not be finalized by the time this environmental impact statement (EIS) is issued.

Consequently, at this time, for the high-level waste and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, the staff assumed that limits were developed along the lines of the 1995 National Academy of Sciences (NAS) report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely would be developed at some site that would comply with such limits, with peak doses to virtually all individuals of 100 millirem (1 mSv) per year or less (NAS 1995; NRC 1996).

Despite the current uncertainty with respect to these rules, some judgment as to the National Environmental Policy Act of 1969 (NEPA) implications of offsite radiological impacts of spent fuel and high-level waste disposal should be made. The staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the construction and operation of new units at the VEGP site should be denied.

Section 6.2 of NUREG-1437 (NRC 1996) describes the generation, storage, and ultimate disposal of low-level waste, mixed waste, and spent fuel from power reactors. For the reasons stated above, the staff concludes that the environmental impacts of radioactive waste disposal are SMALL.

6.1.7 Occupational Dose

In the review and evaluation of the environmental impacts of the fuel cycle, the staff considered a capacity factor of 95 percent with a total net electric output of 2185 MW(e) for two new units at the VEGP site (Southern 2007). This is referred to as the 1000-MW(e) LWR-scaled model. The annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e)

LWR-scaled model is about 18 person-Sv (1800 person-rem). This is based on a 6 person-Sv (600 person-rem) occupational dose estimate attributable to all phases of the fuel cycle for the model 1000 MW(e) LWR (NRC 1996). The environmental impact from this occupational dose is considered SMALL because the dose to any individual worker is maintained within the limits of 10 CFR Part 20, which is 0.05 Sv/yr (5 rem/yr).

6.1.8 Transportation

The transportation dose to workers and the public totals about 0.025 person-Sv (2.5 person-rem) annually for the reference 1000-MW(e) LWR per Table S–3 (Table 6-1). This corresponds to a dose of 0.075 person-Sv (7.5 person-rem) for the 1000-MW(e) LWR-scaled model. For comparative purposes, the estimated collective dose from natural background radiation to the population within 80 km (50 mi) of the VEGP site is 2300 person-Sv/yr (230,000 person-rem/yr) (Southern 2007). On the basis of this comparison, the staff concludes that environmental impacts of transportation would be SMALL.

6.1.9 Conclusions

The staff evaluated the environmental impacts of the uranium fuel cycle, as given in Table S–3 (Table 6-1), considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on this evaluation, the staff concludes that the impacts would be SMALL and that mitigation is not warranted.

6.2 Transportation Impacts

This section addresses both the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to the VEGP site, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities.

The NRC evaluated the environmental effects of transportation of fuel and waste for LWRs in WASH-1238 (AEC 1972) and NUREG-75/038 (NRC 1975) and found the impact to be small. These documents provided the basis for Table S–4 in 10 CFR 51.52 that summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) (1000 to 1500 MW(e)). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR.[a] Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 0.04 person-Sv (4 person-rem) per reference reactor year. The combined dose to the public

(a) The transportation impacts associated with the VEGP site were normalized for a reference 1100-MW(e) LWR at an 80-percent capacity factor for comparisons to Table S–4.

along the route and dose to onlookers were estimated to result in a collective dose of 0.03 person-Sv (3 person-rem) per reference reactor year.

Environmental risks (radiological) during accident conditions were determined to be SMALL. Nonradiological impacts from postulated accidents were estimated as one fatal injury in 100 reactor years and one nonfatal injury in 10 reference reactor years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977a) and Sprung et al. (2000) concluded that impacts were bounded by Table S–4 in 10 CFR 51.52.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts is not required when licensing an LWR (i.e., impacts are assumed bounded by Table S–4) if the reactor meets the following criteria:

- The reactor has a core thermal power level not exceeding 3800 MW(t).

- Fuel is in the form of sintered uranium oxide pellets having a uranium-235 enrichment not exceeding 4 percent by weight; and pellets are encapsulated in zirconium-clad fuel rods.

- Average level of irradiation of the fuel from the reactor does not exceed 33,000 MWd/MTU, and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.

- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.

- Unirradiated fuel is shipped to the reactor by truck; irradiated (spent) fuel is shipped from the reactor by truck, rail, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or rail.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (see above) are met; if not, then a full description and detailed analysis is required for initial licensing. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis; for example, higher burnups (above 33,000 MWd/MTU), enrichments (above 4 percent uranium-235), or thermal power levels (above 3800 MW(t)). Departures from the conditions itemized in 10 CFR 51.52(a) must be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing for new reactors.

In its application, Southern requested an ESP for two additional reactors at its VEGP site in Burke County, Georgia. Both proposed new reactors would be Westinghouse AP1000 advanced LWRs. The Westinghouse AP1000 reactor has a thermal power rating of

3400 MW(t), with a minimum net electrical output of 1117 MW(e). The Westinghouse AP1000 reactors are expected to operate with a 93 percent capacity factor, so the net electrical output (annualized) is about 1039 MW(e) (Southern 2007). Fuel for the plants would be enriched up to about 4.5 weight percent U-235, which exceeds the 10 CFR 51.52(a) condition. In addition, the expected irradiation level of about 48,700 MWd/MTU exceeds the 10 CFR 51.52(a) condition. Therefore, a full description and detailed analysis of transportation impacts is required.

In its ER (Southern 2007), Southern provided a full description and detailed analyses of transportation impacts that was based primarily on previous EISs for proposed ESP sites at North Anna, Clinton, and Grand Gulf (NRC 2004, 2005, and 2006, respectively). In these analyses, radiological impacts of transporting fuel and waste to/from the VEGP and alternative sites were calculated using the RADTRAN 5 computer code (Neuhauser et al. 2003). Since that time, a new version of RADTRAN 5 has been released (Weiner et al. 2006). Therefore, for this EIS, radiological impacts are calculated using the new version of RADTRAN 5. The results that were generated using the new version of RADTRAN 5 were then used to judge the adequacy of the applicant's analysis of transportation impacts.

Comments on the three previous ESP EISs were also considered when developing the scope of this EIS. The most significant change is that this EIS includes an explicit analysis of the non-radiological impacts of transporting workers and construction materials to/from the VEGP site. Publicly available information about traffic accident, injury, and fatality rates was used to estimate nonradiological impacts.

6.2.1 Transportation of Unirradiated Fuel

The staff performed an independent analysis of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the VEGP site. Radiological impacts of normal operating conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts to populations and maximally exposed individuals (MEIs) are presented.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without releasing any radioactive material to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the unirradiated fuel shipping containers. Radiation exposures would occur to (1) persons residing along the transportation corridors between the fuel fabrication facility and the VEGP site; (2) persons in vehicles traveling on the same route as a unirradiated fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

Truck Shipments

Table 6-3 provides an estimate of the number of truck shipments of unirradiated fuel for the Westinghouse AP1000 advanced reactor design compared to those of the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972) operating at 80-percent capacity (880 MW[e]). After normalization, the number of truck shipments of unirradiated fuel to the VEGP site is fewer than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238.

Shipping Mode and Weight Limits

In 10 CFR 51.52, a condition is identified that states all unirradiated fuel is shipped to the reactor by truck. Southern specifies that unirradiated fuel would be shipped to the reactor site by truck. Section 10 CFR 51.52 includes a condition that the truck shipments not exceed 33,100 kg (73,000 lbs) as governed by Federal or State gross vehicle weight restrictions. Southern states in its ER that the unirradiated fuel shipments to the proposed VEGP site would comply with applicable weight restrictions (Southern 2007).

Radiological Doses to Transport Workers and the Public

Section 10 CFR 51.52, Table S–4, includes conditions related to radiological dose to transport workers and members of the public along transport routes. These doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel and stop times), and number of shipments to which the individuals are exposed. For this EIS, the radiological dose impacts of the transportation of unirradiated fuel were calculated for the worker and the public using the RADTRAN 5 computer code (Weiner et al. 2006).

One of the key assumptions in WASH-1238 (AEC 1972) for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 1 m (3.3 ft) from the transport vehicle is about 0.001 mSv/hr (0.1 mrem/hr). This assumption was also used in the analysis of the Westinghouse AP1000 reactor unirradiated fuel shipments. This assumption is reasonable because the Westinghouse AP1000 reactor fuel materials would be low-dose-rate uranium radionuclides and would be packaged similarly to that described in WASH-1238 (i.e., inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table 6-3 by 40 years of operation. Other key input parameters used in the radiation dose analysis for unirradiated fuel are shown in Table 6-4.

Table 6-3. Numbers of Truck Shipments of Unirradiated Fuel for Each Advanced Reactor Type

Reactor Type	Number of Shipments per Reactor Unit: Initial Core[a]	Annual Reload	Total[b]	Unit Electric Generation, MW(e)[c]	Capacity Factor[c]	Normalized, Shipments per 1100 MW(e)[d]
Reference LWR (WASH-1238)	18	6	252	1100	0.8	252
VEGP Westinghouse AP1000	23	5.4	233	1117	0.93	198

(a) Shipments of the initial core have been rounded up to the next highest whole number.
(b) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(c) Unit capacities and capacity factors were taken from WASH-1238 for the reference LWR and the ER (Southern 2007) for the Westinghouse AP1000 reactor.
(d) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100-MW(e) plant at 80 percent or net electrical output of 880 MW(e)).

Table 6-4. RADTRAN 5 Input Parameters for Fresh Fuel Shipments

Parameter	RADTRAN 5 Input Value	Source
Shipping distance, km	3200	AEC (1972)[a]
Travel Fraction – Rural	0.90	NRC (1977a)
Travel Fraction – Suburban	0.05	
Travel Fraction – Urban	0.05	
Population Density – Rural, persons/km^2	10	DOE (2002a)
Population Density – Suburban, persons/km^2	349	
Population Density – Urban, persons/km^2	2260	
Vehicle speed – km/hr	88.49	Conservative in transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr	530	DOE (2002a)
Traffic count – Suburban, vehicles/hr	760	
Traffic count – Urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC (1972)
Packaging length, m	7.3	Approximate length of two LWR fuel element packages placed on end
Number of truck crew	2	AEC (1972), NRC (1977a), and DOE (2002a)
Stop time, hr/trip	4	Based on 1 30-minute stop per 400 km
Population density at stops, persons/km^2	See Table 6-8 for truck stop parameters	

(a) AEC (1972) provides a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for fresh fuel shipments. A 3200-km (2000-mi) "representative" shipping distance was assumed here.

The RADTRAN 5 results for this "generic" unirradiated fuel shipment are as follows:

- Worker dose: 1.71 x 10^{-5} person-Sv/shipment (1.71 x 10^{-3} person-rem/shipment)
- General public dose (onlookers/persons at stops and sharing the highway): 2.97 x 10^{-5} person-Sv/shipment (2.97 x 10^{-3} person-rem/shipment)
- General public dose (along route/persons living near a highway): 1.24 x 10^{-6} person-Sv/shipment (1.24 x 10^{-4} person-rem/shipment).

These values were combined with the average annual shipments of unirradiated fuel for the Westinghouse AP1000 reactor to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological impacts to workers, public onlookers (persons at stops and sharing the road), and members of the public along the route (i.e., residents within 800 m [0.5 mi] of the highway) for transporting unirradiated fuel to the VEGP site. The cumulative annual dose estimates in Table 6-5 were normalized to 1100 MW(e) (880 MW(e) net electrical output). The staff performed an independent review and determined that all dose estimates are bounded by the Table S–4 conditions of 0.04 person-Sv/yr (4 person-rem/yr) to transportation workers, 0.03 person-Sv/yr (3 person-rem/yr) to onlookers, and 0.03 person-Sv/yr (3 person-rem/yr) to members of the public along the route.

Table 6-5. Radiological Impacts Under Normal Conditions of Transporting Unirradiated Fuel to the VEGP Site

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose; person-Sv/yr per 1100 MW(e)[(a)] (880 MW(e) net)		
		Workers	Public - Onlookers	Public - Along Route
Reference LWR (WASH-1238)	6.3	1.1 x 10^{-4}	1.9 x 10^{-4}	7.8 x 10^{-6}
VEGP Westinghouse AP1000	5.0	8.5 x 10^{-5}	1.5 x 10^{-4}	6.1 x 10^{-6}
10 CFR 51.52, Table S–4 Condition	<1 per day	4.0 x 10^{-2}	3.0 x 10^{-2}	3.0 x 10^{-2}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses below about 100 mSv (10,000 mrem) and at low dose rates. However, radiation protection experts conservatively assume that any amount of radiation exposure may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response model is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, supports the linear, no-threshold dose response theory. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from ICRP Publication 60 (ICRP 1991). The public doses presented in Table 6-5 for the proposed Westinghouse AP1000 reactors are less than or equal to 2×10^{-4} person-Sv/yr (2×10^{-2} person-rem/yr); therefore, the total detriment estimates associated with these doses would all be less than 2×10^{-5} fatal cancers, nonfatal cancers, and severe heredity effects per year. To place these impacts in perspective, the average United States resident receives about 300 mrem/yr effective dose equivalent from natural background radiation (i.e., exposures from cosmic radiation, naturally occurring radioactive materials such as radon, and global fallout from testing of nuclear explosive devices) (NCRP 1987b). Using this average effective dose, approximately 160 fatal cancers, nonfatal cancers, and severe hereditary effects would occur in the population along this representative route from natural background radiation. The risks of transporting unirradiated fuel to the VEGP site are small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that would be expected to occur annually in the same population from exposure to natural sources of radiation.

MEIs Under Normal Transport Conditions

A scenario-based analysis was conducted to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the VEGP site. The following discussion applies to unirradiated fuel shipments to and spent fuel and radioactive shipments from any reactor design. The analysis is based on information in DOE (2002b) and incorporates information about exposure times, dose rates, and the number of times an individual may be exposed to an offsite shipment. Adjustments were made where necessary to reflect the fuel and waste shipments addressed in this EIS. In all cases, the staff assumed that the dose rate emitted from the shipping containers is 0.1 mSv/hr (10 mrem/hr) at 2 m (6.6 ft) from the side of the transport vehicle, the maximum dose rate allowed by U.S. Department of Transportation (DOT) regulations, even though most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (AEC 1972; DOE 2002a). An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the VEGP site. The analysis is described below.

<u>Truck crew member</u>. Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period of time. The analysis assumed that crew member doses are limited to 0.02 Sv (2 rem) per year, which is the DOE administrative control level presented in DOE-STD-1098-99, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2005). This limit is

anticipated to apply to spent nuclear fuel shipments to a disposal facility, because DOE would take title to the spent fuel at the reactor site. Spent nuclear fuel represents the bulk of the fuel and waste shipments to and from reactor sites, and those with the highest radiation dose rates; consequently, crew doses from unirradiated fuel and radioactive waste shipments would be lower than the spent nuclear fuel shipments. The NRC limit for occupational exposures is 0.05 Sv/yr (5 rem/yr) (see 10 CFR Part 20).

The DOT does not regulate annual occupational exposures, but recommends limits to air crew members that are a 5-year effective dose of 0.02 Sv/yr (2 rem/yr) with no more than 0.05 Sv (5 rem) in a single year (DOT 2003). As a result, a 0.02 Sv/yr (2 rem/yr) MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the VEGP site.

Inspectors. Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. DOE (2002a) assumed that inspectors would be exposed for 1 hour at a distance of 1 m (3.3 ft) from the shipping containers. The dose rate at 1 m (3.3 ft) is about 0.14 mSv/hr (14 mrem/hr); therefore, the dose per shipment is about 0.14 mSv (14 mrem). This is independent of the location of the reactor site. Based on this conservative value, the annual doses to vehicle inspectors were calculated to be about 0.01 Sv/yr (1 rem/yr), assuming the same person inspects all shipments of fuel and waste to and from the VEGP site. This value is about one-half of the 0.02 Sv/yr (2 rem/yr) DOE administrative control level on individual doses and one-fifth of the 0.05 Sv/yr (5 rem/yr) NRC occupational dose limit. Doses to state inspectors would be doubled for a site with two Westinghouse AP1000 reactors, which would bring their annual dose to approximately the administrative limit.

Resident. The analysis assumed that a resident lives adjacent to a highway where a shipment would pass and would be exposed to all shipments along a particular route. Exposures to residents on a per-shipment basis were extracted from RADTRAN 5 output files. These dose estimates are based on an individual located 30 m (100 ft) from the shipments that are traveling 24 km/hr (15 mph). The potential radiation dose to the maximally exposed resident is about 0.00043 mSv/yr (0.043 mrem/yr) for shipments of fuel and waste to/from the VEGP site. This dose would be doubled for a site with two Westinghouse AP1000 reactors.

Individual stuck in traffic. This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for one hour at a distance of 1.2 m (4 ft). The analysis assumed this exposure scenario would occur only one time to any individual, and the dose rate was at the regulatory limit of 0.1 mSv/hr (10 mrem/hr) at 1.8 m (6 ft) from the shipment. The dose to the MEI was calculated in DOE (2002a) to be 0.016 mSv (1.6 mrem). These doses would not be doubled for a site with two Westinghouse AP1000 reactors because it was assumed that this scenario would occur only once to any individual.

Person at a truck service station. This scenario estimates doses to an employee at a service station where all truck shipments to and from the VEGP site are assumed to stop. DOE (2002a) assumed this person is exposed for 49 minutes at a distance of 15.8 m (52 ft) from the loaded shipping container. This results in a dose of about 0.0007 mSv/shipment (0.07 mrem/shipment) and an annual dose of about 0.05 mSv/yr (5 mrem/yr) for the VEGP site, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the VEGP site. This dose would be doubled for a site with two Westinghouse AP1000 reactors.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Accident frequencies for transportation of unirradiated fuel to the VEGP site are expected to be lower than those used in the analysis in WASH-1238 (AEC 1972), which forms the basis for Table S–4 of 10 CFR 51.52, because of improvements in highway safety and security, and an overall reduction in traffic accident, injury, and fatality rates since WASH-1238 was published. There is no significant difference in consequences of accidents severe enough to result in a release of unirradiated fuel particles to the environment between the Westinghouse AP1000 and current-generation LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, the impacts of accidents during transport of unirradiated fuel for advanced LWRs to the VEGP site are expected to be smaller than the impacts listed in Table S–4 for current-generation LWRs.

6.2.1.3 Nonradiological Impacts of Transportation Accidents

Nonradiological impacts are the human health impacts projected to result from traffic accidents involving shipments of unirradiated fuel to the VEGP site; they do not consider radiological or hazardous characteristics of the cargo. Nonradiological impacts include the projected number of traffic accidents, injuries, and fatalities that could result from shipments of unirradiated fuel to the site and return shipments of empty containers from the site.

Nonradiological impacts are calculated using accident, injury, and fatality rates from published sources. The rates (i.e., impacts per vehicle-km traveled) are then multiplied by estimated travel distances for workers and materials. The general formula for calculating nonradiological impacts is:

Impacts = (unit rate) x (round-trip shipping distance) x (annual number of shipments)

In this formula, impacts are presented in units of the number of accidents, number of injuries, and number of fatalities per year. Corresponding unit rates (i.e., impacts per vehicle-km traveled) are used in the calculations.

Accident, injury, and fatality rates were taken from Table 4 in ANL/ESD/TM-150 *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Nation-wide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport unirradiated fuel to the VEGP site.

The nonradiological accident impacts for transporting unirradiated fuel to (and empty shipping containers from) the VEGP site are shown in Table 6-6. The nonradiological impacts associated with the WASH-1238 reference LWR are also shown for comparison purposes. Note that there are only small differences between the impacts calculated for the VEGP Westinghouse AP1000 and the reference LWR in WASH-1238 due entirely to the smaller number of shipments. The impacts would be doubled for a site with two reactors.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the VEGP Site, Normalized to Reference LWR

Plant Type	Total Shipments Normalized to Reference LWR	One-Way Shipping Distance km	Round-trip Distance km	Annual Impacts: Fatalities per Year	Annual Impacts: Injuries per Year	Annual Impacts: Accidents per Year
WASH-1238	252	3200	1.6×10^6	3.7×10^{-4}	7.7×10^{-3}	1.1×10^{-2}
VEGP Westinghouse AP1000	198	3200	1.3×10^6	2.9×10^{-4}	6.0×10^{-3}	8.9×10^{-3}

(AEC 1972)

6.2.2 Transportation of Spent Fuel

The staff performed an independent analysis of the environmental impacts of transporting spent fuel from the proposed VEGP site to a spent fuel disposal repository. For the purposes of these analyses, the staff considered the proposed Yucca Mountain, Nevada, site as a surrogate destination. The staff considers that an estimate of the impacts of the transportation of spent fuel to a possible repository in Nevada to be a reasonable bounding estimate of the transportation impacts to a storage or disposal facility because of the distances involved and the representativeness of the distribution of members of the public in urban, suburban, and rural areas (i.e., population distributions) along the shipping routes. Radiological and nonradiological environmental impacts of normal operating conditions and transportation accidents, as well as nonradiological impacts, are discussed in this section.

This analysis is based on shipment of spent fuel by legal-weight trucks in shipping casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with assumptions made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1999). These assumptions are conservative because the alternative assumptions involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999), thus reducing impacts. Also, use of current shipping cask designs results in conservative impact estimates because the current designs are based on transporting short-cooled spent fuel (approximately 120 days out of reactor). Future shipping casks would be designed to transport longer-cooled fuel (greater than 5 years out of reactor) and would require much less shielding to meet external dose limitations. Therefore, future shipping casks are expected to have higher cargo capacities, thus reducing the numbers of shipments and associated impacts.

Radiological impacts of transportation of spent fuel were calculated using the RADTRAN 5 computer code (Wiener et al. 2006). Routing and population data used in RADTRAN 5 for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2000). The population data in the TRAGIS code are based on the 2000 census. Nonradiological impacts were calculated using published traffic accident, injury, and fatality data (Saricks and Tompkins 1999) in addition to route information from TRAGIS.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without an accident occurring enroute. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Radiation exposures would occur to (1) persons residing along the transportation corridors between the VEGP site and the proposed repository location; (2) persons in vehicles traveling on the same route as a spent fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers. It was assumed that the destination for the spent fuel shipments is the proposed Yucca Mountain disposal facility in Nevada. This assumption is conservative because it tends to maximize the shipping distance from the VEGP site.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the Westinghouse AP1000. Information in INEEL (2003) indicated that advanced LWR fuel designs would not be significantly different from existing LWR designs; therefore, current shipping cask designs were used for the analysis of Westinghouse AP1000 reactor spent fuel shipments. The assumed capacity of a truck shipment of Westinghouse AP1000 reactor spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH-1238 (AEC 1972).

Input to RADTRAN5 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2000) for the VEGP-to-Yucca-Mountain shipments. The resulting route characteristics information is shown in Table 6-7. Note that for truck shipments, all the spent fuel is assumed to be shipped to the Yucca Mountain site over designated highway-route controlled quantity routes. In addition, TRAGIS data was loaded into RADTRAN 5 on a state-by-state basis. This increases precision and allows the results to be presented for each state along the route between the VEGP site and Yucca Mountain, if desired.

Table 6-7. Transportation Route Information for Shipments from Advanced Reactor Sites to the Yucca Mountain Spent Fuel Disposal Facility

Advance Reactor Site	One-way Shipping Distance, km				Population Density, persons/km^2			Stop time per trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
VEGP Westinghouse AP1000	4091	3230	754	107	9.4	334.7	2270.4	4

Note: This table presents aggregated route characteristics. Input to the RADTRAN 5 computer code was disaggregated to a state-by-state level.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate, packaging dimensions, number in the truck crew, stop time, and population density at stops. A listing of the values for these and other parameters and the sources of the information is provided in Table 6-8.

Table 6-8. RADTRAN 5 Normal (Incident-free) Exposure Parameters

Parameter	RADTRAN 5 Input Value	Source
Vehicle speed, km/hr	88.49	Based on average speed in rural areas given in DOE (2002a). Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr Traffic count – Suburban, vehicles/hr Traffic count – Urban, vehicles/hr	State-specific	Wiener et al. (2006)
Vehicle occupancy, persons/vehicle	1.5	DOE (2002a)
Dose rate at 1 m from vehicle, mrem/hr	14	DOE (2002a, b) – approximate dose rate at 1 m that is equivalent to maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle.
Packaging dimensions, m	Length – 5.2 Diameter – 1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977a), and DOE (2002a, b)
Stop time, hr/trip	4	See Table 6-5
Population Density at Stops, persons/km^2	30,000	Sprung et al. (2000). Nine persons within 10 m of vehicle. See Figure 6-2.
Min/Max Radii of Annular Area Around Vehicle at Stops, m	1 to 10	Sprung et al. (2000)
Shielding Factor Applied to Annular Area Surrounding Vehicle at Stops	1 (no shielding)	Sprung et al. (2000)
Population Density Surrounding Truck Stops, persons/km^2	340	Sprung et al. (2000)
Min/Max Radius of Annular Area Surrounding Truck Stop, m	10 to 800	Sprung et al. (2000)
Shielding Factor Applied to Annular Area Surrounding Truck Stop	0.2	Sprung et al. (2000)

For purposes of this analysis, the transportation crew for spent fuel shipments delivered by truck is assumed to consist of two drivers. Escorts were considered, but they were not included because their distance from the shipping cask would reduce the dose rates to levels well below the dose rates experienced by the drivers. Stop times were assumed to accrue at the rate of 30 min per 4 hrs driving time. TRAGIS outputs were used to determine the number of stops. Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN 5 analyses. For this analysis, stop doses are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure 6-2. The inner ring represents persons who may be at the truck stop at the same time as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is similar to that used in Sprung et al. (2000). Population densities and shielding factors were also taken from Sprung et al. (2000), which were based on the observations of Griego et al. (1996).

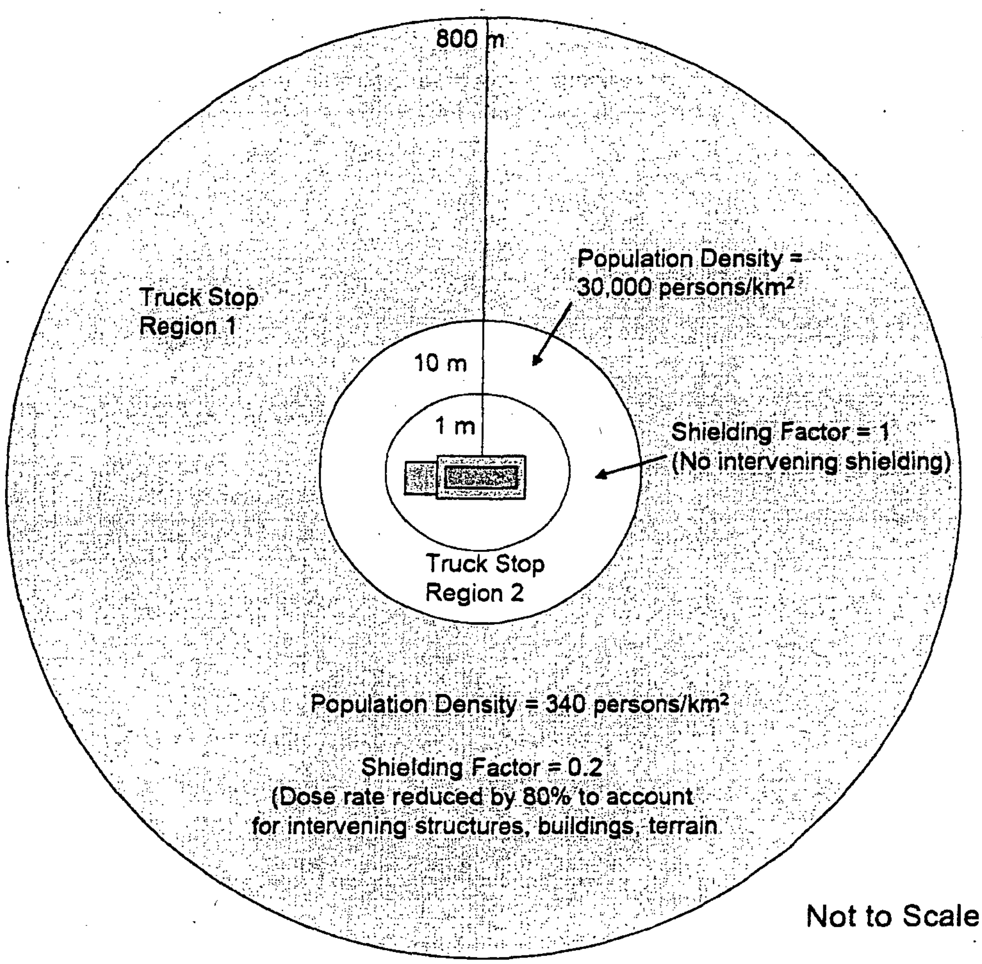

Figure 6-2. Illustration of Truck Stop Model (Sprung et al. 2000)

The results of these normal (incident-free) exposure calculations are shown in Table 6-9 for the proposed VEGP site. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at stops and persons on highways exposed to the spent fuel shipment,) and along the route (persons living near the highway). Annual doses were calculated assuming the annual number of spent fuel shipments is equivalent to the annual refueling requirements. Shipping schedules for spent fuel generated by the proposed new VEGP site units have not been determined; therefore, this assumption was judged by the staff to be reasonable. Population doses were normalized to the reference LWR in WASH-1238 (880 net MW[e]). This corresponds to an 1100-MW(e) LWR operating at 80-percent capacity. Note that the impacts in Table 6-9 would be doubled for a site with two reactors.

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the VEGP Site to the Proposed High-Level Waste Repository at Yucca Mountain

	Worker (Crew)	Onlookers	Along Route
Reference LWR, Person-Sv/yr[a]	5.6×10^{-2}	1.0×10^{-1}	2.6×10^{-3}
VEGP ESP Normalized Impacts, person-Sv/yr	3.6×10^{-2}	6.5×10^{-2}	1.7×10^{-3}
Table S–4 Condition	4×10^{-2}	3×10^{-2}	3×10^{-2}

(a) to convert person-Sv to person-rem, mulitply by 100

(10 CFR 51)

The bounding cumulative doses to the exposed population given in Table S–4 are

- 0.04 person-Sv/reactor-year (4 person-rem/reactor-year) to transport workers
- 0.03 person-Sv/reactor-year (3 person-rem/reactor-year) to general public (onlookers), and members of the public along the route.

Population doses to the crew and onlookers for the reference LWR and to onlookers for the VEGP site shipments exceed Table S–4 values. A key reason for the higher population doses relative to Table S–4 is the longer shipping distances assumed for this ESP analysis (i.e., to a possible repository in Nevada) than were used in WASH-1238. WASH-1238 used a "typical" distance for a spent fuel shipment of 1600 km (1000 mi), whereas the shipping distance used in this assessment was about 4100 km (2500 mi). Another important difference is the stop model described above as well as additional precision that results from incorporating state-specific route characteristics and vehicle densities.

Where necessary, the staff made conservative assumptions to calculate impacts. Some of the key conservative assumptions are:

- Use of the regulatory maximum dose rate (0.1 mSv/hr [10 mrem/hr] at 2 m) in the RADTRAN 5 calculations. The shipping casks assumed in the EIS prepared by DOE in support of the application for a geologic repository at the proposed Yucca Mountain repository (DOE 2002b) were designed to transport spent fuel that has cooled for 5 years. Most spent fuel would have cooled for much longer than 5 years before it is shipped to a possible geologic repository. Based on this, shipments from the VEGP site is also expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 could be further reduced if more realistic dose rate projections and shipping cask capacities are used.

- Use of 30 minutes as the average time at a truck stop in the calculations. Many stops made for actual spent fuel shipments are of short duration (i.e., 10 minutes) for brief visual inspections of the cargo (e.g., checking the cask tie-downs). These stops typically occur in minimally populated areas, such as an overpass or freeway ramp in an unpopulated area. Furthermore, empirical data provided in Griego et al. (1996) indicate that a 30-minute duration is toward the high end of the stop time distribution. Average stop times observed by Griego et al. (1996) are on the order of 18 minutes.

A sensitivity study was performed to demonstrate the effects on the incident-free population doses of using more realistic dose rates and stop times. For this sensitivity study, the dose rate was reduced to 5 mrem/hr, the approximate 50 percent confidence interval of the dose rate distribution estimated by Sprung et al. (2000) for future spent fuel shipments. The stop time was reduced to 18 minutes per stop. All other RADTRAN 5 input values were unchanged. The result is that the annual crew doses were reduced to 1.3×10^{-2} person-Sv/yr, or about 36 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 1.7×10^{-2} person-Sv/yr (26 percent) and the annual doses to persons along the route were reduced to 6.5×10^{-4} person-Sv/yr (38 percent). All of these dose estimates are below the Table S-4 conditions.

Southern described the results of a RADTRAN 5 analysis of the impacts of incident-free transport of spent fuel to a spent fuel disposal facility. The assumed transport of spent fuel originated from the Savannah River Site (a distance approximately equal to the VEGP site) and terminated at the proposed repository at Yucca Mountain, Nevada. Dose estimates per shipment were taken from three previous ESP EISs (NRC 2004, 2005, 2006) that used an earlier version of RADTRAN 5 than is available today. The results are similar to those calculated by the staff in this EIS.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses below about 100 mSv (10,000 mrem) and at low dose rates. However, radiation protection experts conservatively assume that any amount of radiation exposure may pose some risk of causing cancer or a severe hereditary effect and that the risk is greater for higher radiation exposures. Therefore, a linear, no-threshold dose response model is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, supports the linear, no-threshold dose-response theory. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably overestimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 mrem]) from ICRP Publication 60 (ICRP 1991). The population doses presented in Table 6-9 are less than 0.1 person-Sv/yr (10 person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 1×10^{-2} fatal cancers, nonfatal cancers, and severe hereditary effects per year. To place these impacts in perspective, the average U.S. resident receives about 300 mrem/yr effective dose equivalent from natural background radiation (i.e., exposures from cosmic radiation, naturally occurring radioactive materials such as radon, and global fallout from testing of nuclear explosive devices) (NCRP 1987b). Using this average effective dose, approximately 160 fatal cancers, nonfatal cancers, and severe hereditary effects would occur in the population along this representative route from natural background radiation. The risks of transporting spent fuel from the VEGP site to a spent fuel disposal facility are small compared to the fatal cancers, nonfatal cancers, and severe hereditary effects that the same population would incur annually from exposure to natural sources of radiation.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and wastes under normal conditions are presented in Section 6.2.1.1.

6.2.2.2 Radiological Impacts of Accidents

As discussed previously, the staff used the RADTRAN 5 computer code to estimate impacts of transportation accidents involving spent fuel shipments. RADTRAN 5 considers a spectrum of postulated transportation accidents, ranging from those with high frequencies and low consequences (e.g., "fender benders") to those with low frequencies and high consequences (i.e., accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were from *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003) and are the same as those presented in Southern's ER. This report includes 140 radionuclides for Westinghouse AP1000 reactor spent fuel. A screening analysis was conducted to select the dominant contributors to accident risks to simplify the RADTRAN 5 calculations. The screening identified the radionuclides that would contribute more than 99.999 percent of the dose from inhalation of radionuclides released following a transportation accident. Spent fuel inventories used in the staff analysis are presented in Table 6-10. The list of radionuclides set forth in the table includes all of the radionuclides that were included in the analysis conducted by Sprung et al. (2000). However, INEEL (2003) did not provide radionuclide source terms for radioactive material deposited on the external surfaces of LWR spent fuel rods (commonly called "crud"). Because crud is deposited from corrosion products generated elsewhere in the reactor cooling system and the complete reactor design and operating parameters are uncertain, the quantities and characteristics of crud deposited on Westinghouse AP1000 reactor spent fuel are not available at this time. The VEGP Westinghouse AP1000 reactor spent fuel transportation accident impacts were calculated assuming the cobalt-60 inventory in the form of crud is 4.4 TBq/MTU (120 Ci/MTU), based on information in Sprung et al. (2000).

Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe postulated accident conditions with essentially no loss of containment or shielding capability. These casks

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for Each Advanced Reactor Type[(a)(b)]

Radionuclide	Ci/MTU	Bq/MTU
Pu-241	6.96×10^{4}	2.57×10^{15}
Pu-238	6.07×10^{3}	2.24×10^{14}
Cm-244	7.75×10^{3}	2.87×10^{14}
Am-241	7.27×10^{2}	2.69×10^{13}
Pu-240	5.43×10^{2}	2.01×10^{13}
Pu-239	2.55×10^{2}	9.44×10^{12}
Sr-90	6.19×10^{4}	2.29×10^{15}
Cs-137	9.31×10^{4}	3.44×10^{15}
Am-243	3.34×10^{1}	1.24×10^{12}
Cm-243	3.07×10^{1}	1.13×10^{12}
Am-242m	1.31×10^{1}	4.85×10^{11}
Ru-106	1.55×10^{4}	5.72×10^{14}
Eu-154	9.13×10^{3}	3.38×10^{14}
Cs-134	4.80×10^{4}	1.78×10^{15}
Ce-144	8.87×10^{3}	3.28×10^{14}
Sb-125	3.83×10^{3}	1.42×10^{14}
Pu-242	1.82×10^{0}	6.72×10^{10}
Cm-242	2.83×10^{1}	1.05×10^{12}
Pm-147	1.76×10^{4}	6.52×10^{14}
Cm-245	1.21×10^{0}	4.46×10^{10}
Y-90	6.19×10^{4}	2.29×10^{15}
Eu-155	4.62×10^{3}	1.71×10^{14}
Co-60[(c)]	1.20×10^{2}	4.40×10^{12}

(a) Divide becquerel/metric ton Uranium (Bq/MTU) by 3.7×10^{10} to obtain curies/MTU
(b) The source of the spent fuel inventories is INEEL (2003).
(c) Cobalt-60 is the key radionuclide constituent of fuel assembly crud.

are also designed with fissile material controls to ensure the spent fuel remains subcritical under normal and accident conditions. According to Sprung et al. (2000), the probability of encountering accident conditions that would lead to shipping cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The staff assumed that shipping casks for Westinghouse AP1000 reactor spent fuel would provide equivalent mechanical and thermal protection of the spent fuel cargo.

The RADTRAN 5 accident risk calculations were performed using radionuclide inventories (Bq/MTU) for the spent fuel shipments from a Westinghouse AP1000 reactor (INEEL 2003). The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (MTU/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from the VEGP site to the proposed repository at Yucca Mountain in Nevada. As was done for routine exposures, the staff assumed that the numbers of shipments of spent fuel per year are equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuel designs (Sprung et al. 2000) were used to approximate the impacts from the Westinghouse AP1000 reactor spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave similarly to current LWR fuel under applied mechanical and thermal conditions.

The NRC staff used RADTRAN 5 to calculate the population dose from the released radioactive material from four of five possible exposure pathways.[a] These pathways are:

1. External dose from exposure to the passing cloud of radioactive material (cloudshine).

2. External dose from the radionuclides deposited on the ground by the passing plume (groundshine). The staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, thus preventing long-term exposures from this pathway.

3. Internal dose from inhalation of airborne radioactive contaminants (inhalation).

4. Internal dose from resuspension of radioactive materials that were deposited on the ground (resuspension). The staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

(a) Internal dose from ingestion of contaminated food was not considered because the staff assumed evacuation and subsequent interdiction of foodstuffs following a postulated transportation accident.

Table 6-11 presents the environmental consequences of transportation accidents when shipping spent fuel from the VEGP site to the proposed Yucca Mountain repository. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions (see Section 6.2.2.1). The results are normalized to the WASH-1238 reference reactor (880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80-percent capacity).

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for Advanced Reactors, Normalized to Reference 1100-MW(e) LWR Net Electrical Generation

	Population Impacts, Person-Sv/yr[a]
Reference LWR, Person-Sv/yr	3.5×10^{-7}
VEGP ESP Normalized Impacts, person-Sv/yr	2.2×10^{-7}

(a) Multiply person-Sv/yr times 100 to obtain person-rem/yr.

Although radiation may cause cancers at high doses and high dose rates, currently there are no data that unequivocally establish the occurrence of cancer following exposure to low doses below about 100 mSv (10,000 mrem) and at low dose rates. However, radiation protection experts conservatively assume that any amount of radiation exposure may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response model is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, supports the linear, no-threshold dose response theory. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. This theory is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model probably over estimates those risks.

Based on this model, the staff estimates the risk to the public from radiation exposure using the nominal probability coefficient for total detriment (730 fatal cancers, nonfatal cancers, and severe hereditary effects per 10,000 person-Sv [1,000,000 person-rem]) from ICRP Publication 60 (ICRP 1991). The population doses presented in Table 6-11 are less than 1×10^{-6} person-Sv/yr (1×10^{-4} person-rem/yr); therefore, the total detriment estimates associated with these population doses would all be less than 1×10^{-7} fatal cancers, nonfatal cancers, and severe hereditary effects per year. These risks are small.

6.2.2.3 Nonradiological Impact of Spent Fuel Shipments

The general approach used to calculate nonradiological impacts of spent fuel shipments is the same as that used for unirradiated fuel shipments. The main difference is that the spent fuel shipping route characteristics are better-defined so the state-level accident statistics in Saricks and Tompkins (1999) may be used. State-by-state shipping distances were obtained from the

TRAGIS output file and combined with the annual number of shipments and accident, injury, and fatality rates by state from Saricks and Tompkins (1999) to calculate nonradiological impacts. The results are shown in Table 6-12.

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting waste from the VEGP site. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) would be packaged and in solid form.
- Radioactive waste (except spent fuel) would be shipped from the reactor by truck or rail.
- The weight limitation of 33,100 kg (73,000 lb) per truck and 90.7 MT (100 tons) per cask per railcar would be met.
- Traffic density would be less than the one truck shipment per day or three railcars per month condition.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the VEGP site to Yucca Mountain, Normalized to Reference LWR

		One-way Shipping	Nonradiological Impacts, per year		
State	**Highway Type**	**Distance, km**	**Accidents/yr**	**Injuries/yr**	**Fatalities/yr**
AR	Interstate	4.6×10^2	4.9×10^{-3}	3.6×10^{-3}	2.3×10^{-4}
AZ	Interstate	5.7×10^2	6.1×10^{-3}	5.4×10^{-3}	4.3×10^{-4}
CA	Interstate	3.5×10^2	4.4×10^{-3}	3.4×10^{-3}	1.9×10^{-4}
	Primary	1.5×10^2	5.3×10^{-4}	4.0×10^{-4}	2.6×10^{-5}
GA	Interstate	4.3×10^2	2.3×10^{-2}	1.6×10^{-2}	6.6×10^{-4}
	Primary	4.6×10^1	2.5×10^{-3}	1.7×10^{-3}	7.2×10^{-5}
NM	Interstate	6.0×10^2	5.4×10^{-3}	5.5×10^{-3}	5.6×10^{-4}
NV	Primary	1.2×10^2	3.7×10^{-3}	2.4×10^{-3}	1.6×10^{-4}
OK	Interstate	5.3×10^2	1.1×10^{-2}	1.2×10^{-2}	5.7×10^{-4}
TN	Interstate	5.6×10^2	5.5×10^{-3}	4.1×10^{-3}	4.5×10^{-4}
TX	Interstate	2.8×10^2	1.4×10^{-2}	1.2×10^{-2}	2.9×10^{-4}
Totals		$\mathbf{4.1 \times 10^3}$	$\mathbf{8.1 \times 10^{-2}}$	$\mathbf{6.7 \times 10^{-2}}$	$\mathbf{3.6 \times 10^{-3}}$

Note: The number of shipments of spent fuel assumed in the calculations is 40 shipments/yr after normalizing to the reference LWR.

Radioactive waste from the Westinghouse AP1000 reactor is expected to be capable of being shipped in compliance with Federal or State weight restrictions. Table 6-13 presents estimates of annual waste volumes and annual waste shipment numbers for a Westinghouse AP1000 reactor at the VEGP site normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). The expected annual waste volumes and waste shipments for the Westinghouse AP1000 reactor were less than the 1100-MW(e) reference reactor that was the basis for Table S–4. Maximum projected waste generation rates for the VEGP ESP reactor could exceed the reference LWR waste generation rate. However, waste generation rate projections are uncertain and are a function of Southern's radioactive waste management practices. Therefore, waste generation rates for the VEGP reactor are anticipated to be much closer to the expected rate than the maximum rate.

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste is well below the one-truck-shipment-per-day condition given in 10 CFR 51.52, Table S–4 for a Westinghouse AP1000 reactor located at the VEGP site. Doubling the shipment estimates to account for empty return shipments of fuel and waste is included in the results. An additional doubling to account for a second reactor at the VEGP site is also less than the one-shipment-per-day condition.

Table 6-13. Summary of Radioactive Waste Shipments from the VEGP Site

Reactor Type	Waste Generation Information	Annual Waste Volume, m^3/yr per Unit	Electrical Output, MW(e) per Unit	Normalized Rate, m^3/1100 MW(e) Unit (880 MW(e) Net)[a]	Shipments/ 1100 MW(e) (880 MW(e) Net) Electrical Output[b]
Reference LWR (WASH-1238)	3800 ft^3/yr per unit	108	1100	108	46
VEGP Westinghouse AP1000, expected	1964 ft^3/yr per unit[c]	56	1117[c]	47	21
VEGP Westinghouse AP1000, maximum	5717 ft^3/yr per unit[c]	162	1117[c]	137	59

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 liters (0.21 m^3).

(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are 80 percent for the reference LWR (AEC 1972) and 93 percent for the VEGP Westinghouse AP1000 (Southern 2007). Waste generation for the Westinghouse AP1000 is normalized to 880 MW(e) net electrical output (1100-MW(e) unit with an 80-percent capacity factor).

(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3 per shipment (108 m^3/yr divided by 46 shipments/yr).

(c) These values were taken from the ER (Southern 2007).

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and waste under normal conditions are presented in Section 6.2.1.1.

Nonradiological impacts of radioactive waste shipments were calculated using the same general approach as unirradiated and spent fuel shipments. For this EIS, the shipping distance was assumed to be 800 km (500 mi) one way (AEC 1972). Because the actual destination is uncertain, national median accident, injury, and fatality rates were used in the calculations (Saricks and Tompkins 1999). The results are presented in Table 6-14.

The total annual construction fatalities represents about 3 percent increase above the 12 traffic fatalities that occurred in Burke County Georgia in 2005 (DOT 2005). The fatalities during operations, including both permanent and outage workers, represents about a 0.04 percent increase. These impacts represent small increases relative to current traffic fatality risks in the area surrounding the proposed VEGP site.

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the VEGP Site

	Shipments per Year	One-Way Distance, km	Fatalities per Year	Injuries per Year	Accidents per Year
WASH-1238	46	800	6.6×10^{-4}	1.4×10^{-2}	2.1×10^{-2}
VEGP Westinghouse AP1000	21	800	3.1×10^{-4}	6.4×10^{-3}	9.4×10^{-3}

Note: The shipments and impacts have not been normalized to the reference LWR; the expected waste volumes from the VEGP Westinghouse AP1000 reactor were used. Normalized shipments and impacts would be slightly smaller (see Table 6-12).

(AEC 1972)

6.2.4 Conclusions

An independent confirmatory analysis was conducted of the impacts under normal operating and accident conditions of transporting construction materials, construction and operations personnel, and fuel and wastes to/from an Westinghouse AP1000 reactor proposed to be located at the proposed VEGP site. To make comparisons to Table S–4, the environmental impacts are normalized to a reference reactor year. The reference reactor is an 1100-MW(e) reactor that has an 80-percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electric output for the proposed Westinghouse AP1000 reactor at the VEGP site to the electric output of the reference reactor.

Because of the conservative approaches and data used to calculate impacts, actual environmental effects are not likely to exceed those calculated in this EIS. Thus, the staff concludes that the environmental impacts of transportation of construction materials, personnel, fuel, and radioactive wastes to and from the VEGP site would be SMALL, and would be consistent with the environmental impacts associated with transportation of materials, personnel, fuel, and radioactive wastes from current-generation reactors presented in Table S–4 of 10 CFR 51.52.

6.3 Decommissioning Impacts

At the end of the operating life of a power reactor, NRC regulations require that the facility undergo decommissioning. Decommissioning is the removal of a facility safely from service and the reduction of residual radioactivity to a level that permits termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75.

Environmental impacts from the activities associated with the decommissioning of any LWR before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). If an applicant for a CP or COL referencing the Southern ESP applies for a license to construct new nuclear units at the VEGP site, there is a requirement to provide a report containing a certification that financial assurance for radiological decommissioning would be provided. At the time an application is submitted, the requirements in 10 CFR 50.33, 50.75, and 52.77 (and any other applicable requirements) would have to be met.

At the ESP stage, applicants are not required to submit information regarding the process of decommissioning, such as the method chosen for decommissioning, the schedule, or any other aspect of planning for decommissioning. Southern did not provide this information in its application; however, it did provide a decommissioning cost analysis summary. The regulatory requirements on decommissioning activities are expected to limit the impacts of decommissioning to a SMALL impact.

6.4 References

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10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits; Standard Design Certifications; and Combined License for Nuclear Power Plant."

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7.0 Cumulative Impacts

When evaluating the potential impacts of construction and operation of new units at the Vogtle Electric Generating Plant (VEGP) site proposed by Southern Nuclear Operating Company, Inc. (Southern) in its early site permit (ESP) application and Environmental Report (ER) (Southern 2007), the staff considered potential cumulative impacts that could occur because of the construction and operation of two Westinghouse Electric Company, LLC (Westinghouse) AP1000 advanced light-water reactors at the VEGP site. For purposes of this analysis, past actions are those related to the existing VEGP Units 1 and 2. Present actions are those related to resources at the time of the ESP application until the start of construction. Future actions are those that are reasonably foreseeable through construction and operation of the proposed VEGP Units 3 and 4, including decommissioning. Southern has submitted an application to renew the operating licenses for VEGP Units 1 and 2 (Southern 2007b). The impacts of this potential license renewal also are considered in this analysis. The geographical area over which past, present, and future actions could contribute to cumulative impacts is dependent on the type of action considered and is described below for each impact area. The staff considered cumulative effects of the proposed VEGP Units 3 and 4 with current operations at the Savannah River Site, and proposed new facilities at the Savannah River Site such as the proposed mixed oxide (MOX) fuel fabrication facility (NRC 2005).

The impacts of the proposed action, as described in Chapters 4 and 5, are combined with other past, present, and reasonably foreseeable future actions in the vicinity of VEGP that would affect the same resources impacted by the proposed VEGP Units 3 and 4, regardless of what agency (Federal or non-Federal) or person undertakes such actions. These combined impacts are defined as "cumulative" in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

7.1 Land Use

The NRC staff reviewed the available information on the impacts on land use of constructing one or more additional nuclear units at the VEGP site including one additional transmission line in a new right-of-way. In addition to land-use impacts at the VEGP site, cumulative impacts for land use include possible additional growth and land conversions to accommodate new workers and services. However, cumulative land-use impacts are expected to be relatively minor because the construction and the operations workforces are expected to be drawn from an area wider than Burke County, Georgia. Because the workforce would be dispersed over larger geographic areas in the labor supply region, the induced impacts on land use (resulting from either construction or operations of one or more new units at the VEGP site) can be absorbed in that wider region.

Construction of the planned 500-kV transmission line would have land-use impacts, as discussed in Sections 4.1.2 and 5.1.2 of this environmental impact statement (EIS). However, because the Georgia Power Company (GPC) generally provides easements for agricultural activities under transmission lines, the cumulative land-use impacts associated with construction of the new transmission line are expected to be relatively SMALL.

7.2 Air Quality

Permitted air emission sources nearby the VEGP site include the Allen B. Wilson Combustion Turbine Plant (Plant Wilson) and the Savannah River Site. Plant Wilson is located to the east-southeast on adjacent property to the current VEGP site and is operated by the GPC. The facility has six combustion turbines and one black start diesel generator, all of which are listed as significant emission units in the facility's Title V Clean Air Act operating permit 4911-033-0008-V-02.0 (Georgia EDP 2007). The Savannah River Site is a U.S. Department of Energy (DOE) facility and is located across the Savannah River to the east-northeast of the VEGP site. Air emissions from Savannah River Site are permitted under DOE's operating permit (TV-0090-0041) and include radioactive, nonradioactive toxic, and criteria pollutants from approximately 47 nonexempt emission units, with each emission unit having specific emission limits, operating conditions, and monitoring and reporting requirements (Savannah River Site 2006). In addition, a MOX facility has been proposed for development on the Savannah River Site. The MOX facility would be in support of DOE's surplus plutonium disposition program for converting depleted uranium and weapons-grade plutonium into a MOX fuel that is proliferation-resistant. Estimated air emissions from the MOX facility are detailed in the EIS for the proposed facility (NRC 2005). Emissions of criteria pollutants primarily include dust during construction and NO_2 and particulates from processing during operation. Limited air emissions would also result from emergency and standby diesel-power generators and fuel storage (NRC 2005).

As was discussed in Section 2.3.2 of this EIS, the VEGP site is located in an area that is in attainment for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.314). Section 4.2 of this EIS examined air-quality impacts associated with construction; emissions would be predominately dust from construction activities and exhaust from equipment and vehicles. Emissions from construction are expected to be temporary and limited in magnitude and impacts on air quality would be small. Section 5.2 addressed air-quality impacts from operations. Natural draft cooling towers proposed for VEGP Units 3 and 4 would not release emissions regulated under the NAAQS. Air emissions from operations would be primarily from diesel generators and auxiliary power supplies. These systems would be permitted and operated in accordance with State and Federal regulatory requirements and emissions would be infrequent and impacts would be small. No other significant air impacts from other actions at the VEGP were identified. Based on its evaluation, the NRC staff concludes that the cumulative impacts of air quality would be SMALL and that mitigation is not warranted.

7.3 Water Use and Quality

The assessments performed by the NRC staff in Sections 4.3 and 5.3 describe the impacts of construction and operation of the proposed VEGP Units 3 and 4 on the hydrological environment. This section addresses the cumulative impacts of the proposed VEGP Units 3 and 4, the existing VEGP Units 1 and 2, the DOE's Savannah River Site directly across the Savannah River from the VEGP site, and other water users in the region.

7.3.1 Water-Use Impacts

The potential impacts on the environment from surface-water withdrawals from the Savannah River during operation of the proposed units are described in Section 5.2 of the ER (Southern 2007a). The potential impacts on the environment from groundwater use during operation of the proposed VEGP Units 3 and 4 at the VEGP site are described in Section 5.2.2.2 of the ER (Southern 2007a), in Southern's response to requests for additional information (Southern 2007bc), and in Section 5.3.2.2 of this EIS. Other past, present, and reasonably foreseeable future actions in the vicinity of the proposed site include (1) the cumulative impact from operation of the existing VEGP Units 1 and 2, (2) saltwater intrusion issues in the State of Georgia, (3) observed tritium in the unconfined aquifer, and (4) contamination in the environment surrounding the Savannah River Site.

7.3.1.1 Surface-Water-Use Impacts

Water withdrawn from the Savannah River and used to cool both the existing VEGP Units 1 and 2 and the proposed VEGP Units 3 and 4 were compared as a percent of the total river discharge. As shown in Table 7-1, during periods of average discharge conditions, surface-water withdrawals amount to 2 percent of the discharge. During periods of drought, the withdrawal percentage increases, finally reaching 4.6 percent when the river discharge has declined to Drought Level 3. Comparable levels for Drought Level 4 are not shown in Table 7-1 because they cannot be calculated; the river discharge is not specified.

Visually, the impact of withdrawing 4.90 m^3/s (173 cfs) can be qualitatively gaged by inspecting Figure 2-5. Although the average river discharge rate is 250 m^3/s (8830 cfs), numerous periods exist when the discharge rate exceeds 424.85 m^3/s (15,000 cfs). At a discharge rate of 424.85 m^3/s (15,000 cfs), the combined withdrawal represents 1.2 percent of the total river discharge. The impact of these withdrawals on the shoreline was evaluated by investigating the net change in river stage resulting from a withdrawal of 4.90 m^3/s (173 cfs). Assuming the river was at Drought Level 3 conditions, a further reduction of discharge resulting from the combined

Table 7-1. Savannah River Discharge Rates and Combined Surface-Water Withdrawal Rates

	River Discharge	Normal Withdrawal		Combined Withdrawal	
Case	m³/s (cfs)	VEGP Units 1 and 2 m³/s (cfs)	VEGP Units 3 and 4 m³/s (cfs)	m³/s (cfs)	% of river
Average Conditions	250 (8830)	2.5 (90)	2.35 (83)	4.90 (173)	2.0
Drought Level 1	119 (4200)	2.5 (90)	2.35 (83)	4.90 (173)	4.1
Drought Level 2	113 (4000)	2.5 (90)	2.35 (83)	4.90 (173)	4.3
Drought Level 3	108 (3800)	2.5 (90)	2.35 (83)	4.90 (173)	4.6

Sources: NRC 1985 and ER (Southern 2007a).

withdrawals of VEGP Units 1 through 4 resulted in a net lowering of the water surface elevation by 5 cm (2 in.). Water would be returned to the Savannah River from the site via two discharge outfalls, one serving VEGP Units 1 and 2 and the other serving the proposed VEGP Units 3 and 4. Under normal operating conditions, the consumptive use of the plants would be 1.90 m^3/s (67 cfs) for VEGP Units 1 and 2 (Southern 2007a) and 1.76 m^3/s (62 cfs) for the proposed VEGP Units 3 and 4 (Southern 2007a). Table 7-2 presents these consumptive water uses as ratios of the total discharge in the Savannah River. The combined consumptive use is

Table 7-2. Consumptive Use of Savannah River Water

	River Discharge	Normal Consumptive Use		Combined Consumptive Use	
Case	m³/s (cfs)	VEGP Units 1 and 2 m³/s (cfs)	VEGP Units 3 and 4 m³/s (cfs)	m³/s (cfs)	% of river
Average Conditions	250 (8830)	1.90 (67)	1.76 (62)	3.65 (129)	1.5
Drought Level 1	119 (4200)	1.90 (67)	1.76 (62)	3.65 (129)	3.1
Drought Level 2	113 (4000)	1.90 (67)	1.76 (62)	3.65 (129)	3.2
Drought Level 3	108 (3800)	1.90 (67)	1.76 (62)	3.65 (129)	3.4

Source: Southern (2007a)

approximately 1.5 percent of the average river discharge and 3.4 percent of the discharge during Drought Level 3 conditions. Comparable levels for Drought Level 4 are not shown in Table 7-2 because they cannot be calculated; the river discharge is not specified.

As described in Section 2.6.2.1, nearby water users to the proposed VEGP Units 3 and 4 include the existing VEGP Units 1 and 2, the South Carolina Electric and Gas (SCE&G) D-Area Powerhouse, and the SCE&G Urquhart Station. Of these, the D-Area Powerhouse consumptive use (1.89 m^3/s [68.4 cfs]) and the Urquhart Station consumptive use (3.52 m^3/s [127.5 cfs]) were the largest water users outside the VEGP site. Assuming maximum consumption from both the proposed VEGP Units 3 and 4, the maximum water withdrawal would be 4.77 m^3/s (173 cfs), making the VEGP site the largest water consumer in the region. However, as stated above, during times of average or above-average discharge in the Savannah River, the VEGP site water use would be 1.5 percent or less of the total river discharge.

Because (1) the total the VEGP site withdrawals are expected to be less than 5 percent of the total river discharge, (2) the total VEGP site consumptive use is expected to be less than 3.5 percent of the total river discharge, (3) other nearby surface-water users consume less water than the VEGP site would with the proposed two new units, and (4) the reduction in the river stage near the VEGP site caused by its withdrawals is expected to be less than 5 cm (2 in.), the staff concluded that the combined surface-water-use impacts resulting from the operation of the proposed VEGP Units 3 and 4 would be minor. Although the effects may be detectable, they would not destabilize the resource; therefore, the staff concludes that the impacts would be SMALL, and mitigation is not warranted.

7.3.1.2 Groundwater-Use Impacts

Potential offsite impact during the operation of VEGP Units 1, 2, 3, and 4 is represented by a total normal operation groundwater requirement of 93.50 L/s (1482 gpm) for all units. This is a multi-year average rate applicable to the long-term operation of VEGP. It is based on the normal operation of VEGP Units 1 and 2, requiring 46.1 L/s (730 gpm), and the proposed VEGP Units 3 and 4, requiring 47.44 L/s (752 gpm) (Southern 2007a). The maximum rate for the operation of VEGP Units 1 and 2 is 145 L/s (2300 gpm), and for the proposed VEGP Units 3 and 4 is 198.1 L/s (3140 gpm). Thus, in the unlikely event that all four units were at the maximum groundwater usage, a total rate of 343.2 L/s (5440 gpm) would be required. However, this would not be a long-term rate, and may only be required for a short time (e.g., Southern simulated a 2-day period) (Southern 2007b). Potential offsite impact is evaluated based on the decline in hydraulic head in the Cretaceous aquifer estimated using a simple conservative analysis based on withdrawal from a single onsite well nearest the VEGP property boundary.

The well selected for analysis is deep production well MU-2A, and the property boundary is 1740 m (5700 ft) away. Data on the hydraulic properties of the Cretaceous aquifer are published in the Final Safety Analysis Report for VEGP Units 1 and 2 (Southern 2003) and were gathered during the installation and testing of the deep production wells. The transmissivity of 0.0227 m^2/s (158,000 gal/d/ft) is identified by Southern (2007a) as a mid-range value for use in analyses. The storativity value of 3.1E-04 (dimensionless) is the arithmetic mean of values reported in the Final Safety Analysis Report (Southern 2003).

The staff performed an independent analysis of cumulative normal and maximum unit operations confirming Southern's calculations and to examine a range of cases. The cumulative drawdown resulting from normal operation at the nearest offsite location is approximately 3.7 m (12 ft) in 2045 (i.e., after 59 years operation of VEGP Units 1 and 2 and 31 years operation of the proposed VEGP Units 3 and 4). Although the drawdown associated with a short-term (i.e., 2 days) maximum operational level is approximately 2.7 m (9 ft), a longer period response (i.e., 30 days) is approximately 6 m (20 ft). The long-term drawdown associated with normal operation represents a small fraction of the approximately 120 m (400 ft) of confining hydraulic head in the Cretaceous aquifer. The drawdown associated with maximum operation levels for brief periods would be temporary because the hydraulic head would rebound to prior levels.

If either VEGP Unit 1 or 2 were to require maximum groundwater withdrawal, the incremental drawdown after 30 days would be approximately 0.9 m (3 ft). If either the proposed VEGP Unit 3 or 4 were to require maximum off-normal groundwater withdrawal, the incremental in drawdown after 30 days would be approximately 1.4 m (4.5 ft). Incremental drawdowns of 0.9 to 1.4 m (3 to 4.5 ft) would not dewater installed screens in either the Tertiary or Cretaceous aquifers, and are within the operational tolerance of pumps installed to recover groundwater from confined aquifers.

In addition to identifying the MU-2A well for analysis, Southern identified the proposed locations of water supply wells for the proposed VEGP Units 3 and 4 (see Southern 2007d). The staff estimated the distance from the VEGP property line to the nearest proposed well location as 1070 m (3500 ft). The proximity of the boundary caused the drawdown estimates to increase by approximately 10 percent for long time periods, by approximately 20 percent for 30-day periods, and by approximately 40 percent for 2-day periods. These results do not alter the staff's conclusions.

The estimates above reflect the potential impact at the property boundary. The closest users of the Cretaceous aquifer are a municipal well 23.3 km (14.5 mi) away, an industrial well 13.7 km (8.5 mi) away, and wells located in the Savannah River Site D-Area 6.4 km (4 mi) away. At these distances, the cumulative drawdown resulting from the production of water during operation of all units through 2045 (approximately 30 years after startup of the proposed units) would be less than 3 m (10 ft) for these users.

Clearly, the pumping stress to support the cumulative operation of VEGP Units 1, 2, 3, and 4 would not dewater the confined aquifer, does not substantially alter the 120 m (400 ft) of confined head in the Cretaceous aquifer, and does not substantially alter the hydraulic head in the Cretaceous aquifer at the nearest neighbor offsite well location.

Based on the projected relatively low drawdown of normal operation and the temporary drawdowns of maximum operation, the staff concluded that cumulative groundwater-use impacts are SMALL and mitigation is not warranted.

7.3.2 Water-Quality Impacts

This section describes cumulative water-quality impacts resulting from operation and interaction of the proposed VEGP Units 3 and 4 with the surrounding environment.

7.3.2.1 Surface-Water-Quality Impacts

Near the mouth of the Savannah River approximately 240 km (150 mi) downstream of the VEGP site, saltwater is intruding into the Floridan aquifer because of groundwater withdrawals. To preserve the groundwater resource, a shift in water supply may occur whereby consumers of Floridan aquifer water may meet their water needs through the use of surface water originating from the Savannah River (GDNR 2006). Accordingly, the use of Savannah River water at the VEGP site may diminish the quantity of river water that would be available downstream. However, as discussed earlier in Section 5.3.2.1, the consumptive water use of the proposed VEGP Units 3 and 4 is expected to be less than 1 percent of the total river discharge during average periods and only up to 1.7 percent during periods of water scarcity (Drought Level 3). The normal cumulative water use for VEGP Units 1 through 4 (i.e., the VEGP site with four operating reactors) is not large when compared to the total Savannah River discharge and, as shown in Table 7-2, is expected to be 3.4 percent or less of the total river discharge.

The NRC staff's assessment of the cumulative water temperature impacts from VEGP Units 1 through 4 is in Section 5.3. This analysis considers the combined impacts by assigning the total effluent discharge from VEGP Units 1 through 4 to the outfall pipe for the proposed VEGP Units 3 and 4. It should be noted that this scenario is not proposed by Southern, but was considered to produce the maximum single thermal plume. The numerical model CORMIX was used to compute the extent of the effluent plume. The maximum downstream extent of the 2.8°C (5°F) above ambient isotherm was computed to occur 29.6 m (97 ft) downstream of the outfall pipe, and the maximum width of the curved isotherm was 4.6 m (15 ft).

The staff conducted a second assessment of the cumulative water temperature impacts from VEGP Units 1 through 4 by separating the effluent discharges, as proposed by Southern, into two different discharge pipes (i.e., the existing VEGP Units 1 and 2 and the proposed VEGP Units 3 and 4 pipes). Both pipes were assigned a diameter of 61 cm (2.0 ft). The effluent discharge from VEGP Units 1 and 2 was set at 631.5 L/s (22.3 cfs) based on an average value at 4 cycles of concentration (Southern 2007a). The effluent discharge from the proposed VEGP

Units 3 and 4 was set at the maximum design discharge of 1939.7 L/s (68.5 cfs) (Southern 2007a). The staff made a bounding assumption that all waste issuing from both pipes was at a temperature of 32.7°C (91°F). River temperatures were set to the minimum observed value of 5°C (41°F), resulting in the maximum temperature difference (28°C [50°F]) between the ambient river and the discharge effluent.

As in Chapter 5, the staff used the numerical model CORMIX version 5.0 (Jirka et al. 2004) to compute the size of the two discharge plumes. Southern states in its ER that the two discharge locations would be 123.14 m (404 ft) apart (Southern 2007a). At this distance downstream from the existing discharge, the increase in water temperature above ambient was computed by staff to be 0.8°C (1.4°F). For comparison, at half the distance between the proposed and existing outfalls (i.e., 60.96 m [200 ft]), the increase in water temperature was computed to be 1.1°C (2.0°F). The expected impact of the existing outfall on the proposed VEGP Units 3 and 4 outfall would be expected to be less than 1.0°C (1.8°F). The proposed VEGP Units 3 and 4 plume computed as part of the second analysis was smaller in extent than the plume computed in Chapter 5, which would be expected because the effluent discharge is less.

Southern, in its ER, also investigated the cumulative impact of the existing VEGP Units 1 and 2 outfall on the proposed VEGP Units 3 and 4 outfall. At a distance of 123.14 m (404 ft) downstream from the existing outfall, the expected increase in water temperature was computed to be less than 0.5°C (0.9°F) (Southern 2007a). Values computed in Southern's analysis were based on expected differences between ambient river and tower blowdown water temperatures, not the maximum range, as was done in the staff's analysis.

Therefore, although the cumulative surface-water-quality impacts may be detectable, they are expected to be minor and would not destabilize the resource. Therefore, the staff concludes that cumulative impacts resulting from the operation of the proposed VEGP Units 3 and 4 would be SMALL.

7.3.2.2 Groundwater-Quality Impacts

The potential cumulative impact of groundwater quality on VEGP Units 1, 2, 3, and 4 operation is addressed in this section. Three aspects of cumulative groundwater quality deserve mention: (1) water quality associated with the regional issue of saltwater intrusion, (2) water quality associated with observed tritium in the Water Table aquifer in the vicinity of the VEGP site, and (3) the potential for Savannah River Site contamination to impact the quality of groundwater withdrawn at the VEGP site.

Saltwater Intrusion

The staff review of the potential for saltwater intrusion to impact VEGP operation resulted in the acquisition and review of the permitting plan published by the State of Georgia (GDNR 2006).

After nearly a decade of study, the State of Georgia issued the permitting plan for managing saltwater intrusion (GDNR 2006). Burke County is identified in that plan as one of 19 counties that do not contribute substantially to the development or extent of saltwater intrusion in coastal areas. However, applications for water-use permits in the 19-county region, including Burke County, would be reviewed to ensure a justified need exists, and that aggressive and practical conservation and reuse principles would be applied. Southern notes in its ER that groundwater wells would be completed in the Cretaceous aquifer to supply groundwater for operation of the proposed VEGP Units 3 and 4, and that Southern would request a modification of the existing groundwater-use permit (Southern 2007a). The quality of water withdrawn from groundwater wells in Burke County is not impacted by saltwater intrusion.

Tritium in the Unconfined Aquifer

The staff independently reviewed documents published by the State of Georgia and the U.S. Geological Survey (USGS) to fully understand the observed tritium contamination. Tritium has been identified as a pollutant in the Water Table aquifer in the vicinity of the VEGP site (Summerour et al. 1998). Tritium was first discovered in 1988 in a public water supply well serving the DeLaigle Mobile Home Park, which is a short distance from the VEGP site, and it was initially believed to contaminate the confined aquifer system. A thorough study of the region (Summerour et al. 1994, 1998) revealed the following:

- The measured tritium levels were well below the drinking water standard, and there was no public health threat.
- The Water Table aquifer was contaminated, and the Tertiary aquifer was only contaminated by a poor well completion that has since been sealed.
- The contamination likely resulted from recharge of the Water Table aquifer by atmospheric deposition of tritium that was released from the Savannah River Site.

Transriver flow within the groundwater system was assumed initially to be a second potential pathway for tritium found in the Georgia aquifer systems (i.e., groundwater flowing from the Savannah River Site in South Carolina beneath the Savannah River into Georgia) (Summerour et al. 1998). Transriver flow has been studied by the USGS (Clarke and West 1997, 1998; Cherry 2006) and found to be an unlikely source for the broadly observed tritium found in the unconfined aquifer in Georgia. Southern does not withdraw water from the Water Table aquifer for operation of the VEGP site.

Savannah River Site Groundwater Contamination

Regarding groundwater contamination at the Savannah River Site, the staff reviewed several USGS studies referenced by Southern, and the staff acquired and reviewed documents detailing groundwater contamination and management practices at the Savannah River Site. Several aspects of the hydrogeology of the Georgia and South Carolina aquifer systems argue against the movement of groundwater contamination from the Savannah River Site into Georgia groundwater. However, there are circumstances illustrated by USGS analyses when it could occur to a limited extent. Salient aspects of the hydrogeology and Savannah River Site contamination are listed below:

- The Savannah River in the vicinity of Savannah River Site and the VEGP site incises the Water Table aquifer and acts as a discharge boundary for the unconfined aquifer, thus intercepting all unconfined aquifer groundwater from both Georgia and South Carolina. Contamination in the unconfined aquifer underlying Savannah River Site is intercepted by the Savannah River.

- In the vicinity of Savannah River Site and the VEGP site, the Tertiary aquifer exhibits hydraulic head contours indicative of either groundwater flow toward the Savannah River from both states, or groundwater flow toward upriver locations where the river has incised the overlying confining unit allowing the Tertiary aquifer to discharge to the Savannah River alluvium. Thus, contamination in the Tertiary aquifer underlying the Savannah River Site is intercepted by the Savannah River.

- In the vicinity of the Savannah River Site and the VEGP site, three aspects of the Cretaceous aquifer are significant:

  - DOE maintains an upward hydraulic gradient, and, hence, a natural barrier between the uppermost confined aquifer and the deep confined aquifer (Wells 1999). This protects the quality of Cretaceous aquifer groundwater.

  - USGS has studied the transriver flow issue (Clarke and West 1997, 1998; Cherry 2006) and found that contaminants in the groundwater at the Savannah River Site are not drawn to the production wells at the VEGP site. In general, Cherry (2006) shows that regions of transriver flow discharge are within the Savannah River Alluvium near the river and are of limited extent.

  - The USGS study by Cherry (2006) presents piezometric contours of the confined aquifer, and it appears groundwater in the confined system moves toward the VEGP site from lateral and downgradient regions. The groundwater then moves in an upstream direction away from the VEGP site to erosional windows in the confining unit, thus allowing Cetaceous aquifer discharge to the Savannah River.

Summary

The VEGP site does not introduce contaminants to the aquifer system. This evaluation of cumulative impact has examined offsite influences on the VEGP site. Based on (1) the absence of any impact from saltwater intrusion, (2) an understanding of tritium levels in the Water Table aquifer and its origin, and (3) an understanding of the relationship between aquifers underlying the Savannah River Site and the VEGP site, and the circumstances that may lead to contamination at the Savannah River Site reaching Georgia, the staff concludes that cumulative groundwater impacts would be small, and mitigation is not warranted.

7.4 Terrestrial Ecosystem

Construction and operation of two new units at the VEGP site were evaluated to determine the magnitude of their contribution to regional cumulative adverse impacts on terrestrial ecological resources. Potential impacts due to plant construction were made for important terrestrial species (animal and plant) and habitats (as defined in NRC 2000) by evaluating the impact of construction in light of other past, present, and future actions in the region. Potential impacts due to plant operation were made for resource attributes normally affected by cooling tower operation, transmission line operation, and right-of-way maintenance. For this analysis, the geographic region encompassing past, present, and foreseeable future actions is the area immediately surrounding the VEGP site, including adjoining sections of the Savannah River bottomland.

The GPC completed a transmission line study in 2007 to identify potential rights-of-ways for the proposed 500-kV transmission line (GPC 2007). For the analysis of cumulative impacts related to the addition of the transmission line and its right-of-way, the geographic region encompassing past, present, and foreseeable future actions is the original Representative Delineated Corridor (RDC) right-of-way identified by the GPC (2007).

VEGP

Approximately 200 ha (500 ac) of land would be disturbed by construction of the proposed VEGP Units 3 and 4 (Southern 2007a). An estimated 9.11 ha (22.5 ac) of wetlands habitat on the site would be disturbed with construction of the proposed VEGP Units 3 and 4. Most of the acreage involved would be in the wetlands within the Savannah River floodplain (Southern 2007c). Of the 9.11 ha (22.5 ac) that would disturbed, only a small portion would be permanently lost (Southern 2007c). The amount of acreage that would be disturbed represents about 13 percent of the total 69 ha (170 ac) of wetlands currently available onsite and less than 0.03 percent of available wetlands associated with the Savannah River floodplain in the vicinity of VEGP (i.e., within 16 km [10 mi] from midpoint of VEGP). Approximately 0.57 ha (1.4 ac) of land composed of pond and bottomland hardwood would be within the onsite portion of the new transmission line right-of-way. At this time, it is not known if any of this land would be considered wetlands. An estimated 113 ha (279 ac) of upland habitat including planted pines, previously disturbed areas, and open fields would be lost to permanent structures and facilities (including the onsite portion of the new transmission line), representing about 16 percent of the total 700 ha (1730 ac) of pine forests and open areas currently available onsite. The amount of upland habitat that would be disturbed is less than 0.05 percent of the available forested habitat (23,788 ha [58,781 ac]) in the vicinity of the VEGP site (NRSAL 2003). An estimated 1.6 ha (4 ac) of mixed hardwood and pine habitat would be lost to permanent structures and facilities, representing less than 1 percent of the total 248 ha (612 ac) of hardwood habitat available onsite and less than 0.5 percent of hardwoods (25,887 ha [63,966 ac]) in the vicinity of the site (NRSAL 2003).

The area around the VEGP site is rural and primarily forested and farmland. The habitats that would be disturbed at VEGP are common in the region, and are not considered to be critical for the survival of any species including those Federally protected. In addition, the percent of wetlands that would be disturbed represents only a small portion of the available wetlands in the vicinity of the site. Therefore, the staff concludes that the development of the VEGP site on the cumulative habitat loss and important species in the region associated with construction impacts would be negligible.

During the review of the Southern ESP application, no other past, present, or future actions in the region were identified that could significantly affect wildlife and wildlife habitat in ways similar to those associated with the proposed VEGP Units 3 and 4 site cooling tower operation (cooling tower noise, drift from cooling towers, and birds colliding with cooling towers). Southern estimates that a single plume from the proposed VEGP Units 3 and 4 cooling towers would have a maximum deposition rate of only 4.0 kg/ha/mo (3.6 lbs/ac/mo). Southern estimates that maximum deposition would occur approximately 490 m (1600 ft) from each tower. Thus, the deposition from the proposed VEGP Units 3 and 4 cooling towers would overlap because the towers are only 340 m (1100 ft) apart. The maximum estimated cumulative deposition rate is about 8 kg/ac/mo (7 lbs/ac/mo) at 490 m (1600 ft) from the proposed VEGP Units 3 and 4 towers (4.0 kg/ac [3.6 lbs/ac] per tower). At this distance, the maximum deposition would occur on the VEGP site. The existing pair of cooling towers for VEGP Units 1 and 2 are located approximately 1200 m (4000 ft) to the east-northeast of the proposed cooling towers (Southern 2007c). This separation distance is greater than the distance of the maximum deposition rate of 490 m (1600 ft) predicted for the proposed VEGP Units 3 and 4 cooling towers (Southern 2007c). Moreover, given the location and orientation of the proposed cooling towers with respect to the existing cooling towers, it is unlikely that plumes would interact appreciably for any extended period of time (Southern 2007a). General guidelines for predicting effects of drift deposition on plants suggest that many species have thresholds for visible leaf damage in the range of 10 to 20 kg/ha/mo (9 to 18 lbs/ac/mo) during the growing season (NRC 1996). Because of the separation distance, it is unlikely the maximum cumulative deposition for all units would reach a threshold that would cause visible leaf damage, and impacts would be negligible for the VEGP site. Furthermore, there are no other significant sources of cooling tower drift in the vicinity of the site.

The impacts associated with cooling tower operation were considered negligible for the VEGP site; the cumulative adverse impact of these types of activities in the region would also be considered minor. Consequently, the staff concludes that the contribution of VEGP site cooling tower operation to cumulative impacts on wildlife and wildlife habitat in the region would be minimal.

Transmission Line Right-of-Way

The extent and type of wildlife habitat within the proposed new transmission line right-of-way is not known at this time because Southern and the GPC are evaluating rights-of-way alternatives within a larger Representative Delineated Corridor (RDC). It is anticipated that the transmission line would cross Burke, Jefferson, McDuffie, and Warren Counties and would be 45 m (150 ft) wide and 97 km (60 mi) long (Southern 2007a). There are no U.S. Forest Service Wilderness Areas, Wild/Scenic Rivers or Wildlife Refuges, State or national parks within the RDC (GPC 2007). If possible, wetland areas would be avoided in the routing (GPC 2007).

A hypothetical transmission line right-of-way that represents what the GPC believes is a feasible route within the RDC was identified as part of a 2007 study (GPC 2007). Based on the GPC analysis, habitats within the right-of-way could include approximately 97 ha (240 ac) of forested habitat, 133.1 ha (329 ac) of planted pine, 2.6 ha (6.4 ac) of open water, and 63.9 ha (158 ac) of open land (Southern 2007d). Other land-use categories identified as potentially being impacted, such as quarry mine, pecan orchard, utility, transportation, and row crops, provide little value as wildlife habitat. In the region surrounding the proposed transmission line right-of-way, there are approximately 18,085 ha (44,688 ac) of forest, 1354 ha (3346 ac) of open water, and 17,262 ha (42,656 ac) of open land (GPC 2007). Assuming the actual routing was similar to the hypothetical route, the number of acres of forested habitat, open water, open land, and planted pine forest that would be affected represent a very small portion of the available habitat. If the actual route was similar to the hypothetical route, impacts on wildlife habitat in the region would be negligible. However, if the actual route differs from the hypothetical route, wildlife habitat impacts could either be greater or smaller.

There are no known occurrences of Federally listed threatened and endangered species within the RDC. However, suitable habitat for the red-cockaded woodpecker (*Picoides borealis)*, wood stork (*Mycteria americana*), flatwoods salamander (*Ambystoma cingulatum*), American alligator (*Alligator mississippiensis)*, Georgia aster (*Symphyotrichum georgianum*), and Canby's dropwort (*Oxypolis canbyi*) could exist within the RDC. The GPC would site the line in accordance with Georgia Code Title 22, Section 22-3-161. Part of the GPC procedures for implementing this regulation include consultation with FWS and GDNR and an evaluation of impacts to special habitats and threatened and endangered species. In addition, the GPC would comply with all applicable laws, regulations, and permit requirements, and would use good engineering and construction practices (Southern 2007a). Based on this review, cumulative impacts on important species and habitat loss in the region associated with construction would be negligible.

During the review of the Southern application, no other past, present, or future actions in the region were identified that could significantly affect wildlife and wildlife habitat in ways similar to those associated with transmission line operation and right-of-way maintenance (i.e., birds colliding with transmission lines, flora and fauna affected by electromagnetic fields and right-of-way maintenance, and floodplains and wetlands affected by right-of-way maintenance). Thus, because these impacts were considered negligible for the VEGP site transmission line operation and right-of-way maintenance, the cumulative adverse impacts of these types of activities in the region would also be minor. Consequently, the staff concludes that the contribution of the operation of transmission lines and the maintenance of transmission line rights-of-way to cumulative impacts on wildlife and wildlife habitat in the region would be minimal.

Summary

The cumulative terrestrial resource impacts may be detectable, but are expected to be minor and not destabilize the resource. Therefore, the staff concludes that cumulative impacts to terrestrial resources resulting from the operation of the proposed VEGP Units 3 and 4, including transmission line operation and maintenance, would be SMALL.

7.5 Aquatic Ecosystem

The staff evaluated construction and operation of the proposed Units 3 and 4 at the VEGP site to determine whether interactions with past, present, and future actions could contribute to adverse cumulative impacts to aquatic resources. For this analysis, the geographic area of interest is the Savannah River from upstream of the VEGP site to the mouth of the river.

Factors contributing to the impacts include the construction of the proposed VEGP Units 3 and 4, operation of the existing VEGP Units 1 and 2 (with or without the addition of the proposed VEGP Units 3 and 4), activities at the DOE Savannah River Site on the South Carolina side of the Savannah River, anthropogenic activities not directly related to VEGP or the Savannah River (e.g., increased urban development and recreational activity in or near the river), and natural environmental stressors (e.g., short- or long-term changes in precipitation or temperature and the resulting response of the aquatic community. The staff considered these potential sources of impacts in its evaluation of the cumulative aquatic ecology impacts presented in Southern's ER.

From an aquatic ecological perspective, the construction of VEGP Units 1 and 2 did not change the Savannah River observably or significantly. Likewise, activities related to construction of the intake and discharge structures and the barge slip to support the proposed VEGP Units 3 and 4 would have minimal and temporary impacts on the aquatic ecosystem that can largely be mitigated, as discussed in Section 4.4.2. No species of special interest or Federally or State-listed threatened and endangered species are expected to be affected by construction activities (including the shortnose sturgeon [*Acipenser brevirostrum*]). Therefore, the staff concludes that the overall contribution of construction to cumulative losses of aquatic organisms in the region would be minor, and no further mitigation is needed beyond that identified in Section 4.4.2.

For operations, the staff considered the potential cumulative impacts related to water use, impingement and entrainment of aquatic organisms, thermal, and chemical releases.

Water consumed for operation of the proposed VEGP Units 3 and 4 would be less than 1 percent of the total river discharge during normal water periods and up to 1.7 percent during periods of relative water scarcity (Drought Level 3). Including the consumptive use of VEGP Units 1, 2, 3, and 4, cumulative water use for the entire VEGP site, expressed as a percentage of Savannah River discharge, would range from 1.7 to 3.4 percent, as discussed in Section 7.3.2.1. Thus, the staff considered the cumulative impacts to the aquatic ecosystem from cumulative water consumption at the existing VEGP Units 1 and 2 to be minor.

The staff considered the potential cumulative impacts of impingement and entrainment of aquatic organisms. VEGP Units 1 and 2 are in compliance with Clean Water Act Section 316(b) (entrainment and impingement). In addition, a trip report from NRC staff (NRC 2007) including an investigation of the existing VEGP Units 1 and 2 intake, discussions with Southern staff, and examination of the traveling screens, wash system, and debris trough and basket, indicated that there was no evidence of any significant impingement of fish. As discussed in Section 5.4.2.2, the proposed closed-cycle cooling system (with cooling towers) for the proposed VEGP Units 3 and 4 would not be expected to result in measurable impingement or entrainment-related impacts. Monitoring of two locations above and below the VEGP site by the Academy of Natural Sciences of Philadelphia (ANSP) has not reported any evidence of impacts from the existing VEGP Units 1 and 2 (ANSP 2003). Thus, the staff considers the cumulative impacts on impingement and entrainment to be minor and to not negatively impact aquatic organisms, including species of special interest or Federally or State-listed threatened and endangered species.

The staff also considered the potential cumulative impacts related to thermal discharges from the existing VEGP Units 1 and 2. The assessments performed by the staff and described in Section 5.3 explicitly considered the combined impacts of concurrent operation of the existing VEGP Units 1 and 2 and the proposed VEGP Units 3 and 4. The maximum size, computed by the staff, of the area that would result in a 2.8°C (5°F) temperature increase above ambient mixing zone was approximately 29.6 m (97 ft) long (downstream) and 4.6 m (15 ft) wide. The size of the plume is small in comparison to the width of the Savannah River near the VEGP site. The effluent discharge from VEGP Units 1 and 2 at the proposed location for the VEGP Unit 3 and 4 discharge (123 m [404 ft]) downstream of the discharge for VEGP Units 1 and 2, resulted in an average increase of less than 0.5°C (0.9°F) (Southern 2007a). Because this change in temperature is so small, the cumulative effects from operation of VEGP Units 1 and 2 would not negatively impact aquatic organisms and is not expected to affect species of special interest or Federally or State-listed threatened and endangered species.

The staff considered the potential cumulative impacts from chemical releases from the existing VEGP units. VEGP Units 1 and 2 are in compliance with the Clean Water Act Section 316(a) (thermal discharges) impacts from cooling water systems. Chemical releases from the existing units currently comply with the State of Georgia's National Pollutant Discharge Elimination System permit requirements and would continue to be monitored in the future. Thus, the cumulative effects from VEGP Units 1 and 2 would not negatively impact aquatic organisms and is not expected to affect species of special interest or Federally or State-listed threatened and endangered species, and are considered by the staff to be minor.

Current and past activities at the DOE Savannah River Site have been well monitored, and studies by the ANSP have not reported any evidence of a Savannah River Site impact on the fish assemblages in the Savannah River (ANSP 2005).

Anthropogenic stressors not directly associated with the VEGP site activities may contribute to the cumulative impacts to the river. These impacts include habitat loss and nonpoint pollution related to increased urbanization along the shores of the river and increased recreational use of the Savannah River. Although the potential for long-term development in this area exists, its interactions with plant operations is not expected to result in significant adverse impacts to the river downstream of the VEGP site.

The presence of natural environmental stressors (e.g., short- or long-term changes in precipitation or temperature) would contribute to the cumulative environmental impacts to the Savannah River. These impacts are not related to Southern's activities and are difficult to predict. At certain times of the year, the VEGP site operations, other anthropogenic stressors, and climatic events could combine to adversely impact the aquatic populations of the Savannah River. Adequate freshwater flows are necessary in the lower river to prevent saltwater from moving upstream and degrading fish and wildlife habitat. Adequate releases are also necessary to allow for assimilation of National Pollutant Discharge Elimination System-permitted wastewater that enters the river in the Augusta area. These issues were identified in a report entitled *Savannah River Basin Comprehensive Reconnaissance Study* issued by the U.S. Army Corps of Engineers in July 1999 (USACE 1999) and are being addressed by both the States of Georgia and South Carolina (Southern 2007a). As a result of the awareness of the issues related to the need for adequate flow in the river, the small amount of consumptive loss from all the units at the VEGP site, the negligible direct affects that construction and operation of the facility would have on aquatic organisms, and the high level of regulation of the Savannah River by upstream dams, the staff concludes that cumulative impacts related to the proposed VEGP Units 3 and 4 would be SMALL.

7.6 Socioeconomics, Historic and Cultural Resources, Environmental Justice

Much of the analyses of socioeconomic impacts presented in Sections 4.5 and 5.5 already incorporate cumulative impact analysis because the metrics used for analysis only make sense when placed in the total or cumulative context. For example, the impact of the total number of additional housing units that may be needed can only be evaluated with respect to the total number that would be available in the affected area. Therefore, the geographical area of the cumulative analysis varies depending on the particular impacts considered, and may depend on specific boundaries, such as taxation jurisdictions, or may be distance-related, as in the case of environmental justice.

There are potential cumulative impacts on road congestion on the River Road connector to VEGP. The potential cumulative increase in the number of vehicles during a combined outage, construction, and permanent workforce egress and ingress into the site are likely, but temporary, and can be mitigated with proper planning, incentives to car pool, and minor road improvements, such as turn lanes, which are already planned.

The construction and operation of one or more additional units at the VEGP site would not be likely to add to any cumulative socioeconomic impacts beyond those already evaluated in Sections 4.5 and 5.5. In other words, the impacts of issues such as transportation or taxes are not likely to be detectable beyond the regions previously evaluated and would quickly decrease with increasing distance from the site. The staff concludes that construction impacts would generally be SMALL, but there are exceptions if more workers than expected settle in Burke and Screven Counties, in which case a MODERATE impact level may be reached for the impacts on roads, housing, and some public services. In terms of beneficial effects, including tax revenues benefits, the impacts on Burke County would be LARGE under current Georgia law.

As part of the analysis of the cumulative socioeconomic impacts, NRC staff considered the potentially simultaneous construction of the nearby Savannah River Site MOX facility in Barnwell County, South Carolina, which may have socioeconomic impacts in both Richmond and Columbia Counties in Georgia. County planners from both Richmond and Columbia Counties expect negligible impacts on socioeconomic infrastructure and housing in the region as a result of the VEGP proposed activities, even at the height of construction.[a] NRC's staff, therefore, expects cumulative impacts including Savannah River Site MOX facility construction impacts on the 80-km (50 mi) region around VEGP to be SMALL.

The construction and operation of one or more additional units at the VEGP site would likely add significantly to cumulative cultural resource impacts. Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Because impacts to important resources from construction of the proposed VEGP Units 3 and 4 are moderate, the cumulative environmental impacts related to cultural resources would be MODERATE.

The staff found no unusual resource dependencies or practices or environmental pathways through which minority and low-income populations would be disproportionately affected. As a result, the cumulative environmental impacts related to environmental justice would be SMALL. However, if significant demands are placed on Burke County services as a result of more workers than expected settling in the county (without a corresponding increase in tax revenues), the socioeconomic impacts of reduced services or higher taxes would fall disproportionately on the residents of the county.

7.7 Nonradiological Health

In Section 5.8.1, the health impacts of operating the existing and two new units at the VEGP site were evaluated regarding the ambient temperature of the Savannah River and the potential formation of thermophilic microorganisms. The evaluation showed that the addition of two new units is not likely to increase populations of thermophilic microorganisms. Health risks to workers can be expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts to the public and workers from noise, dust emissions, acute electromagnetic fields, and transportation also were evaluated and found to be small. The staff concludes that the cumulative impacts resulting from construction and operation of the existing VEGP Units 1 and 2 and the proposed new VEGP Units 3 and 4 on nonradiological health would be SMALL, and that mitigation is not warranted. The staff has not come to a conclusion on the chronic impacts of electromagnetic fields.

7.8 Radiological Impacts of Normal Operation

The radiological exposure limits and standards for the protection of the public and for occupational exposures have been developed assuming long-term exposures and, therefore, incorporate cumulative impacts. As described in Section 5.9, the public and occupational doses

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(a) Information provided by Jeff Browning, Columbia County Planner, in e-mail correspondence, dated November 7, 2006, and in interviews with Richmond County Planners (PNNL 2006).

predicted from the proposed operation of two new units at the VEGP site are well below regulatory limits and standards. Specifically, the site boundary dose to the maximally exposed individual (MEI) from the VEGP site would be well within the regulatory standard of 40 CFR Part 190. For purposes of this cumulative impact analysis, the area within an 80-km (50-mi) radius of the VEGP site is considered, which includes the existing operating VEGP Units 1 and 2 and DOE's Savannah River Site in South Carolina.

As stated in Section 2.5, Southern has conducted a radiological environmental monitoring program around the VEGP site since 1987. The radiological environmental monitoring program measures radiation and radioactive materials from all sources, including the existing units at the VEGP site. The NRC, the DOE, and the States of Georgia and South Carolina would regulate or control any reasonably foreseeable future actions in the region that could contribute to cumulative radiological impacts. The Savannah River Site has monitored radionuclides for many years and has completed annual tritium monitoring since 1960. The annual release of tritium from the Savannah River Site has decreased from about 140,000 Ci in the mid 1960s to the present level below 5000 Ci. The Savannah River Site (2006) reports mean tritium concentrations in the Savannah River (based on weekly sampling results) of 79.4 pCi/L upstream of the VEGP site (River Mile 160.0), 984 pCi/L at the VEGP site outfall (River Mile 150.4), and 546 pCi/L downstream of the VEGP site (River Mile 118.8). These results, which include all sources of tritium (i.e., the VEGP site, Savannah River Site, and any other sources), remain far below the EPA drinking water standard of 20,000 pCi/L.

Southern (2007a) calculated the combined total body dose for the existing VEGP Units 1 and 2 and the proposed VEGP Units 3 and 4 to be 2.36 mrem/yr, and the corresponding population dose to be 2.05 person-rem/yr for a population of 674,101. The Savannah River Site (2006) reports the dose to the MEI from Savannah River Site releases to be 0.13 mrem/yr, with approximately 60 percent contribution from H-3, 20 percent from Cs-137, and 4 percent from I-129. The Savannah River Site (2006) reports the population dose to be about 5.0 person-rem/yr for a population of 713,500. Nine additional activities at the Savannah River Site, with the most significant contributor to dose being salt processing, have a combined MEI dose of 0.41 mrem/yr and a population dose of 21.6 person-rem/yr (NRC 2005).

Additional nuclear facilities within 80 km (50 mi) of the VEGP site include Chem-Nuclear Inc, a commercial low-level waste burial site approximately 30 km (19 mi) east northeast of the VEGP site; Starmet CMI, Inc., a facility that used to process uranium-contaminated metals located approximately 29 km (18 mi) east of the VEGP site; and hospitals located in the area. The operations of Chem-Nuclear, Inc. and Starmet CMI, Inc. are reported not to noticeably affect radiation levels in air or water pathways near the Savannah River Site and would be expected to have an even lower effect near the VEGP site, which is more distant from these facilities.

A reasonably foreseeable future action near the VEGP site is the potential construction and operation of facilities related to the proposed MOX fabrication facility at the Savannah River

Site. These MOX fabrication facilities are composed of the Pit Disassembly and Conversion Facility, the Fuel Fabrication Facility, and the Waste Solidification Facility. The dose to the MEI is reported to be 0.004 mrem/yr, and the corresponding population dose is reported to be 1.6 person-rem/yr (NRC 2005).

The MEIs for these facilities likely are composed of different individuals, locations, and periods of time. Simple addition of MEI doses does not yield a technically accurate result; however, it is done here to be conservative (i.e., to ensure an overestimate of the impact). Combining these results yields an estimate of cumulative impacts of about 2.9 mrem/yr for the MEI and about 30 person-rem/yr for the population dose.

Therefore, the staff concludes that the cumulative radiological impacts of operating two new units, along with the existing units at VEGP and the influence of the Savannah River Site, would be SMALL and that additional mitigation is not warranted.

7.9 Severe Accidents

The environmental impacts of potential severe accidents for a single Westinghouse AP1000 reactor at the VEGP site are discussed in Section 5.10.2 and 5.10.3. Southern has requested an ESP for two Westinghouse AP1000 reactors. Assuming that the risks for two reactor are independent, the risks associated with two Westinghouse AP1000 reactors at the VEGP site are twice the risks for a single reactor.

The risks associated with two Westinghouse AP1000 reactors in addition to the two existing reactors is the sum of the risks for the four individual reactors. Southern (2007b) states that the population dose risk for VEGP Unit 1 or VEGP Unit 2 is about 1.9×10^{-2} person-Sv/Ryr; the population dose risk for the two existing reactors is about 3.7×10^{-2} person-Sv/Ryr. The population dose risk for a single Westinghouse AP1000 reactor is about 2.8×10^{-4} person-Sv/Ryr. Thus, the combined risk for the existing two units plus two Westinghouse AP1000 reactors is about 3.8×10^{-2} person-Sv/Ryr. This is not a significant increase in risk. Similar conclusions are obtained when other risks, such as cost risk, early fatalities, and decontamination areas, are evaluated. As a result, the staff concludes that the cumulative severe accident impacts associated with adding two Westinghouse AP1000 reactors to the VEGP site are SMALL.

7.10 Fuel Cycle, Transportation, and Decommissioning

The addition of the proposed new units on the VEGP site would result in the need for additional nuclear fuel. The impacts of producing this fuel include mining of the uranium ore, milling of the ore, conversion of the uranium oxide to uranium hexafluoride, enrichment of the uranium hexafluoride, fuel fabrication where the uranium hexafluoride is converted into uranium oxide fuel pellets, and disposition of the spent fuel in a proposed Federal waste repository. As discussed in Section 6.1 of this EIS, the environmental impacts of fuel cycle activities for the proposed units would be about three times those presented in Table S–3 of 10 CFR 51.51. Table S–3 provides the environmental impacts from uranium fuel cycle operations for a model 1000-MW(e) light-water reactor operating at 80-percent capacity with a 12-month fuel-loading cycle and an average fuel burnup of 33,000 MWd/MTU. Per 10 CFR 51.51(a), the staff considers the impacts in Table S–3 to be acceptable for the 1000-MW(e) reference reactor. As discussed in Section 6.1.1 of this EIS, advances in reactors since the development of Table S–3 impacts would have the effect of reducing environmental impacts of the operating reference reactor. For example, a number of fuel management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. Fuel cycle impacts would occur not only at the VEGP site but would also be scattered through other locations in the United States, or in the case of foreign-purchased uranium, in other countries. The staff considers the cumulative fuel cycle impacts of operating the VEGP site to be SMALL.

The addition of the proposed new VEGP Units 3 and 4 would result in additional shipments of unirradiated fuel to the site and additional shipments of spent fuel and waste from the site. Cumulative impacts would be approximately twice that of the existing operating plant. Environmental impacts from transportation of unirradiated fuel, spent fuel, and waste are found in Section 6.2 of this EIS based on the Westinghouse AP1000 reactor design. The following conclusions were derived from the staff's analysis of unirradiated fuel shipments: (1) the number of unirradiated fuel shipments equates to less than one truck shipment per day within criteria specified in Table S–4 of 10 CFR 51.52, (2) annual dose to workers and the public would be less than dose specified in Table S–4, and (3) health impacts are projected to be small (i.e., less than 1×10^{-4} detriment/yr). The following conclusions were derived from the staff's analysis of spent fuel: (1) after accounting for conservative assumptions in the staff's evaluation, doses to the worker and the public would be within criteria specified in Table S–4, and (2) health impacts from normal conditions and accident conditions would be small (i.e., less than 0.1 detriment/yr). Regarding transportation of waste shipments, the staff concluded that the normalized number of waste shipments would be within the value specified in Table S–4 for the 1100-MW(e) reference reactor. Cumulative impacts of transportation for operating the VEGP site would be SMALL.

As discussed in Section 6.3 of this EIS, environmental impacts from decommissioning are expected to be small because the licensee would have to comply with decommissioning regulatory requirements. In Supplement 1 to NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, the NRC found the impacts on radiation dose to workers and the public, waste management, water quality, air quality, ecological resources, and socioeconomics to be small (NRC 2002). Therefore, the cumulative impacts for the VEGP site would be SMALL.

7.11 Staff Conclusions and Recommendations

The staff considered the potential impacts resulting from construction and operation of two additional nuclear units together with the past, present, and future actions in the VEGP site area. For the duration of the proposed action (i.e., the construction period plus 40 years of operation), the evaluation took into account the potential impacts from factors known or likely to affect the environment. This included considering conditions at the site and surrounding vicinity from past, present, and future human activities.

For each impact area, the staff concludes the potential cumulative impacts resulting from construction and operation are generally SMALL, and additional mitigation is not warranted.

7.12 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

40 CFR Part 81, Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81 "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

40 CFR Part 1508. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

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8.0 Need For Power

The U.S. Nuclear Regulatory Commission (NRC) regulation implemented in Title 10 of the Code of Federal Regulations (CFR) Part 52.17(a)(2) states that an early site permit (ESP) application "...need not include an assessment of the benefits for example need for power of the proposed." Potential applicants for an ESP are allowed to defer the analysis until they submit an application for a construction permit (CP) or a combined license (COL). However, an applicant may address the Need for Power in its ESP application. Southern Nuclear Operating Company, Inc. (Southern) intends to apply for a COL for the Vogtle Electric Generating Plant (VEGP) Units 3 and 4 in 2008 (Southern 2006), and has, therefore, included a discussion of Need for Power in its ESP application.

The NRC's *Environmental Standard Review Plan of Nuclear Plants* (NUREG-1555) Section 8.0 through Section 8.4, guides the staff's review of the Need for Power analysis (NRC 2000). The guidance in NUREG-1555 is limited because of changes in the regulatory structure that were occurring as this guidance was being revised. Deregulation in the electricity markets has a significant impact on the analysis of the Need for Power. Applicants may be power generators rather than traditional utilities; therefore, analysis of the Need for Power must be sufficiently flexible to accommodate the applicant type. Because of deregulation in bulk sales markets for electricity, the advent of independent power producers, and the increased use of purchases and exchanges of electricity among utilities to meet demand, the demand for electricity by ultimate consumers and customers within a utility's service area is increasingly not being met by the utility's own generating resources. Trading of electricity is further facilitated by the Federal Energy Regulatory Commission's final rule 61 FR 21540-21736, requiring all public utilities that own, control, or operate facilities used for transmitting electricity in interstate commerce to file open access nondiscriminatory transmission tariffs that contain minimum terms and conditions on nondiscriminatory service.

The term "relevant service area" is used here to indicate any region to be served by the proposed facility, whether or not it corresponds to a traditional utility service area. "Relevant service area" is a situation-specific concept and must be defined on a case-by-case basis.

Affected states or regions may prepare a Need for Power evaluation and assessment of the regional power system for planning or regulatory purposes. A Need for Power analysis may also be prepared by a regulated utility and submitted to a regulatory authority, such as a State public utility commission. The NRC staff would review the evaluation and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty (NRC 2000). If the Need for Power evaluation is found to be acceptable, no additional independent review by the NRC is needed. However, the data may be supplemented by information from other sources such as the Energy Information Agency, Federal Energy Regulatory Commission, and the North American Electric Reliability Council.

8.1 Description of Power System

Southern has been authorized to submit the ESP application by the Georgia Power Company (GPC), acting as agent for the following co-owners of the existing VEGP Units 1 and 2: the GPC, 45.7 percent; the Oglethorpe Power Corporation (OPC), 30.0 percent; the Municipal Electric Authority of Georgia (MEAG), 22.7 percent; and the city of Dalton, an incorporated municipality in the State of Georgia acting by and through its Board of Water, Light, and Sinking Fund Commissioners (Dalton Utilities), 1.6 percent. The existing co-owners of VEGP Units 1 and 2 support the development of VEGP Units 3 and 4, and anticipate the same ownership interest percentages in VEGP Units 3 and 4 as exist in VEGP Units 1 and 2. The GPC and Southern are subsidiaries of Southern Company, which owns and operates the electricity generating facilities shown in Figure 8-1.

Southern is engaged in the operation of nuclear power plants. Besides operating VEGP Units 1 and 2, it operates the Edwin I. Hatch Nuclear Plant, Units 1 and 2 (Plant Hatch) for GPC; and the Joseph M. Farley Nuclear Plant Units 1 and 2 (Plant Farley) for Alabama Power Company. The combined electric generation of all six units is approximately 5700 MW(e) (DOE/EIA 2007a). Should a nuclear facility be constructed at the proposed VEGP site, Southern is expected to be the exclusive licensed operator of VEGP Units 3 and 4.

The GPC is engaged in the generation and transmission of electricity and the distribution and sale of such electricity within the State of Georgia. The GPC serves more than two million customers in a service area of approximately 148,000 km^2 (57,000 mi^2). With a rated electricity generation capability of approximately 14,000 MW(e), the GPC currently provides retail electric service in all but six of Georgia's 159 counties.

The OPC, an Electric Membership Corporation (EMC), supplies electricity at wholesale prices to 38 EMCs in the State of Georgia, which in turn distribute this electricity at retail to their residential, commercial, and industrial customers. The EMCs serve approximately 1.5 million metered electric customers, representing approximately 3.7 million people of the 9 million total residents in the State of Georgia. The EMCs serve customers in 150 of the 159 counties in Georgia.

The MEAG is an electric generation and transmission public corporation, which provides wholesale power to 49 communities in the State of Georgia and other wholesale customers outside the State of Georgia. These communities, in turn, supply electricity to more than 675,000 retail customers, representing approximately 10 percent of Georgia's population, in their respective service areas across the State.

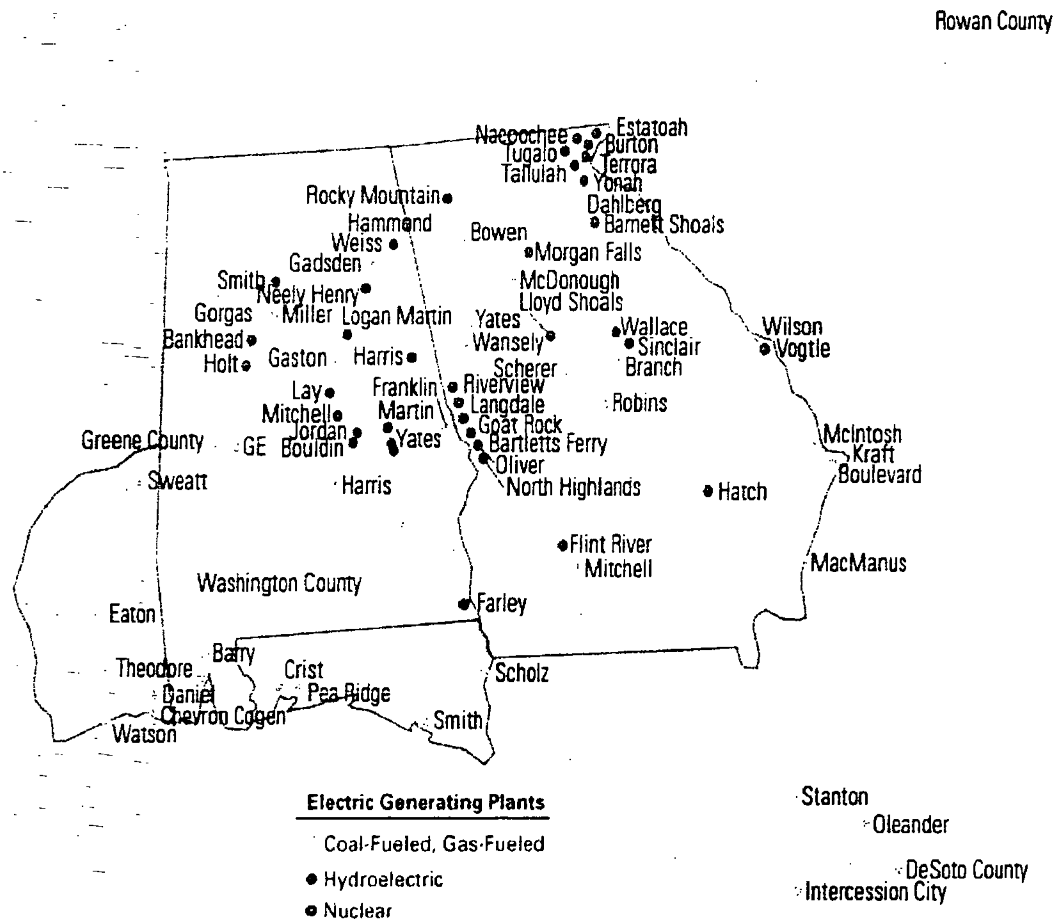

Figure 8-1. Electricity Generating Facilities Owned and Operated by Southern Company (Southern Company 2007)

The city of Dalton is a municipality within the State of Georgia. Acting by and through its Board of Water, Light, and Sinking Fund Commissioners, doing business as Dalton Utilities, the city of Dalton owns electric generation capacity, transmission capacity, and a distribution system. The city of Dalton is a duly incorporated municipality under the laws of the State of Georgia.

Savannah Electric and Power merged with GPC on July 1, 2006, adding an additional 320,000 residents in a 5180 km^2 (2000 mi^2) region along the Georgia Atlantic coast. Collectively, the potential co-owners have a service area that encompasses the entire State of Georgia, except for the northwest corner, and supply electricity to approximately 6.2 million people, who represent approximately 76 percent of Georgia's (year 2000) population. However, Savannah Electric and Power customers are not included in the 6.2 million figure.

8.2 Power Demand/Integrated Resource Planning

Need for Power is an intricate part of all integrated resource planning, and is a derivative of load demand forecasting.

Integrated resource planning can be thought of as a process of planning to meet users' needs for electricity services in a way that satisfies multiple objectives with limited resources. Broad objectives can include, but are not limited to:

- conforming to national, regional, State, and local development objectives
- ensuring that all households and businesses have access to electricity services
- maintaining reliability of supply
- minimizing the short-term or long-term economic costs of delivering electricity services
- minimizing the environmental impacts of electricity supply and use
- enhancing energy security by minimizing the use of external resources
- providing economic benefits.

Integrated resource planning is built on principles of comprehensive analysis. Traditional methods of electric resource planning focused on "supply-side" projections only for such things as construction of generation, transmission, and distribution facilities. Integrated resource planning considers a full range of feasible supply-side and demand-side options, and assesses them against a common set of planning objectives.

Integrated resource planning provides an opportunity for electric planners to address complex issues in a structured, inclusive, and transparent manner. At the same time, it provides a chance for interested parties both inside and outside the planning region to review, understand, and provide additional input.

The steps in the integrated resource planning process generally are to:

- establish objectives
- survey historical energy use patterns and develop load demand forecasts
- investigate electricity supply options
- investigate demand-side management measures
- prepare and evaluate supply plans
- prepare and evaluate demand-side management plans
- integrate supply-side and demand-side plans into candidate integrated resource plans
- select the preferred plan.

8.3 Power Supply/Integrated Resource Planning in the State of Georgia

The mission of the Georgia Public Service Commission (GPSC) is to ensure that consumers receive safe, reliable, and reasonably priced electric services from financially viable and technically competent companies subject to its jurisdiction. For companies subject to its jurisdiction, the GPSC has the authority to set rates and require long range plans and projections.

The GPSC regulates the GPC. Under the Georgia Integrated Resource Plan Act, at least every 3 years the GPC must submit to the GPSC an integrated resource plan (IRP) that:

- includes GPC's electric demand and energy forecast for at least a 20-year period
- includes GPC's program for meeting the requirements shown in its forecast in an economical and reliable manner
- includes GPC's analysis of all capacity resource options, including demand-side and supply-side options
- sets forth GPC's assumptions and conclusions with respect to the effect of each capacity option.

Provisions in the Georgia Integrated Resource Plan Act require the GPSC to hold a public hearing on the IRP and establish criteria for the GPSC to use in determining whether to approve and adopt a plan. A related provision in the Georgia Integrated Resource Plan Act prohibits a utility from constructing an electric plant, or increasing the capacity of an existing plant, without first obtaining a certificate of public convenience and necessity from the GPSC. A certificate application must include the current IRP and a benefit-cost analysis for the proposed additional capacity.

The Consumer's Utility Counsel Division of the Governor's Office of Consumer Affairs represents State residents and small commercial customers in utility proceedings, including IRP reviews, before the GPSC (Official Code of Georgia [OCGA], Section 46-10). This provides a viewpoint that might not otherwise be present in the review process for IRPs.

The GPSC has established detailed regulatory requirements for IRPs in Chapter 515-3-4 of the Rules and Regulations of the State of Georgia. The requirements include the following:

- <u>Energy and Demand Forecasting</u>. An IRP must report and use 3 years of historic data and address each of the next 20 years (forecast). Forecasting must be weather-normalized and address the jurisdictional area, retail and wholesale loads, customer classes, and annual load factors. The GPSC regulations specify forecasting methodologies and standards for data inputs. Finally, an IRP must include an evaluation of the sensitivity of the results to changes in major assumptions and estimates used. The sensitivities must include a reasonable range of sales and demand and include base-growth, high-growth, and low-growth scenarios.

- Capacity Resource Identification. The IRP must identify existing resources, including power purchases, sales and exchanges, demand-side programs, cogeneration, standby generation, spinning reserves, interruptible service, pooling or coordination agreements, generation, and transmission. The IRP must address potential new supply-side and demand-side resources and the associated decision-making process (the GPSC IRP regulations detail the process for securing long-term new supply-side options.)

- Integrated Plan Development and Filing. In addition to energy and demand forecasting and capacity resource identification, the IRP must address alternatives to proposed generation; environmental impact of proposed and alternative generation; economic, environmental, and other benefits to the State of Georgia and consumers; and financial information. The IRP must identify the integrated combination of demand-side and supply-side resources selected to satisfy future electric demands. Periodically after IRP approval, the GPC must report on actions taken to implement the IRP and any deviations from the plan. A new IRP must be filed with the GPSC every 3 years.

The GPSC staff retains experts to assist in reviewing the IRP, developing data requests and reviewing responses, providing reports to and testimony before the GPSC, and responding to GPSC requests. The GPSC can approve the IRP, approve it subject to stated conditions or modifications, approve it in part and reject in part, reject the IRP in its entirety, or provide an alternative plan.

In addition to IRP requirements, the GPSC has detailed requirements for obtaining GPSC approval and certification, of new supply-side resources. An application for GPSC certification for constructing or purchasing capacity, (purchase agreement), must include a discussion of how the proposed application is consistent with the current IRP, a benefit-cost analysis, and detailed information about the proposal and alternatives. Once the GPSC certifies a power purchase agreement, that capacity is added to the IRP's base case for meeting forecast loads.

As part of the 2007 IRP filing with the GPSC (Docket No. 17687-U), the GPC has provided information showing the details of the load and energy forecasts. Portions of this information is proprietary to the GPC.

The proprietary information provided in the IRP constitutes detailed forecasted information regarding GPC's future energy and demand growth. This information could be used to determine GPC's short-term capacity needs. If revealed to the public, a generation wholesaler or power marketer could use the information to tailor proposals with the intention of pricing products that could undermine GPC's market position. Such disclosure could unfairly allow competitors to manipulate the wholesale market and ultimately harm retail customers through higher prices and less reliability. Lastly, GPC's competitors are not required to file their respective forecast information.

Furthermore, the information is subject to substantial procedures to maintain its secrecy. Only select GPC affiliated personnel are granted access to the information on a "need-to-know" basis. Generally, parties outside the GPC who would be granted access to the IRP information would be required to sign confidentiality agreements.

For the reasons cited above, the GPSC granted the GPC proprietary status on parts of its IRP filings. GPC has not included the full IRP into the NRC Docket in support of its Need for Power analysis, but has supplied a summary of its IRP highlights, procedures, and conclusions, in Revision 2 of the VEGP application (Southern 2007). To facilitate the Need for Power review, access to the full 2007 IRP, including proprietary information, was granted to the NRC staff in March 2007. This access to NRC staff occurred at Southern Company's Headquarters in Atlanta, Georgia.

8.4 Assessment of Need for Power/NRC Findings on GPC's IRP

8.4.1 Evaluation of GPC's IRP

The staff considered the GPSC evaluation of GPC's IRP and other energy forecasts to develop a conclusion about the Need for Power. In July 2007, the GPSC issued its final order approving the 2007 GPC IRP (GPSC 2007). The order is an explanation of the proceedings and conclusions. The GPSC approved a 13.5 percent reserve margin for planning within 3 years, and a 15 percent reserve margin for longer forecasts and approved planning that identifies the need for new (generating) resources beginning in 2010. The GPSC determined that it is reasonable for GPC to investigate the opportunity to build nuclear resources. The 2007 GPC IRP includes nuclear generation and shows nuclear additions using the Westinghouse AP1000 nuclear technology as a base case option, with commercial generation expected to start in year 2015/2016.

8.4.2 Other Forecasts for Energy

The NRC compared GPC's IRP demand for electricity forecast in its territory, to the U.S. Department of Energy, Energy Information Administration's (DOE-EIA) Annual Energy Outlook 2007 (DOE/EIA 2007b), which looks at the United States as a whole. The Annual Energy Outlook forecasts total electricity sales to increase by 41.0 percent, from 3660 billion kilowatt-hours in 2005 to 5168 billion kilowatt-hours in 2030. By end-user sector, electricity demand is projected to grow by 39 percent from 2005 to 2030 in the residential sector, 63 percent in the commercial sector, and by 17.0 percent in the industrial sector. This translates into an average annual increase of 1.3 percent in the residential sector, 2.0 percent increase in the commercial sector, and 0.6 percent increase in the industrial sector.

Increases in the demand for electricity is related to population increases, as well as an increase of personal consumption. According to the U.S. Census Bureau, the population in the State of Georgia is expected to increase 46.8 percent from 8.2 million in 2000, to 12.0 million in 2030 (USCB 2007). The surrounding States of Florida and South Carolina anticipate increases in populations of 79.5 percent and 28.3 percent, respectively. These forecast increases are during a time when the population of the whole United States is expected to grow 29.2 percent from 281.4 million in 2000 to 363.6 million in 2030.

In addition, the staff estimates that gross average annual personal consumption for electricity in the State of Georgia may increase 0.30 percent from 13,000 kilowatt-hours per year in 2005 to 14,000 kilowatt-hours per year in 2030, the same gross average annual personal consumption as forecast in the United States as a whole.

GPC assumes a demand for electricity in Georgia alone to grow by an average annual rate of 1.8 percent through 2030. Given the relative changes expected in demography, the demand for electricity growth rate in the State of Georgia is compatible to the national average annual rate of 1.4 percent, as stated in the *Annual Energy Outlook* (DOE/EIA 2007b).

On July 20, 2006, the North American Electric Reliability Corporation was certified as the Electric Reliability Organization in the United States, pursuant to Section 215 of the Federal Power Act. Included in this certification was a provision for the Electric Reliability Organization to delegate authority for the purpose of proposing and enforcing reliability standards in particular regions of the country by entering into delegation agreements with regional entities.

The South Eastern Reliability Council (SERC) serves as a regional entity with delegated authority from the North American Electric Reliability Corporation for the purpose of proposing and enforcing reliability standards within the SERC Region. The State of Georgia is in the SERC territory of responsibility, and the GPC, OPC, and MEAG are SERC members.

The SERC is a nonprofit corporation responsible for promoting and improving the reliability, adequacy, and critical infrastructure of the bulk power supply systems in all or portions of 16 central and southeastern States (Figure 8-2). Owners, operators, and users of the bulk power system in these States cover an area of approximately 560,000 square miles and comprise what is known as the SERC Region.

The NRC also examined the electric energy forecast developed by SERC. Among SERC's 2007 conclusions (SERC 2007):

- There has been significant merchant generation built since 1998, but much of it has not been contracted to serve loads within the SERC region.

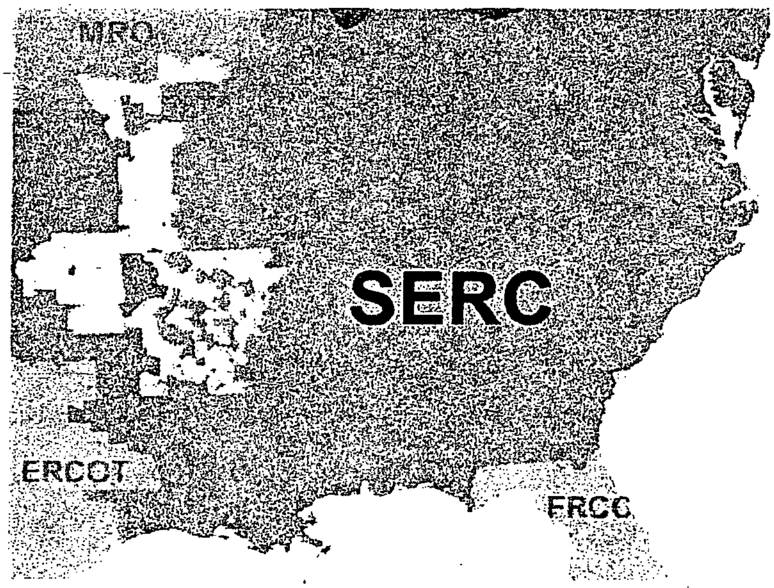

Figure 8-2. SERC Service Territory (SERC 2006)

- More recent surveys have shown downward trends in merchant generation development.
- Projected peak demand is forecast to increase at 2.08 percent annually through 2016.
- Electric demand is forecast to increase 1.7 percent annually through 2016.
- SERC is projecting firm capacity margins of about 13 to 15 percent through 2016, which is a requirement imposed on its members to maintain system reliability.

8.4.3 NRC Conclusions

The NRC staff finds that the GPC has submitted an IRP to the GPSC that contains a detailed review of the Need for Power in the State of Georgia and parts of the surrounding area. The NRC staff reviewed the IRP, and the Need for Power contained within, and determined it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. The NRC staff reviewed and accepts the Need for Power evaluation contained in the IRP submitted to the GPSC.

The NRC staff has considered the past, present, and planned power-producing capability and the predicted load demands from GPC's IRP, the *Annual Energy Outlook* (DOE/EIA 2007b), the U.S. Census Bureau, and the SERC. The NRC staff has concluded that the GPC's detailed prediction of its (proprietary) future load demand is a reasonable basis for planning for 2007 to

2030 and that the GPC cannot expect to satisfy a significant portion of that demand load by additional electric purchases from neighboring producers.

Based on this analysis, the staff concludes that there is a justified Need for Power in the region of interest.

8.5 References

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9.0 Environmental Impacts of Alternatives

This chapter describes alternatives to the proposed action and discusses the environmental impacts of those alternatives. Section 9.1 discusses the no-action alternative. Section 9.2 addresses alternative energy sources. Section 9.3 examines plant design alternatives. Section 9.4 reviews Southern Nuclear Operating Company, Inc.'s (Southern's) region of interest (ROI) and examines its suitability and the suitability of Southern's alternative site-selection process. Section 9.5 summarizes the environmental impacts for the alternative sites. Section 9.6 examines issues that are common to all of the alternative sites and addresses them collectively for all the alternative sites. Section 9.7 summarizes the impacts at the alternative sites. The comparison of the alternative sites with the Vogtle Electric Generating Plant (VEGP) site is made in Chapter 10.

The environmental impacts of the alternatives are evaluated using the U.S. Nuclear Regulatory Commission (NRC's)'s three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality guidelines (CEQ 1997) and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B. The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999)[a] with the additional impact category of environmental justice. While NUREG-1437 was developed for license renewal, it provides useful information for this review and is referenced throughout this chapter.

The evaluation of alternative sites is a two-step process, as set forth in NUREG-1555, Section 9.3 (NRC 2000), and stems from the NRC decision related to licensing the Seabrook Nuclear Power Plant (5 NRC 503, 516). The first step looks at a full suite of environmental issues, using reconnaissance-level information to determine if any of the alternative sites are environmentally preferable to the proposed VEGP site. If an alternative site appears environmentally preferable to the proposed site, the analysis proceeds to the second step. If not, then the evaluation of alternative sites ends at the first step. The second step considers economic, technological, and institutional factors among the environmentally preferred sites to determine if any are obviously superior to the proposed site. If there is no obviously superior site, then the proposed site prevails. A staff conclusion that an alternative site is obviously superior to the early site permit (ESP) site proposed by Southern would normally lead to a recommendation that the ESP application be denied.

(a) NUREG-1437 was originally issued in 1996. Addendum 1 to NUREG-1437 was issued in 1999. Hereafter, all references to the "GEIS" include NUREG-1437 and its Addendum 1.

9.1 No-Action Alternative

For purposes of an ESP application, the no-action alternative refers to a scenario in which the NRC would deny the ESP request. Upon such a denial, the construction and operation of one or more new nuclear units at the proposed location on the VEGP site in accordance with 10 CRF Part 52 process referencing an approved ESP would not occur.

The no-action alternative generally consists of two parts. First, under the no-action alternative the NRC would not issue the ESP. There are no environmental impacts associated with not issuing the ESP, except that the impacts associated with site preparation and preliminary construction activities that could be allowed pursuant to 10 CFR 52.17© and 10 CFR 52.25(a) would be avoided.

Second, given that this environmental impact statement (EIS) addresses the environmental effects of construction and operation of new nuclear generating units as directed by the Commission in 10 CFR 52.18 (a)(2), the no-action alternative would result in no such construction and operation. Therefore, the impacts predicted in this EIS would not occur.

In this context, the no-action alternative would accomplish none of the benefits intended by the ESP process, which would include

- early resolution of siting issues before large investments of financial capital and human resources in new plant design and construction are made
- early resolution of issues on the environmental impacts of construction and operation of new nuclear generating units
- the ability to bank sites on which nuclear plants may be located
- the facilitation of future decisions on whether to construct new nuclear power generation facilities.

9.2 Energy Alternatives

The objective of Southern in seeking an ESP for the VEGP site is to secure a site for new baseload electric power generation (Southern 2007a). This section examines the potential environmental impacts associated with alternatives to construction of a new baseload nuclear generating facility. Section 9.2.1 discusses energy alternatives not requiring new generating capacity. Section 9.2.2 discusses energy alternatives requiring new generating capacity. Other alternatives are discussed in Section 9.2.3. A combination of alternatives is discussed in

Section 9.2.4. Section 9.2.5 compares the environmental impacts from new nuclear, coal-fired, and natural-gas-fired generating units at the VEGP site.

For analysis of energy alternatives, Southern assumed a bounding target value of 2234 megawatts electrical (MW[e]) electrical output (Southern 2007a). The staff also used this level of output in its analysis of energy alternatives.

9.2.1 Alternatives Not Requiring New Generating Capacity

Four alternatives to the proposed action that do not require Southern to construct new generating capacity are to

- Purchase the needed electric power from other suppliers.
- Reactivate retired power plants.
- Extend the operating life of existing power plants.
- Implement conservation or demand-side management programs.

The viability of these four alternatives depends on when Southern would seek a construction permit (CP) or combined license (COL) from the NRC (assuming an ESP is granted). For example, the status of existing and retired nuclear power plants varies over time. At the present time, no firm information is available on when Southern would seek to construct new nuclear units at the VEGP site if it receives an ESP. If Southern is granted an ESP, the duration of the permit would be for 10 to 20 years (10 CFR 52.27(a)). In addition, if Southern is granted an ESP, it would be able to apply for renewal of the permit under the procedures in 10 CFR 52.29 through 52.33.

If power to replace the capacity of the new nuclear units was to be purchased from sources within the United States or from a foreign country, the generating technology likely would be one of those described in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) for license renewal (e.g., coal, natural gas, or nuclear) (NRC 1996). The description of the environmental impacts of other technologies described in NUREG-1437 for license renewal is representative of the impacts associated with the construction and operation of new generating units at the VEGP site. Under the purchased power alternative, the environmental impacts of power production would still occur but would be located elsewhere within the region, nation, or in another country. The environmental impacts of coal-fired and natural-gas-fired plants are discussed in Section 9.2.2.

If the purchased power alternative is implemented, the only environmental unknown is whether new transmission line rights-of-way would be required. The construction of new lines could have both environmental and aesthetic consequences, particularly if new transmission line rights-of-way have to be acquired. The staff concludes that the local environmental impacts from purchased power would be SMALL when existing transmission line rights-of-way are used and could range from SMALL to LARGE if acquisition of new rights-of-way is required. The environmental impacts of power generation would depend on the generation technology and location of the generation site and, therefore, are unknown.

Nuclear power facilities are initially licensed by the NRC for a period of 40 years. The operating license can be renewed for up to 20 years, and NRC regulations permit additional license renewal. Southern currently operates three nuclear power plants. The Edwin I. Hatch Nuclear Plant (Plant Hatch) and the Joseph M. Farley Nuclear Plant (Plant Farley) have received renewed operating licenses from the NRC. Southern submitted an application to the NRC to renew the operating licenses for VEGP Units 1 and 2 on June 29, 2007 (Southern 2007e). The environmental impacts of continued operation of a nuclear power plant are significantly less than construction of a new plant. However, continued operation of an existing nuclear plant does not provide additional generating capacity.

Fossil-fueled plants slated for extensive refurbishment, predominately coal-fired and natural-gas-fired plants, tend to be old enough to have economic difficulty meeting the current and more restrictive environmental standards. As a result, Southern concluded that the environmental impacts of a refurbishment scenario are bounded by the coal-fired and natural-gas-fired alternatives (Southern 2007a).

Georgia Power Company (GPC), one of the co-owners of the proposed project, already offers several conservation and demand-side management programs to its customers to reduce peak electricity demands and daily power consumption. In its most recent Integrated Resource Plan filing to the Georgia Public Service Commission, GPC evaluated approximately 500 additional demand-side management measures, but did not identify any that were cost effective for development (Southern 2007a).

The staff believes it would be unreasonable for an applicant to request a CP or COL if (1) the power could be purchased from other electricity suppliers at a reasonable cost, (2) the power could be obtained by reactivating one or more retired generating plants or by extending the life of one or more existing generating plants, or (3) conservation or demand-side management programs could make the additional power from the new nuclear units unnecessary.

Based on the preceding discussion, the staff concludes that the options of purchasing electric power from other suppliers, reactivating retired power plants, extending the operating life of existing power plants, and conservation and demand-side programs are not reasonable alternatives to providing new baseload power generation capacity.

9.2.2 Alternatives Requiring New Generating Capacity

In keeping with the NRC's evaluation of alternatives to operating license renewal, a reasonable set of energy alternatives to the construction and operation of one or more new nuclear units at the VEGP site should be limited to analysis of discrete power generation sources and those power generation technologies that are technically reasonable and commercially viable (NRC 1996). The current mix of baseload power generation options in Georgia is one indicator of the feasible choices for power generation technology within the State.

This section discusses the environmental impacts of energy alternatives to the proposed action that would require Southern to construct new generating capacity. The discussion in Section 9.2.2 is limited to the individual alternatives that are viable: coal-fired and natural-gas-fired generation. The impacts discussed in this section are estimates based on present technology.

The staff assumed that new generation capacity would be located at the VEGP site for the coal-fired and natural-gas-fired alternatives. Either natural draft or mechanical draft cooling towers would be used for the coal-fired and natural-gas-fired alternatives (Southern 2007a). Southern estimates that one new 500-kV electric power transmission line in a new right-of-way would be needed to serve a new baseload generating facility at the VEGP site (Southern 2007a).

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an annual energy outlook. In its *Annual Energy Outlook 2007* (DOE/EIA 2007), the EIA reference case projects that coal-fired capacity would account for approximately 54 percent of total electric generating capacity additions between 2006 and 2030. Coal-fired plants generally are used to meet baseload requirements. EIA projects that natural-gas-fired plants would account for approximately 36 percent of new capacity additions during this period. EIA projects that renewable energy sources would account for approximately 6 percent of new capacity additions during the period and that new nuclear plants would account for approximately 4 percent (DOE/EIA 2007). The EIA projections are based on the assumption that providers of new generating capacity would seek to minimize cost while meeting applicable environmental requirements.

9.2.2.1 Coal-Fired Power Generation

For the coal-fired generation alternative, the staff assumed construction of four pulverized coal-fired units, each with a net capacity of 530 MW(e) at the VEGP site. These assumptions are consistent with the ESP application submitted by Southern (Southern 2007a). The staff also assumed the construction of an additional transmission line right-of-way, as discussed in Section 3.3. The plant is assumed to have an operating life of 40 years.

The staff also considered an integrated gasification combined cycle (IGCC) coal-fired plant. IGCC is an emerging technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation (Southern 2007a). The technology is cleaner than conventional pulverized coal plants because major pollutants can be removed from the gas stream before combustion. The IGCC alternative also generates less solid waste than the pulverized coal-fired alternative. The largest solid waste stream produced by IGCC installations is slag, a black, glassy, sand-like material that is potentially a marketable by-product. The other large-volume by-product produced by IGCC plants is sulfur, which is extracted during the gasification process and can be marketed rather than placed in a landfill. IGCC units do not produce ash or scrubber wastes (Southern 2007a). In spite of the preceding advantages, the staff concludes that, at present, a new IGCC plant is not a reasonable alternative to a 2234-MW(e) nuclear power generation facility for the following reasons: (1) IGCC plants are more expensive than comparable pulverized coal plants (DOE/EIA 2007), (2) existing[a] IGCC plants have considerably smaller capacity that the proposed 2234-MW(e) nuclear plant, (3) system reliability of existing IGCC plants has been lower than pulverized coal plants, (4) the existing IGCC plants have had an extended (though ultimately successful) shakedown period (NPCC 2005), and (5) a lack of overall plant performance warranties for IGCC plants has hindered commercial financing (NPCC 2005). For these reasons, IGCC plants are not considered further in this EIS.

Coal and limestone (calcium carbonate) for a pulverized coal-fired plant would be delivered to the plant by train. Southern estimates that the plant would consume approximately 7 million MT (7.3 million tons) per year of pulverized bituminous coal with an ash content of approximately 11 percent (Southern 2007a). Lime or limestone, used in the scrubbing process for control of sulfur dioxide (SO_2) emissions, is injected as a slurry into the hot effluent combustion gases to remove entrained SO_2. The lime-based scrubbing solution reacts with SO_2 to form calcium sulfite, which precipitates and is removed from the process as sludge. Southern estimates that approximately 166,000 MT (183,000 tons) per year of limestone would be used for flue gas desulfurization (Southern 2007a).

Air Quality

Southern assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. Southern estimates that the coal-fired alternative emissions for SO_2, nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM) would be as follows (Southern 2007a):

- SO_2 – 5068 MT (5587 tons) per year
- NO_x – 1647 MT (1815 tons) per year
- CO – 1647 MT (1815 tons) per year
- PM_{10} – 83 MT (91 tons) per year
- $PM_{2.5}$ – 0.35 MT (0.39 tons) per year.

PM_{10} is particulate matter with a diameter equal to or less than 10 microns (40 CFR 50.6). $PM_{2.5}$ is particulate matter with a diameter equal to or less than 2.5 microns (40 CFR 50.7).

(a) Currently operating coal gasification power plants in the United States are the Tampa Electric IGCC Project (Polk Power Station), using the Chevron-Texaco gasification process, and the Wabash River Coal Gasification Repowering Project, using the ConocoPhilips E-Gas process (NPCC 2005).

The impacts on air quality from coal-fired generation would vary considerably from those of nuclear generation because of emissions of SO_2, NO_x, CO, PM, and hazardous air pollutants such as mercury. A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

The acid rain requirements of the Clean Air Act capped the nation's SO_2 emissions from power plants. Southern would need to obtain sufficient pollution credits either from a set-aside pool or purchases on the open market to cover annual emissions from the plant. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions.

A new coal-fired generation plant at the VEGP site would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the Clean Air Act Amendments of 1990. The plant would need to comply with the new source performance standards (NSPS) for such plants in 40 CFR 60, Subpart Da. The standards establish emission limits for PM and opacity (40 CFR 60.42Da), SO_2 (40 CFR 60.43Da), NO_X (40 CFR 60.44Da), and mercury (40 CFR 60.45Da).

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as in attainment or unclassified for criteria pollutants under the Clean Air Act (40 CFR 51.307(a)). Criteria pollutants under the Clean Air Act are lead, ozone, particulates, CO, NO_2, and SO_2. Ambient air-quality standards for criteria pollutants are in 40 CFR Part 50. The VEGP site is in an area designated as in attainment or unclassified for all criteria pollutants (40 CFR 81.311).

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment occurs because of air pollution resulting from human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a State. The State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). If a new coal-fired power generation station were located close to a mandatory Class I area, additional air-pollution control requirements could be imposed. There are no mandatory Class I Federal areas within 160 km (100 mi) of the VEGP site.

The fugitive dust emissions from construction activities would be mitigated using best management practices (BMP); such emissions would be temporary.

NUREG-1437 for license renewal (NRC 1996) did not quantify emissions from coal-fired power plants, but suggested that air impacts would be substantial. NUREG-1437 also mentioned global warming from unregulated carbon dioxide emissions and acid rain from sulfur oxides and nitrogen oxide emissions as a potential impact (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the byproducts of coal combustion.

Overall, the staff concludes that air-quality impacts from coal-fired generation at the VEGP site would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Waste Management

NUREG-1437 for license renewal (NRC 1996) and the NRC's experience from operating license renewal analyses indicate that coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction (SCR) catalyst, and scrubber sludge. In its Environmental Report (ER) (Southern 2007a), Southern estimates that a coal-fired plant would generate approximately 715,000 MT (788,000 tons) per year of ash. Southern would expect to recycle approximately 35 percent of the ash (Southern 2007a). The coal plant would also generate approximately 197,800 MT (218,000 tons) per year of scrubber sludge. Southern estimates that disposal of the ash and scrubber sludge over a 40-year plant life would require approximately 164 ha (406 ac) (Southern 2007a)

In May 2000, EPA issued a "Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels" (65 FR 32214). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because of health concerns. Accordingly, EPA announced its intention to issue regulations for disposal of coal-combustion waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) of 1976.

Waste impacts on groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage area occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses. Construction-related debris would be generated during plant construction activities.

For the reasons stated above, the staff concludes that the impacts from waste generated at a coal-fired plant would be MODERATE. The impacts would be clearly noticeable but would not destabilize any important resource.

Human Health

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risk from coal and lime/limestone transportation, worker and public risk from disposal of coal-combustion waste, and public risk from inhalation of stack emissions. In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the EPA and State agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by the EPA and State agencies, the staff concludes that the human health impacts from radiological doses and inhaled toxins and particulates generated from coal-fired generation would be SMALL.

Other Impacts

Approximately 450 ha (1100 ac) of land would need to be converted to industrial use for the powerblock, infrastructure and support facilities, coal and limestone storage and handling, and landfill disposal of ash and scrubber sludge (Southern 2007a). Additional land would be needed for a new transmission line right-of-way. Land-use changes would occur offsite in an undetermined coal-mining area to supply coal for the plant. Overall, the staff concludes that land-use impacts would be MODERATE.

The impacts on water use and quality from constructing and operating a coal-fired plant at the VEGP site would be comparable to the impacts associated with a new nuclear plant. Cooling water would likely be withdrawn directly from the Savannah River. Plant discharges would consist mostly of cooling tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving waterbody and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by the Georgia Department of Natural Resources (GDNR) through a National Pollution Discharge Elimination System (NPDES) permit. Indirectly, water quality could be affected by acids and mercury from air emissions. The water would be consumed because of evaporation from the cooling towers. In NUREG-1437 for license renewal, the staff determined that some erosion and sedimentation would likely occur during construction of new facilities (NRC 1996). Overall, the staff concludes that the water-use and water-quality impacts would be SMALL.

The coal-fired generation alternative would introduce impacts from construction and new incremental impacts from operations. The impacts could include wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. The impacts could occur at the ESP site and at the sites used for coal and limestone mining. Extraction of cooling make-up water could have adverse impacts on aquatic resources. Construction and maintenance of a new transmission line would have ecological impacts. Cooling tower drift would have minimal impacts on terrestrial ecology. Disposal of fly ash could affect water quality and the aquatic environment. The impacts on threatened and endangered species at the VEGP site would be similar to the impacts from a new nuclear facility. Overall, the staff concludes that the ecological impacts would be MODERATE.

Socioeconomic impacts would result from the approximately 200 workers needed to operate the coal-fired facility, demands on housing and public services during construction, and the loss of jobs after construction. Overall, the staff concludes that these impacts would be SMALL to MODERATE, resulting from the mitigating influence of the site's proximity to the surrounding population area and the relatively small number of workers needed to operate the plant. The plant would pay significant property taxes to Burke County. Considering the population and economic condition of the county, the staff concludes that the taxes would have a LARGE beneficial impact on the county.

The four coal-fired powerblock units would be as much as 60 m (200 ft) tall and would be visible offsite during daylight hours. The four exhaust stacks would be as much as 180 m (600 ft) high. The stacks and associated emissions would likely be visible in daylight hours for distances greater than 16 km (10 mi). Cooling towers and associated plumes also would have aesthetic impacts. Natural draft towers could be up to 180 m (600 ft) high. The powerblock units and associated stacks and cooling towers would also be visible at night because of outside lighting. The Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 200 ft above ground level have markings and/or lighting so as not to impair aviation safety (FAA 2000). A mitigating factor is that the VEGP site is currently an industrial site located in a rural, forested area. The visual impacts of a new coal-fired plant could be further mitigated by landscaping and color selection for buildings that is consistent with the environment. Visual impacts at night could be mitigated by reduced use of lighting, provided the lighting meets FAA requirements, and appropriate use of shielding. The new transmission line would have a larger aesthetic impact. Overall, the staff concludes that the aesthetic impacts associated with new coal-fired power generation at the VEGP site would be SMALL, but the aesthetic impacts of the transmission lines would be MODERATE.

Coal-fired power generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, use of outside loudspeakers, and the commuting of plant employees. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly increases noise levels near the rail corridor, the short duration of the noise reduces the impacts. Nevertheless, given the frequency of train transport and the fact that many people are likely to be within hearing distance of the rail line, the impacts of noise on residents in the vicinity of the facility and of the rail line are considered MODERATE. Noise and light from the plant would be detectable offsite.

Historic and cultural resource impacts for a new coal-fired plant located at the VEGP site would be similar to the impacts for a new nuclear plant as discussed in Sections 4.6 and 5.6. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. The studies would likely be needed for all areas of potential disturbance at the plant site, any offsite affected areas, such as mining and waste-disposal sites, and along associated rights-of-way where new construction would occur, for example, roads and transmission line rights-of-way. The staff concludes that the historic and cultural resource impacts would be MODERATE.

As discussed in Section 2.10, there are large proportions of minority and low-income persons in the population near the VEGP site. Environmental impacts on minority and low-income populations associated with a coal-fired plant at the VEGP site could be SMALL to MODERATE, depending on the distribution and intensity of adverse air-quality impacts on the local population.

Other construction and operation impacts would be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation beyond that discussed would not be warranted.

The construction and operation impacts of coal-fired power generation at the VEGP site are summarized in Table 9-1.

9.2.2.2 Natural-Gas-Fired Power Generation

For the natural gas alternative, the staff assumed construction and operation of a natural-gas-fired plant with a closed-cycle cooling system and cooling towers located at the VEGP site. The staff assumed that the natural-gas-fired plant would use combined-cycle combustion turbines, which is consistent with the Southern ESP application (Southern 2007a). The staff used the Southern assumption of four units with a net capacity of 530 MW(e) per unit (Southern 2007a). The staff also assumed the construction of an additional transmission line right-of-way, as discussed in Section 3.3 of this EIS.

Air Quality

Natural gas is a relatively clean-burning fuel. When compared with a coal-fired plant, a natural-gas-fired plant would release similar types of emissions but in lower quantities.

Table 9-1. Summary of Environmental Impacts of Coal-Fired Power Generation

Impact Category	Impact	Comment
Land use	MODERATE	Uses approximately 450 ha (1100 ac) for powerblock; coal handling, storage, and transportation facilities; infrastructure facilities; waste disposal; and cooling-water facilities. Additional land needed for a new transmission line right-of-way. Mining activities would have additional impacts offsite.
Air quality	MODERATE	SO_2 – 5068 MT (5587 tons) per year NO_x – 1647 MT (1815 tons) per year CO – 1647 MT (1815 tons) per year PM_{10} – 82.6 MT (91 tons) per year $PM_{2.5}$ - 0.35 MT (0.39 tons) per year Small amounts of hazardous air pollutants
Water use and quality	SMALL	Impacts would be comparable to the impacts for a new nuclear power plant located at the VEGP site.
Ecology	MODERATE	Uses the undeveloped upland area of the VEGP site and probably some adjacent offsite undeveloped land. Potential upland hardwood forest loss and fragmentation, reduced productivity and biological diversity, and impacts on terrestrial ecology from cooling tower drift. Additional impacts are associated with coal mining and construction of a rail spur.
Waste management	MODERATE	Total waste volume would be approximately 715,000 MT (788,000 tons) per year of ash and an additional 197,800 MT (218,000 tons) per year of scrubber sludge.
Socioeconomics	LARGE Beneficial to MODERATE Adverse	Construction-related impacts would be noticeable. Impacts during operation would be minor. Local property tax base would benefit mainly during operations. Depending on where the workforce lives, the construction-related impacts would be noticeable or minor. Impacts during operation likely would be smaller than during construction. The plant and new transmission line would have aesthetic impacts. Some offsite noise impacts would occur.
Human health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and cultural resources	MODERATE	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground.
Environmental justice	SMALL to MODERATE	There is a high proportion of minority and low-income persons in the local population. Impacts would depend on the distribution and intensity of adverse air-quality impacts on this population.

A new natural-gas-fired power generation plant would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. A new natural-gas-fired, combined-cycle plant would also be subject to the new source performance standards specified in 40 CFR 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_X.

The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as in attainment or unclassified under the Clean Air Act. The VEGP site is in an area designated as in attainment or unclassified for criteria pollutants (40 CFR 81.311).

Section 169A of the Clean Air Act (42 USC 7491) establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a State, State regulatory agencies must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a new natural-gas-fired power plant were located close to a mandatory Class I area, additional air-pollution control requirements could be imposed. There are no mandatory Class I Federal areas within 160 km (100 mi) of the VEGP site.

Southern estimates that a natural-gas-fired plant equipped with appropriate pollution control technology would have approximately the following emissions (Southern 2007a):

- SO_2 – 153 MT (169 tons) per year
- NO_x – 490 MT (540 tons) per year
- CO – 102 MT (112 tons) per year
- $PM_{2.5}$ – 85 MT (94 tons) per year.

A natural-gas-fired power plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

The combustion turbine portion of the combined-cycle plant would be subject to EPA's National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (40 CFR 63, Subpart YYYY) if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 9 MT/yr (10 tons/yr) or more of any single hazardous air pollutant or 23 MT/yt (25 tons/yr) or more of any combination of hazardous air pollutants (40 CFR 63.6085(b)).

The fugitive dust emissions from construction activities would be mitigated using BMP; such emissions would be temporary.

The impacts of emissions from a natural-gas-fired power generation plant would be clearly noticeable, but would not be sufficient to destabilize air resources. Overall, the staff concludes that air-quality impacts resulting from construction and operation of new natural-gas-fired power generation at the VEGP site would be SMALL to MODERATE.

Waste Management

In NUREG-1437, the staff concluded that waste generation from natural-gas-fired technology would be minimal (NRC 1996). The only significant waste generated at a natural-gas-fired power plant would be spent SCR catalyst, which is used to control NO_x emissions. The spent catalyst would be regenerated or disposed of offsite. Other than spent SCR catalyst, waste generation at an operating natural-gas-fired plant would be largely limited to typical operations and maintenance waste. Construction-related debris would be generated during construction activities. Overall, the staff concludes that waste impacts from natural-gas-fired power generation would be SMALL.

Human Health

In NUREG-1437, the staff identified cancer and emphysema as a potential health risk from natural-gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risk. Air emissions from a natural-gas-fired power generation plant located at the VEGP site would be regulated by the GDNR. The human health effect is expected to be either undetectable or sufficiently minor. Overall, the staff concludes that the impacts on human health from natural-gas-fired power generation would be SMALL.

Other Impacts

The natural-gas-fired generating plant would require approximately 64 ha (159 ac) for the power-block and support facilities (Southern 2007a). Construction of a natural gas pipeline from the VEGP site to the closest natural gas distribution line would require approximately 99 ha (242 ac) (Southern 2007a). Thus, the total land-use commitment would be approximately 160 ha (400 ac). Additional land would be needed for a new transmission line right-of-way. For any new natural-gas-fired power plant, additional land would also be required for natural gas wells and collection stations. In NUREG-1437, the staff estimated that approximately 1460 ha (3600 ac) would be needed for a 1000-MW(e) plant (NRC 1996). Overall, the land-use impacts from new natural-gas-fired power generation would be MODERATE.

The impacts on water use and quality from constructing and operating a natural-gas-fired plant at the VEGP site would be comparable to the impacts associated with constructing and operating a new nuclear facility. Closed-cycle cooling with cooling towers is assumed. The impacts on water quality from sedimentation during construction of a natural-gas-fired plant were characterized in NUREG-1437 as SMALL (NRC 1996). NRC also noted in NUREG-1437 that the impacts on water quality from operations would be similar to, or less than, the impacts from other generating technologies. Overall, the staff concludes that impacts on water use and quality would be SMALL.

Siting of the natural-gas-fired plant would have ecological impacts that would be comparable to a new nuclear facility. Much of the impact would occur in areas that were previously disturbed during the construction of VEGP Units 1 and 2. Constructing a new underground gas pipeline to the site would cause temporary ecological impacts. Ecological impacts on the plant site and utility easements would not affect threatened and endangered species, although some wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity would be likely. Withdrawal and discharge of make-up water for the cooling system could affect aquatic resources, and drift of condensation from the cooling towers could affect terrestrial ecology. Overall, the staff concludes that ecological impacts would be SMALL to MODERATE.

Socioeconomic impacts would result from the approximately 88 workers needed to operate the natural-gas-fired facility, demands on housing and public services during construction, and the loss of jobs after construction. Overall, the staff concludes that these impacts would be SMALL because of the mitigating influence of the site's proximity to the surrounding population area and the relatively small number of workers needed to construct and operate the plant in comparison to nuclear and coal-fired generation alternatives. The plant would pay property taxes to Burke County. Considering the population and economic condition of the county, the staff concludes that the taxes would have a MODERATE beneficial impact on the county.

The turbine buildings, four exhaust stacks (approximately 60 m [200 ft] tall) and associated emissions, cooling towers, condensation plumes from the cooling towers, and the gas pipeline compressors would be visible during daylight hours from offsite. Noise and light from the plant would be detectable offsite. A mitigating factor is that the VEGP site is currently an industrial site located in a rural, forested area. The new transmission line would have a greater aesthetic impact. Overall, the staff concludes that the aesthetic impacts associated with new natural-gas-fired power generation at the VEGP site would be SMALL, but the impact along new transmission lines would be MODERATE.

Historic and cultural resource impacts for a new natural gas fired plant located at the VEGP site would be similar to the impacts for a new nuclear plant as discussed in Sections 4.6 and 5.6. A cultural resources inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification, and recording of existing historic and archaeological resources, and possible mitigation of the adverse effect from ground-disturbing actions. The studies would likely be needed for all areas of potential disturbance at the plant site, any offsite affected areas, such as mining and waste-disposal sites, and along associated rights-of-way where new construction would occur, for example, roads and transmission line rights-of-way. The staff concludes that the historic and cultural resource impacts would be MODERATE.

As described in Section 2.10, there are large proportions of minority and low-income persons in the population around the VEGP site. The impacts of a natural-gas-fired plant at the VEGP site on minority or low-income populations would depend on the distribution and magnitude of adverse air-quality impacts, but would likely be SMALL.

Other construction and operation impacts would be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Because of the minor nature of these impacts, mitigation beyond that discussed would not be warranted. The impacts of natural-gas-fired power generation at the VEGP site are summarized in Table 9-2.

9.2.3 Other Alternatives

This section discusses energy alternatives that Southern determined are not reasonable, the staff's conclusions about the overall environmental impacts of each alternative, and the staff's basis for the conclusions. New nuclear units at the VEGP site would be a baseload generation plant. Any feasible alternative to the new units would need to generate baseload power. In performing its initial evaluation in its ER, Southern relied on NUREG-1437 for license renewal (NRC 1996). The staff reviewed the information submitted by Southern and conducted an independent review and finds that Southern's conclusion that these generation options are not reasonable alternatives to one or more new nuclear units is acceptable.

The staff has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, in general, the generation alternatives would have to be installed at a location other than the VEGP site. Any attempt to assign significance levels would require the staff's speculation about the unknown site.

9.2.3.1 Oil-Fired Power Generation

EIA's reference case projects that oil-fired power plants would not account for any new electric power generation capacity in the United States through the year 2030 (DOE/EIA 2007). Oil-fired generation is more expensive than nuclear, natural-gas-fired, or coal-fired generation options. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive. The high cost of oil has resulted in a decline in its use for

Table 9-2. Summary of Environmental Impacts of Natural-Gas-Fired Power Generation

Impact Category	Impact	Comment
Land use	MODERATE	Approximately 160 ha (400 ac) would be needed for power-block, cooling towers and support systems, and connection to a natural gas pipeline. Additional land needed for transmission line right-of-way, infrastructure, and other facilities.
Air quality	SMALL to MODERATE	SO_2 – 153 MT (169 tons) per year NO_x – 490 MT (540 tons) per year CO – 102 MT (112 tons) per year $PM_{2.5}$ – 85 MT (94 tons) per year Some hazardous air pollutants
Water use and quality	SMALL	Impacts would be comparable to the impacts for a new nuclear power plant located at the VEGP site.
Ecology	SMALL to MODERATE	Many of the impacts would occur in areas that were previously disturbed during the construction of VEGP Units 1 and 2. Thus, potential habitat loss and fragmentation and reduced productivity and biological diversity would be small. Impacts on terrestrial ecology from cooling tower drift could occur.
Waste management	SMALL	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions.
Socioeconomics	MODERATE Beneficial to MODERATE Adverse	Construction and operations workforces would be relatively small. Addition to property tax base, while smaller than for a nuclear or coal-fired plant, might still be quite noticeable. Construction-related impacts would be noticeable. Impacts during operation would be minor because of the small work-force involved. The plant and new transmission line would have aesthetic impacts.
Human health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and cultural resources	MODERATE	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on previously disturbed ground.
Environmental justice	SMALL	High proportion of minority and low-income in local population, but adverse health impacts would not be likely.

electricity generation. In Section 8.3.11 of NUREG-1437 for license renewal, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 49 ha (120 ac) of land (NRC 1996). Operation of an oil-fired power plant would have environmental impacts that would be similar to those of a comparably sized coal-fired plant (NRC 1996).

For the preceding economic and environmental reasons, the staff concludes that an oil-fired power plant at or in the vicinity of the VEGP site would not be a reasonable alternative to construction of a 2234-MW(e) nuclear power generation facility that would be operated as a baseload plant.

9.2.3.2 Wind Power

Most of Georgia and South Carolina are in a wind power Class 1 region (average wind speeds lower than 5.6 m/s) (DOE 2005). Class 1 regions have the lowest potential for wind energy generation. Class 1 areas are unsuitable for wind energy development (DOE 2005). Wind turbines typically operate at a 25 to 40 percent capacity factor compared to 90 to 95 percent for a baseload plant such as a nuclear plant (AWEA 1998). The largest operating wind farm is over 700 MW (AWEA 2007a), but most are well under 200 MW. A utility-scale wind generation plant would generally require about 24 ha (60 ac) per MW of installed capacity, although much of this land could be used for other purposes (AWEA 2007b). With modern wind turbine designs, well over 1000 wind turbines would be required to produce the 2234 MW(e) of the proposed nuclear units.

Southern joined the Georgia Institute of Technology to study the viability of offshore wind turbines in the southeast. The study found that technology limitations and regulatory restrictions would make development of offshore wind projects difficult in the southeast (Southern 2007b).

For the preceding reasons, the staff concludes that a wind energy facility at or in the vicinity of the VEGP site would not currently be a reasonable alternative to construction of a 2234-MW(e) nuclear power generation facility that would be operated as a baseload plant.

9.2.3.3 Solar Power

Solar technologies use energy and light from the sun to provide heating and cooling, light, hot water, and electricity for consumers. Solar power technologies (both photovoltaic and thermal) cannot currently compete with conventional nuclear and fossil-fueled technologies in grid-connected applications because of solar power's higher capital cost per kilowatt of capacity. Energy storage requirements also limit the use of solar energy systems as baseload electricity supply. In NUREG-1437 for license renewal, the staff determined that the average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 to 40 percent (NRC 1996).

Construction of solar generating facilities has substantial impacts on natural resources (such as wildlife habitat, land use, and aesthetics). As stated in NUREG-1437, land requirements are high – 142 km^2 (55 mi^2) per 1000 MW(e) for photovoltaic (NRC 1996) and approximately 57 km^2 (22 mi^2) per 1000 MW(e) for solar thermal systems (NRC 1996). Neither type of solar electric system would fit the land area footprint available at the VEGP site.

For flat-plate solar collectors, Georgia has good available resources throughout the State. For concentrating solar collectors, Georgia could pursue some types of technologies, but large-scale thermal utility systems would not be effective (DOE 2006a).

For the preceding reasons, the staff concludes that a solar energy facility at or in the vicinity of the VEGP site would not currently be a reasonable alternative to construction of a 2234-MW(e) nuclear power generation facility that would be operated as a baseload plant.

9.2.3.4 Hydropower

Georgia has an estimated 613 MW of developable hydroelectric resources (INEEL 1998). As stated in Section 8.3.4 of NUREG-1437 for license renewal (NRC 1996), the percentage of U.S. generating capacity supplied by hydropower is expected to decline because hydroelectric facilities have become difficult to site as a result of public concerns about flooding, destruction of natural habitat, and alteration of natural river courses. In NUREG-1437, the staff estimated that land requirements for hydroelectric power are approximately 400,000 ha (1 million ac) per 1000 MW(e) (NRC 1996).

Because of the relatively low amount of undeveloped hydropower resource in Georgia and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to produce 2234 MW(e), the staff concludes that local hydropower is not a feasible alternative to construction of a new nuclear power generation facility operated as a baseload plant at the VEGP site.

9.2.3.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload power generation because of the limited geographical availability of the resource and immature status of the technology (NRC 1996). Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent (DOE 2006c). Geothermal systems have a relatively small footprint and minimal emissions (MIT 2006). Georgia does have high-temperature geothermal resources that are suitable for direct heating applications (DOE 2006a). A recent study led by the Massachusetts Institute of Technology concluded that a $300-$400 million investment over 15 years would be needed to make early-generation enhanced geothermal system power plant installations competitive in the evolving U.S. electricity supply markets (MIT 2006).

For these reasons, the staff concludes that a geothermal energy facility at or in the vicinity of the VEGP site would not currently be a reasonable alternative to construction of a 2234-MW(e) nuclear power generation facility operated as a baseload plant.

9.2.3.6 Wood Waste

In NUREG-1437 for license renewal, the staff determined that a wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant impediment to the use of wood waste to generate electricity is the high cost of fuel delivery and high construction cost per megawatt of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in NUREG-1437 suggest that the overall level of construction impacts per megawatt of installed capacity would be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales (NRC 1996). Similar to coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload power plant, the ecological impacts of large-scale timber cutting (for example, soil erosion and loss of wildlife habitat), and high inefficiency, the staff determined that wood waste would not be a reasonable alternative to a 2234-MW(e) nuclear power generation facility operated as a baseload plant.

9.2.3.7 Municipal Solid Waste

Municipal solid-waste combustors incinerate the waste and use the resultant heat to produce steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2006). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion. In NUREG-1437 for license renewal, the staff determined that the initial capital cost for municipal solid-waste plants is greater than for comparable steam-turbine technology at wood-waste facilities because of the need for specialized waste-separation and waste-handling equipment for municipal solid waste (NRC 1996).

Municipal solid-waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue gases using fabric filters and/or scrubbers (DOE/EIA 2001).

Currently, approximately 89 waste-to-energy plants are operating in the United States. These plants generate approximately 2700 MW(e), or an average of approximately 30 MW(e) per plant

(IWSA 2007). Given the small size of the plants, staff concludes that generating electricity from municipal solid waste would not be a reasonable alternative to a 2234-MW(e) nuclear power generation facility operated as a baseload plant.

9.2.3.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuel, several other biomass-derived fuels are available for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In NUREG-1437 for license renewal, the staff determined that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a large baseload generating plant (NRC 1996). EIA states that biomass is the largest source of renewable electricity generation among the nonhydropower renewable fuels (DOE/EIA 2007). Co-firing biomass with coal is relatively inexpensive when low-cost biomass resources are available (DOE/EIA 2007. A 2003 study concluded that use of biomass-derived fuels for electricity generation in Georgia was not currently economically competitive with existing generation technologies (Curtis et al. 2003). For these reasons, the staff concludes that biomass-derived fuels do not offer a reasonable alternative to a 2234-MW(e) nuclear power generation facility operated as a baseload plant.

9.2.3.9 Fuel Cells

Fuel cells work without combustion and its associated environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode, air over a cathode, and then separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. Higher-temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications, but progress has been slow. The cost of fuel cell power systems must be reduced before they can be competitive with conventional technologies (DOE 2006b).

The staff concludes that, at the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Future gains in cost competitiveness for fuel cells compared to other fuels are speculative.

For the preceding reasons, the staff concludes that a fuel cell energy facility located at or in the vicinity of the VEGP site would not currently be a reasonable alternative to construction of a 2234-MW(e) nuclear power generation facility operated as a baseload plant.

9.2.4 Combination of Alternatives

Individual alternatives to the construction of one or more new nuclear units at the VEGP site might not be sufficient on their own to generate Southern's target value of 2234 MW(e) because of the small size of the resource or lack of cost-effective opportunities. Nevertheless, it is conceivable that a combination of alternatives might be cost effective. There are many possible combinations of alternatives.

Section 9.2.2.2 assumes the construction of four 530-MW(e) natural-gas-fired, combined-cycle generating units at the VEGP site using closed-cycle cooling with cooling towers. For a combined alternatives option, the staff assessed the environmental impacts of an assumed combination of three 530-MW(e) natural-gas-fired, combined-cycle generating units at the VEGP site using closed-cycle cooling with cooling towers, 60 MW of wind energy, 60 MW of hydropower, 100 MW from biomass sources including municipal solid waste, and 424 MW from conservation and demand-side management programs. A summary of the environmental impacts associated with the construction and operation of this combination of alternatives is in Table 9-3.

9.2.5 Summary Comparison of Alternatives

Table 9-4 contains a summary of the staff's environmental impact characterizations for constructing and operating new nuclear, coal-fired, and natural-gas-fired, combined-cycle generating units at the VEGP site. The combination of alternatives shown in Table 9-4 assumes siting of natural-gas-fired, combined-cycle units at the ESP site and siting of other generating units in the general vicinity (within 160 km [100 mi]) of the site. Closed-cycle cooling with natural draft or mechanical cooling towers is assumed for all thermal plants.

The staff reviewed the available information on the environmental impacts of power generation alternatives compared to the construction of new nuclear units at the VEGP site. Based on this review, the staff concludes that, from an environmental perspective, none of the viable energy alternatives are clearly preferable to construction of a new baseload nuclear power generation plant.

Table 9-3. Summary of Environmental Impacts of a Combination of Power Sources

Impact Category	Impact	Comment
Land use	MODERATE	A natural-gas-fired plant would have land-use impacts for power-block, new transmission line right-of-way, cooling towers and support systems, and connection to a natural gas pipeline. Wind, hydro, and biomass facilities and associated transmission lines would also have land-use impacts.
Air quality	SMALL to MODERATE	Emissions from the natural-gas-fired plant would be approximately: SO_2 – 115 MT (127 tons) per year NO_x – 367 MT (405 tons) per year CO – 76 MT (84 tons) per year $PM_{2.5}$ – 64 MT (71 tons) per year Municipal solid waste and biomass facilities would also have emissions.
Water use and quality	SMALL	Impacts would be comparable to the impacts for a new nuclear power plant located at the VEGP site.
Ecology	SMALL to MODERATE	Many of the impacts would occur in areas that were previously disturbed during the construction of VEGP Units 1 and 2. Thus, potential habitat loss and fragmentation and reduced productivity and biological diversity would likely be minimal. Impacts on terrestrial ecology from cooling tower drift could occur. Wind energy facilities could result in some avian mortality. Hydropower facilities would impact terrestrial and aquatic habitat.
Waste management	SMALL to MODERATE	The only significant waste would be from spent SCR catalyst used for control of NO_x emissions and ash from biomass and municipal solid-waste sources.
Socioeconomics	MODERATE Beneficial to MODERATE Adverse	Construction and operations workforces would be relatively small. Addition to property tax base, while smaller than for a nuclear or coal-fired plant, might still be quite noticeable. Construction-related impacts would be noticeable. Impacts during operation would be minor because of the small workforce involved. The plant and new transmission line would have aesthetic impacts.
Human health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and cultural resources	MODERATE	Any potential impacts could likely be effectively managed. Most of the facilities and infrastructure at the site would likely be built on previously disturbed ground.
Environmental justice	SMALL	Some impacts on housing availability and prices during construction may occur, as might beneficial impacts from property tax revenues.

Table 9-4. Summary of Environmental Impacts of Construction and Operation of New Nuclear, Coal-Fired, and Natural-Gas-Fired Generating Units, and a Combination of Alternatives

Impact Category	Nuclear	Coal	Natural Gas	Combination of Alternatives
Land use	MODERATE	MODERATE	MODERATE	MODERATE
Air quality	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Water use and quality	SMALL	SMALL	SMALL	SMALL
Ecology	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Waste management	SMALL	MODERATE	SMALL	SMALL to MODERATE
Socioeconomics	LARGE Beneficial to MODERATE Adverse	LARGE Beneficial to MODERATE Adverse	MODERATE Beneficial to MODERATE Adverse	MODERATE Beneficial to MODERATE Adverse
Human health	SMALL	SMALL	SMALL	SMALL
Historic and cultural resources	MODERATE	MODERATE	MODERATE	MODERATE
Environmental justice	SMALL	SMALL to MODERATE	SMALL	SMALL

9.3 System Design Alternatives

Sections 9.3.1 and 9.3.2 contain information regarding alternative plant cooling systems for the proposed Units 3 and 4 at the VEGP site. Section 9.3.1 discusses use of a once-through cooling system and Section 9.3.2 discusses use of a dry or hybrid wet/dry heat dissipation system.

The purpose of the plant cooling system is to dissipate heat to the environment. The various cooling system options differ in how and where the heat transfer takes place and, hence, have different environmental impacts. For the natural draft wet tower cooling system proposed for both VEGP Units 3 and 4, waste heat is transferred to the atmosphere primarily through evaporation and conduction. Water would be lost from the cooling system due to evaporation, drift, and tower blowdown discharge, and make-up water would be supplied from the Savannah River. Southern states in its ER that approximately 50 to 75 percent of the make-up water flow would be used to replace evaporative water losses with the remaining 25 to 50 percent of the water losses resulting from tower blowdown (Southern 2007a). Cooling system water losses resulting from drift are minor in comparison to evaporative and blowdown discharge losses, and the maximum drift rate reported by Southern is 24 gpm when both towers are operating (Southern 2007a).

9.3.1 Plant Cooling System – Once-Through Operation

A once-through cooling system for VEGP Units 3 and 4 would not employ cooling towers, instead it would transfer waste heat to the atmosphere and aquatic environment of the Savannah River by convection, evaporation, long-wave radiation, and conduction. This type of cooling design would withdraw a larger volume of water from the Savannah River through the intakes as compared to the proposed wet tower design.

Southern states in its ER that the water withdrawal requirements for a once-through cooling system would be 53.5 m^3/s (1890 cfs) per unit (Southern 2007a). Therefore, if both VEGP Units 3 and 4 were operating with once-through cooling, the combined water withdrawal rate would be 107 m^3/s (3780 cfs). Staff computed the Savannah River flow statistics for the Jackson, South Carolina, streamflow gage, which is approximately 6 mi upstream of the site, between October 1971 and when the gage was discontinued (September 2002). The average daily Savannah River flow rate during the period-of-record was 250 m^3/s (8830 cfs), and the minimum discharge was 91.18 m^3/s (3220 cfs). Surface-water withdrawals for VEGP Units 3 and 4 using once-through cooling represent 43 percent of the average Savannah River discharge passing the site, and could potentially be greater than the river discharge during times of drought. As discussed on Section 2.6.1.1 of this EIS, the once-through cooling system withdrawal would also approximately equal to the total discharge released from Thurmond Dam 108 m^3/s (3800 cfs) under Drought Level 3 conditions.

Based on the quantity of water that would be withdrawn from the Savannah River to cool the proposed VEGP Units 3 and 4 using once-through cooling, the staff concludes that a wet tower cooling system would be preferable to a once-through cooling system. See Sections 7.3.1 and 7.5 for additional information.

9.3.2 Dry or Hybrid Wet/Dry Cooling Towers

The use of a dry cooling system design versus the proposed combination wet tower design for VEGP Units 3 and 4 would largely eliminate the impacts on aquatic biota in the Savannah River. The river would not be heated by waste heat discharged to the river nor would the effects of impingement and entrainment occur.

A dry cooling tower designed to dissipate waste heat to the atmosphere would eliminate circulating water-related impacts of operating the new units, but it also has some disadvantages. In comparing dry cooling and wet cooling, EPA (66 FR 65256) found there are additional expenses associated with dry cooling, making this technology less cost effective. In addition, to achieve the necessary cooling, dry systems must move a large amount of air through a heat exchanger, and the fans that move the air consume a significant amount of power. This, in turn, would increase the environmental impacts of fuel use and spent fuel transport and storage relative to the net electrical power production. The fans and the large volume of air required for cooling also result in elevated noise levels. The dry cooling system would also occupy more land than a mechanical or natural draft wet-cooling tower system, affecting site land use and increasing terrestrial impacts.

Hybrid wet/dry cooling towers employ both a wet section and a dry section and reduce or eliminate the visible plumes associated with wet cooling towers. Consumptive water use for the hybrid wet/dry cooling alternative is bounded by the wet cooling towers water use. Compared to the wet cooling towers, less evaporation, make-up water, and blowdown are involved in the hybrid wet/dry process, therefore reducing water-related impacts. However, the disadvantages of dry cooling still apply to the dry cooling portion of the heat dissipation process. The dry cooling process is not as efficient as the wet cooling process because it requires the movement of a large amount of air through the heat exchanger to achieve the necessary cooling. This results in a net loss of electrical power for distribution, which would increase the environmental impacts of fuel use and spent fuel transport and storage. In addition, the hybrid wet/dry cooling towers would occupy more land than a wet cooling tower system, affecting site land use and increasing terrestrial impacts.

Even with the disadvantages described above, a dry or hybrid wet/dry cooling system could be a preferred option if a wet tower system would cause significant adverse impacts to water availability, water quality, or aquatic resources. However, as described in Sections 5.3 and 5.4.2, the staff found that the impacts of the proposed natural draft, wet tower system water use, water quality, and aquatic resources would be SMALL. Therefore, based on the increased environmental impacts related with increased land use, fuel use, spent fuel transport, spent fuel storage, and the small impact that the proposed natural draft wet-cooling tower would have on the site environment and the Savannah River, the staff concludes that a wet cooling tower system is preferable to either dry or hybrid wet/dry cooling system for VEGP Units 3 and 4.

9.4 Region of Interest and Alternative Site-Selection Process

NRC regulations require that the ER submitted in conjunction with an application for an ESP include an evaluation of alternative sites to determine whether any obviously superior alternative exists to the site proposed (10 CFR 52.17(a)(2)). This section includes a discussion of Southern's ROI for possible siting of a new nuclear power plant and Southern's alternative site-selection process.

9.4.1 Southern's Region of Interest

Generally, the ROI is the geographic area considered in searching for candidate ESP sites (NRC 2000). The ROI is typically the State in which the proposed site is located or the relevant service area for the proposed plant (NRC 2000).

Southern selected its three-state service area (Alabama, Georgia, and Mississippi) as its ROI (Southern 2007a). Southern's designated ROI is consistent with the preceding ROI description in NRC's Environmental Standard Review Plan for preparation of ERs for nuclear power stations. The staff concludes that the ROI used in Southern's ESP application is reasonable for consideration and analysis of potential ESP sites. The staff also finds that Southern's basis for defining its ROI did not arbitrarily exclude desirable candidate ESP locations.

9.4.2 Southern's Site-Selection Process

Southern determined that the advantages of co-locating new nuclear generating units with an existing power plant owned by Southern outweighed the potential advantages of other possible siting alternatives (Southern 2007a). The following potential advantages of co-location were identified by Southern (Southern 2007a):

- The total number of required generating sites is reduced.

- Construction of new transmission line rights-of-way may not be required due to potential use of existing rights-of-way.

- No additional land acquisitions would be necessary, and Southern can readily obtain control of the property.

- The site has already gone through the alternatives review process mandated by the National Environmental Policy Act (NEPA) of 1969, and was the subject of extensive environmental screening during the original site-selection process.

- The site development costs and environmental impact of any preconstruction activities would be reduced.

- Construction, installation, and operation and maintenance costs would be reduced because of existing site infrastructure.

Based on the preceding advantages, Southern limited its identification of potential sites for new nuclear generation units to sites with existing electric power generation facilities owned by Southern. Within its ROI, Southern selected the following existing Southern plant sites as potential sites for new nuclear units (Southern 2007d):

Alabama	Georgia
Plant Barry (coal)	Plant Bowen (coal)
Plant Gaston (coal)	Plant Branch (coal)
Plant Gorgas (coal)	Plant Hammond (coal)
Plant Greene County (coal)	Plant Scherer (coal
Plant Miller (coal)	Plant Hatch (nuclear)
Plant Farley (nuclear)	Plant Vogtle (nuclear)
The Barton Site (nuclear greenfield)	

The Barton site is an undeveloped greenfield site in central Alabama that was originally proposed for a four-unit nuclear plant in the 1970s, but never developed (Southern 2007a).

Southern's principal criteria for selecting the potential sites were the availability of sufficient land for two Westinghouse AP1000 reactors and the availability of sufficient cooling water for the units (Southern 2007d).

Southern screened its list of potential sites to the following candidate sites: Plant Farley, Plant Hatch, the Barton greenfield site, and the VEGP site. In selecting the four candidate sites, Southern's existing plant sites with coal-fired power plants were eliminated for the following reasons (Southern 2007d):

- Co-located nuclear plants offer distinct advantages because of existing infrastructure and support facilities.

- The environmental impacts of the existing Southern nuclear facilities are known and the impacts of a co-located new facility should be comparable to those of the operating nuclear plant.

- Site physical criteria, primarily geologic/seismic suitability, have been characterized at the existing Southern nuclear sites; these factors are very important in determining site suitability.

- Electric power transmission infrastructure is available at the existing Southern nuclear sites and the sites have nearby power markets.

- The existing Southern nuclear sites have local support and the availability of experienced personnel.

For the screening of the four candidate sites to a proposed site, Southern performed an environmental analysis for each candidate site. The analysis is documented in Section 9.3 of Southern's ER and the results are summarized in Tables 9.3-2 and 9.3-3 of the ER (Southern 2007a). Southern's analysis considered the land use, water-related, ecological, and socioeconomic impacts of locating two new Westinghouse AP1000 reactors at each candidate site. On the basis of its environmental analysis, Southern selected the VEGP site as its proposed ESP site. In making this selection, Southern determined that none of the other three candidate sites was obviously superior to the proposed VEGP site (Southern 2007a).

The staff reviewed the siting methodology used by Southern and concluded that Southern's process for selecting potential and candidate sites and its proposed site was reasonable. In conducting its review, the staff took into account that the NRC's environmental review guidance for alternative nuclear plant sites (Environmental Standard Review Plan 9.3) recognizes there would be special cases for which the proposed site for a new nuclear generating plant was not selected on the basis of a systematic site-selection process (NRC 2000). One example cited in the guidance is when an existing nuclear power plant site previously found acceptable on the basis of a review conducted under NEPA is proposed for the siting of a new nuclear plant.

9.5 Evaluation of Alternative Sites

The three alternative ESP sites examined in detail in this section are Plant Hatch, located in Appling and Toombs Counties, Georgia; Plant Farley, located in Houston County, Alabama; and the Barton greenfield site, located in Chilton and Elmore Counties, Alabama. The staff visited each of the three alternative sites and the proposed VEGP site. The staff collected and analyzed reconnaissance-level information for each of the three alternative sites. Section 9.7 contains tables of the staff's characterization of the impacts at the alternative sites.

9.5.1 Plant Hatch

This section covers the staff's evaluation of the potential environmental impacts of siting two new nuclear units at Plant Hatch.

9.5.1.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

Plant Hatch is located in Appling and Toombs Counties, Georgia. The plant is located southeast of where U.S. Highway 1 crosses the Altamaha River (Figure 9-1). The Plant Hatch site encompasses approximately 906 ha (2240 ac). All of the industrial facilities are located in Appling County on a 542-ha (1340-ac) parcel south of the Altamaha River. The site also includes approximately 360 ha (900 ac) in Toombs County on the north side of the Altamaha

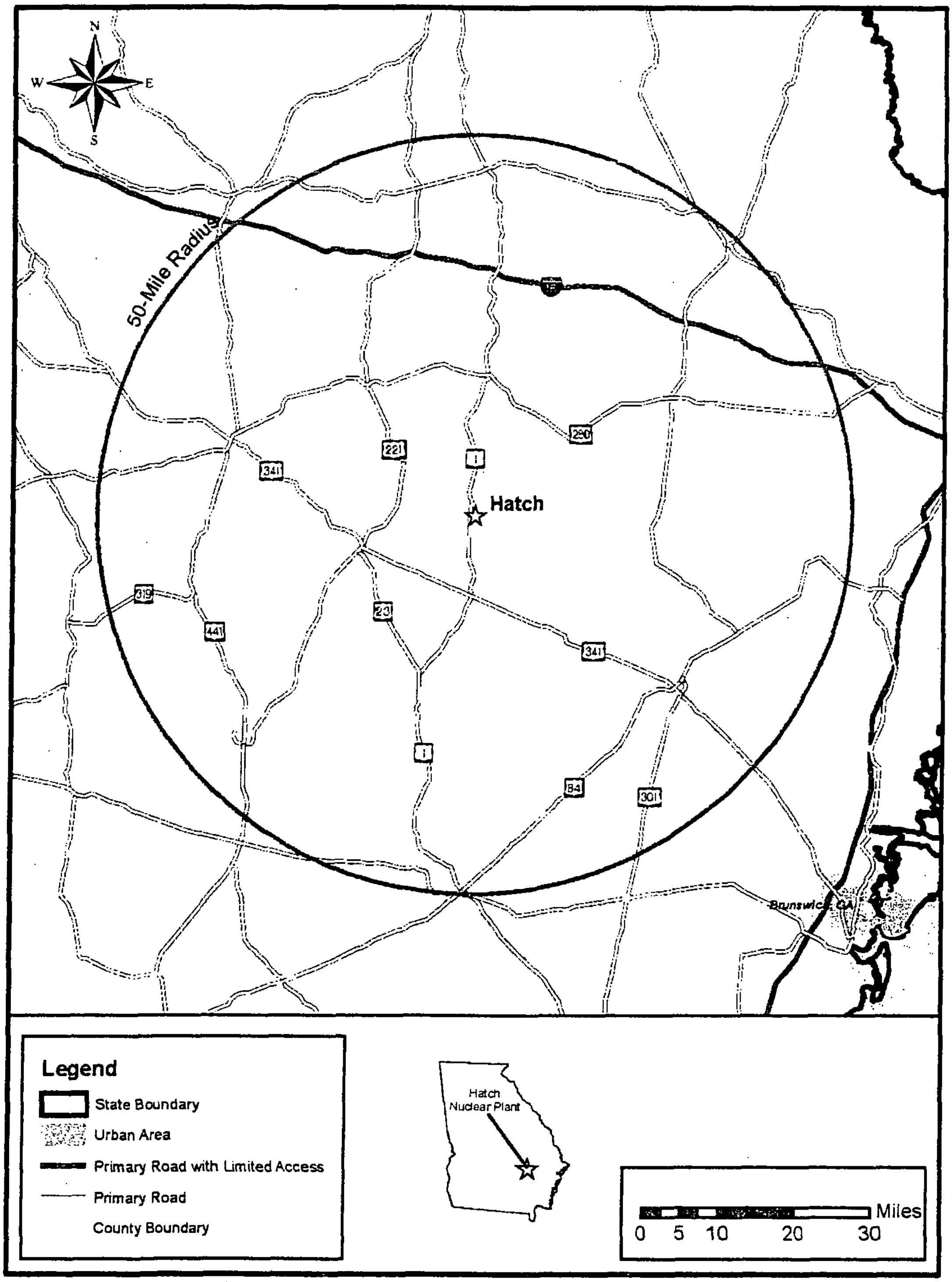


Figure 9-1. Plant Hatch 80-km (50-mi) Vicinity (Southern 2007a)

River. Approximately 142 ha (350 ac) of the plant site are composed of wetlands and transmission rights-of-way. Approximately 650 ha (1600 ac) are managed for timber production and wildlife habitat (Southern 2007a).

The land in the site vicinity is rural and characterized by low, rolling, sandy hills that are predominately forested. The Plant Hatch site is not subject to the Georgia Coastal Zone Management Act because the plant is not located within one of the designated Georgia coastal zone counties (GDNR 2003a).

No new land would be required for the siting of new nuclear reactor units at Plant Hatch. The footprint of new generating units would be approximately 120 ha (300 ac). An additional 101 ha (250 ac) would be needed for temporary facilities and laydown yards (Southern 2007a).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that the land-use impacts of constructing and operating two new nuclear reactor units at the Plant Hatch site would be SMALL.

There are six transmission lines in four transmission line rights-of-way that exit the Plant Hatch site. The transmission line rights-of-way pass through rolling hills that are primarily a mixture of cultivated land, grazing land, and managed timberlands. Southern assumed that if new nuclear reactor units were located at Plant Hatch, one new 500-kV transmission line would be needed (Southern 2007a). The new transmission line would be at least 80 km (50 mi) in length and would either be installed in a new right-of-way or an expansion of an existing right-of-way (Southern 2007c). Two of the existing transmission line rights-of-way run through counties designated under the Georgia Coastal Management Program (GDNR 2003a). Any expansion of these transmission line rights-of-way would require review under the procedures established under the Georgia Coastal Management Act. Procedures for siting new transmission lines in Georgia are discussed in Section 4.1.2 of this EIS.

Because detailed information concerning the routing of the possible new transmission line right-of-way is not known at this time, a complete evaluation of potential land-use impacts cannot be made. Nevertheless, based on the information it has available, the staff concludes that the transmission line land-use impacts of constructing two new nuclear power units at the Plant Hatch site would be SMALL to MODERATE. Operational impacts would be SMALL.

Similar to Burke County, where the VEGP site is located, Appling and Toombs Counties are designated as being unclassified or in attainment with the National Ambient Air Quality Standards (40 CFR 81.311). The air-quality impacts of constructing and operating two new nuclear reactor units at Plant Hatch would be similar to the air-quality impacts at the VEGP site. Therefore, the staff concludes that the air-quality impacts of constructing and operating two new nuclear generating units at the Plant Hatch site would be SMALL.

9.5.1.2 Water Use and Quality

The staff assumed that a new nuclear facility at Plant Hatch would withdraw make-up water from the Altamaha River, and that facility cooling water demands would be satisfied with wet towers. The staff computed the 7Q10 (lowest streamflow that occurs on 7 consecutive days and has a 10-year recurrence interval period, or a 1-in-10 chance of occurring in any one year) and the 30Q2 (lowest streamflow that occurs on 30 consecutive days and has a 2-year recurrence interval period, or a 1-in-2 chance of occurring in any one year) based on data from the U.S. Geological Survey (USGS) stream gage 02225000 (Altamaha River near Baxley, Georgia). Data collected from October 1970 to April 2007 were used to estimate the 7Q10 and 30Q2 values. This gage is approximately 19 km (12 mi) north of Baxley (Plant Hatch is located approximately 18 km [11 mi] north), and the drainage area upstream of the flow gage was reported by the USGS to be 30,000 km^2 (11,600 mi^2). The 7Q10 and 30Q2 values computed by the staff were 47 m^3/s (1660 cfs) and 76.2 m^3/s (2690 cfs), respectively. For the calendar years 1971 through 2006, the average annual-mean discharge at the gage was 319.56 m^3/s (11,285 cfs), and the minimum annual-mean discharge was 106.5 m^3/s (3762 cfs).

The net consumptive water loss for the wet towers proposed at the VEGP site was 62 cfs. Expressed as a percentage of the 7Q10 and 30Q2, the consumptive water loss for two additional units represents 4 and 2 percent, respectively, of the total flow in the Altamaha River. Southern (2007a) estimated cumulative consumptive water loss for the existing and two new units as 3.1 m^3/s (109 cfs), which represents 7 and 4 percent, respectively, of the 7Q10 and 30Q2 flows on the Altamaha River.

Any releases of contaminants to the waters of the State of Georgia would be regulated by GDNR through the NPDES permit process to ensure that water quality is protected.

Based on the requirements of the NPDES permit and the above analysis, the staff concludes that the water-use and water-quality impacts of two additional units at Plant Hatch would be SMALL.

9.5.1.3 Terrestrial Resources Including Endangered Species

The Plant Hatch site encompasses approximately 906 ha (2240 ac), including 360 ha (900 ac) in southern Toombs County and 542 ha (1340 ac) south of the Altamaha River in northern Appling County, Georgia. Approximately 120 ha (300 ac) are currently used for general operation and maintenance. Approximately 142 ha (350 ac) are composed of wetlands and transmission line rights-of-way, and approximately 650 ha (1600 ac) are actively managed for wildlife and timber production (Southern 2007a).

The largest wetlands area covers approximately 40 ha (100 ac) just east of the generating facilities and cooling towers. Wetlands on the site are typically dominated by bald cypress

(*Taxodium distichum*) and black gum (*Nyssa sylvatica*). There are approximately 280 ha (700 ac) of deciduous floodplain forest onsite in the Altamaha River floodplain; this forest is dominated by blackgum, cypress, oak (*Quercus* sp.), and hickory (*Carya* sp.) trees. There are approximately 160 ha (400 ac) of planted pine forests (loblolly [*Pinus taeda*] and longleaf [*P. palustris*] pines) on the Plant Hatch site, mostly south and southwest of the generating facilities (NRC 2001).

Southern assumed that structures required for the construction of the proposed project at the Plant Hatch site would be situated in abandoned fields or developed areas of the existing plant site, and would avoid sensitive areas such as wetlands and mature forests (Southern 2007a).

Six transmission lines encompassing about 2910 ha (7200 ac) make up the transmission system connected to the Plant Hatch site. These transmission lines occur in four rights-of-way. The Plant Hatch transmission lines are primarily within the Coastal Plain physiographic province, but the western portion of the Bonaire 500-kV transmission line enters the Sandhills physiographic province. The transmission lines extend for a distance of nearly 160 km (100 mi) in several different directions from the plant site, and therefore traverse the full range of habitat types and geophysical conditions typically found in south-central Georgia (NRC 2001). These lines traverse a variety of land-use areas including urban and suburban, agricultural, forested, sandhills, floodplains, and abandoned fields. The lines cross three designated Wildlife Management Areas: Ocmulgee, Paulk's Pasture, and the Little Satilla. Otherwise, the lines do not cross any State or Federal parks, National wildlife refuges, or State wildlife management areas. The lines do not cross any "critical habitats" as defined in the Endangered Species Act (Southern 2007a).

Construction Impacts

The footprint of a new plant would be approximately 120 ha (300 ac) and an additional 101 ha (250 ac) would be required for temporary facilities and laydown yards. The proposed project could be configured to fit within the existing, previously disturbed area of the Plant Hatch site (Southern 2007a).

Southern assumed that construction of new nuclear units at Plant Hatch would require the addition of one 500-kV transmission line, within a 60-m (200-ft) wide, 80-km (50-mi) long, transmission line right-of-way. The additional transmission line could be installed via expansion of an existing right-of-way, or it could follow a new right-of-way (Southern 2007a). At this time, the location and total number of acres and habitats that would be removed to upgrade the transmission system are not known.

Several State-listed species of concern were identified on the Plant Hatch site or within the transmission line rights-of-way during the 1998 and 1999 threatened and endangered species surveys. Bachman's sparrows (*Aimophila aestivalis*) (listed as "rare" by GDNR) were observed in the Florida and Thalmann rights-of-way. One State-listed plant species (yellow pitcher plant (*Sarracenia flava*), listed as "unusual" by GDNR) was found on the Plant Hatch site, and five State-listed species were identified on the transmission line rights-of-way. These consisted of the parrot pitcherplant (*S. psittacina*) (threatened), purple honeycomb head (*Balduina atropurpurea*) (rare), cutleaf beardtongue (*Penstemon dissectus*) (rare), yellow pitcherplant (unusual), and hooded pitcherplant (*S. minor*) (unusual) (NRC 2001). Bald eagles (*Haliaeetus leucocephalus*) (state-threatened) have been observed by GPC biologists in the vicinity of Plant Hatch (Southern 2007a).

Southern stated that land clearing associated with construction of the plant and transmission lines would be conducted according to Federal and State regulations, permit conditions, existing Southern procedures, good construction practices, and established BMP (Southern 2007a). Based on the information provided by Southern and NRC's own independent review, the staff concludes that the impacts on terrestrial resources from construction of two new nuclear units at the Plant Hatch site would be SMALL. Because of the uncertainty concerning the possible routing of a new transmission line right-of-way, the staff concludes that the terrestrial resource impacts associated with construction of the new transmission line at the Plant Hatch site could be SMALL to MODERATE.

Operational Impacts

Impacts on terrestrial ecological resources from operation of two new nuclear units at the Plant Hatch site include those associated with cooling towers and transmission lines. Impacts resulting from the operation of cooling towers and transmission lines would be of similar magnitude at all the alternative sites and, thus, cannot be used to discriminate between them. Therefore, operational impacts are discussed generically in Section 9.6.1.

Threatened and Endangered Species

Threatened and endangered species surveys were conducted in 1998 and 1999 to evaluate the presence of plant and animal species listed or proposed by the U.S. Fish and Wildlife Service (FWS) as endangered or threatened, or listed by GDNR as endangered, threatened, rare, or unusual on the Plant Hatch site and associated transmission lines. Several Federally listed species were observed (or evidence of these species was found) in or adjacent to existing transmission line rights-of-way during these surveys. The shed skin of an Eastern indigo snake (*Drymarchon corais couperi*) (listed as "threatened" by FWS and GDNR), was found in the North Tifton transmission line right-of-way. American alligators (*Alligator mississippiensis*) (listed as "threatened due to similarity of appearance" by FWS), were observed at survey locations in three transmission line rights-of-way. Red-cockaded woodpeckers (*Picoides borealis*) (listed as "endangered" by FWS and GDNR) were observed at two locations adjacent to the Florida transmission line right-of-way (Southern 2007a).

Endangered wood storks (*Mycteria americana*) were not detected during the 1998 and 1999 field surveys, but have been observed by GPC biologists and natural resources managers in the general area of the Plant Hatch site. This species is not believed to be nesting in the vicinity of the plant. Wood storks have been observed in a beaver pond wetlands just east of the existing cooling towers. Southern stated that land clearing associated with construction of the plant and transmission lines would be conducted according to Federal and State regulations, permit conditions, existing Southern procedures, good construction practices, and established BMP (Southern 2007a).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that the impacts to threatened and endangered species from construction of two new nuclear units at the Plant Hatch site would be SMALL. Because of uncertainty concerning the possible routing of the transmission line right-of-way, the staff concludes that the threatened and endangered species impacts associated with construction and operation of the new transmission lines at the Plant Hatch site could be SMALL to MODERATE.

9.5.1.4 Aquatic Resources Including Endangered Species

The Altamaha River is the major source of water for Plant Hatch. The Altamaha River, is relatively undisturbed and has no channelization, dredging or major reservoirs. The existing Plant Hatch withdraws cooling water from the Altamaha River through a single intake structure located on the southern shoreline. The intake structure was designed and located to have the ability to intake water under all river conditions including low flow and probable flood levels. Water is discharged back into the river via two lines 384 m (1260 ft) downstream from the intake and approximately 1.2 m (4 ft) below low flow levels (NRC 2001).

The GDNR has classified the Altamaha River as a "High-Priority Water" of the State because of the presence of high-priority species and diverse aquatic communities within the river's watershed. The designation is designed to protect aquatic biodiversity in the State and is part of the state's comprehensive wildlife conservation strategy, which is detailed in "Georgia's Wildlife Action Plan" (GDNR 2007a).

The Altamaha River supports 74 species of fish representing 25 different families. The predominant families of fish found in the river include sunfish (Centrarchidae), minnows (Cyprinidae), suckers (Catostomidae), and catfish (Ictaluridae). Those species available for recreational fishing in the river include the redbreast sunfish (*Lepomis auritus*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), black crappie (*Pomoxis nigromaculatus*), flathead catfish (*Pylodictis olivaris*), and channel catfish (*Ictalurus punctatus*). The flathead catfish is an exotic species introduced into the Altamaha River system in the 1970s and it appears to be causing the decline in several native fish species populations (GDNR 2003b).

In addition to the freshwater species noted above, several species of anadromous fish are also found in the Altamaha River. Anadromous fish hatch in freshwater, migrate to saltwater to grow and mature, and then return to freshwater to spawn. The anadromous species found in the Altamaha include American shad (*Alosa sapidissima*), hickory shad (*A. mediocris*), blueback herring (*A. aestivalis*), Atlantic sturgeon (*Acipenser oxyrinchus*) and the shortnose sturgeon (*A. brevirostrum*). The American shad is an important commercial species in Georgia and the Altamaha River supports the largest shad harvest in the State. At one time, the two species of sturgeon were also fished commercially from the river, but due to declining populations the shortnose sturgeon is now listed as a Federally endangered species and the commercial fishery is closed for both species (GDNR 2003b).

Five years of data were collected from 1975 to 1980 for monitoring of entrained and impinged fish at the intake structure of Plant Hatch. The total number of individual fish collected during the five years was 165 specimens representing 22 different species. The majority of the species were collected only once during each of the five years. The most abundant species collected was the hogchoker (*Trinectes maculatus*) (NRC 2001). One sturgeon larva was collected in the vicinity of Plant Hatch in the 1970s. Identification of the specimen to species was not possible (NRC 2004a).

In 1998, Southern commissioned a freshwater mussel survey of the Altamaha River throughout a 19-km (12-mi) reach upstream and downstream of Plant Hatch. The survey documented viable populations of 12 different mussel species, most of which were considered by FWS and GDNR to be "species of concern" (Southern 2007a). Species of concern are those species whose population numbers are in decline, whose habitat is rapidly disappearing, or whose status is unknown.

Construction Impacts

New cooling water intake and discharge structures would be required to support additional units at Plant Hatch. Construction of a new intake would result in the temporary displacement of aquatic biota within the vicinity of the intake. It is expected that these biota would return to the area after construction is complete. Sedimentation due to disturbances of the river bank and bottom could impact local benthic populations. However, the impacts on aquatic organisms would be temporary and largely mitigable through the use of BMP. The impact on the aquatic ecology of the Altamaha River would be SMALL.

In addition, a new 500-kV transmission line with a 60-m (200-ft) wide, 80-km (50-mi) long, right-of-way would be needed. The additional transmission line could be installed via expansion of an existing right-of-way, or it could follow a new right-of-way (Southern 2007a). Because no information on routing has been provided, the impacts to the aquatic ecosystem in waterbodies crossed by the new right-of-way is not known. However, assuming the use of good management practices during construction, the staff concludes that the impacts would be SMALL to

MODERATE depending on where the right-of-way is routed and whether a new or existing right-of-way is used.

Operation Impacts

Impingement and entrainment of organisms from the Altamaha River would be the most likely aquatic population impacts that could occur from operation of two new nuclear units at Plant Hatch. The NRC has found that entrainment and impingement of fish and shellfish has not been a problem at facilities that use the type of cooling system found at Plant Hatch (closed-cycle with cooling towers), and during the license renewal of Plant Hatch, the staff did not find any significant new information that would cause them to conclude otherwise (NRC 2001). Assuming (1) a closed-cycle cooling system that meets the EPA's Phase I regulations for new facilities (66 FR 65256), (2) a maximum through-screen velocity of 0.15 m/s (0.5 ft/s) at the cooling water intake, (3) an intake flow of less than or equal to 5 percent of the mean annual flow of the Altamaha River, and (4) a design and location of the new intake that is consistent with the existing intake, then anticipated impacts to aquatic populations from entrainment and impingement are expected to be SMALL.

Operational impacts to aquatic biota from the transmission lines would also be SMALL assuming BMP are used for maintenance of the rights-of-way.

Threatened and endangered Species

The shortnose sturgeon is the only Federally listed (endangered or threatened) aquatic species in the Altamaha River in the vicinity of Plant Hatch. It is listed as a Federal and State-endangered species. A biological assessment was initiated by the NRC in 2000 to determine the potential impact from Plant Hatch to the shortnose sturgeon in the Altamaha River. The assessment was presented by the NRC to the National Marine Fisheries Service (NMFS) in compliance with Section 7 of the Endangered Species Act. The staff specifically evaluated the potential impacts from impingement, entrainment, thermal effects, and periodic river maintenance dredging associated with continued plant operation (NRC 2004a). The staff concluded that Plant Hatch may affect, but is not likely to adversely affect, the shortnose sturgeon. The NMFS responded on August 10, 2005 by concluding that continued operation of the Hatch Plant with periodic maintenance dredging is not likely to adversely affect shortnose sturgeon (NMFS 2005).

Based on the biological opinion and assuming a new intake structure would be of similar design and location to the existing structure, it is unlikely that construction or operation of additional units at Plant Hatch would have an impact on the shortnose sturgeon populations of the Altamaha River. Therefore, impacts to the endangered shortnose sturgeon directly related to construction or operation of two additional units would be minor.

Two State-listed species of molluscs occur in the vicinity of Plant Hatch. The Altamaha arcmussel (*Alasmidonta arcula*) is a freshwater mussel that lives in sandy mud below sand bars in slow-moving water and eddies. It is listed by the State of Georgia as a threatened species because of its rarity and vulnerability (GDNR 2007b). The species is endemic to the Altamaha River system and is susceptible to excessive sedimentation and habitat destruction (NRC 2001).

The Altamaha spinymussel (*Elliptio spinosa*) is another freshwater mussel endemic to the Altamaha River system. It is a State-listed endangered species and a candidate for Federal listing as an endangered species (GDNR 2007b). This mussel can be found buried in sandbars in swift current areas of the Altamaha River. The Altamaha spinymussel is the largest spinymussel in the world. It is also highly susceptible to excessive sedimentation in the river and destruction of its limited habitat (NRC 2001).

Based on the potential for the presence of threatened mussels and mussels of concern in the Altamaha River in the vicinity of Plant Hatch, the construction could result in some impacts to mussel species; however, they would be temporary and could be mitigated by time-of-year restrictions on dredging, implementation of BMP, and relocation if needed, depending on the area of disturbance. Operation of the existing facility has not resulted in an evident impact to mussel or shortnose sturgeon populations of the Atlamaha River and therefore the impact of operation of two additional units would be expected to be SMALL.

9.5.1.5 Socioeconomics

In evaluating the socioeconomic impacts of construction at Plant Hatch near Baxley, Georgia, in Appling and Toombs Counties, the staff and Southern undertook a reconnaissance survey of the site using readily obtainable data from the Internet or published sources. The socioeconomic subsections follow the organizational structure of the socioeconomic discussions in Sections 2.8, 4.5, and 5.5. Impacts from both construction and station operation are discussed.

Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport construction materials and equipment. The Georgia State Department of Transportation is planning extensive road improvement work on the existing roads near the site, including U.S. Routes 1 and 280 (GDOT 2006). Offsite areas that would support construction activities (for example, borrow pits, quarries, and disposal sites) are expected to be already permitted and operational. Impacts on those facilities from construction of the new units would be small incremental impacts associated with their normal operation.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions. New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. Traffic at the site would also be a source of noise. Any noise coming from the proposed VEGP site would be controlled in accordance with standard noise protection and abatement procedures (Southern 2007a). By inference, this practice is also expected to apply to the Plant Hatch site. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to Plant Hatch site (Southern 2007a).

Any new units at the Plant Hatch site would have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce (Southern 2007a).

Construction activities would be temporary and would occur mainly within the boundaries of the Plant Hatch site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operations, noise levels would be managed to State and local ordinances. Air-quality permits would be required for the diesel generators, and chemical use would be limited, which should limit odors. Based on the information provided by Southern and NRC's own independent review, the staff concludes that the physical impacts of construction and operation would be SMALL.

Aesthetics

The Plant Hatch site encompasses approximately 906 ha (2240 ac) and is characterized by low, rolling sandy hills that are predominantly forested. The developed area at Plant Hatch is located near the center of a 542 ha (1340 ac) parcel on the south bank of the Altamaha River. The existing facilities at Plant Hatch are visible from portions of U.S. Highway 1 and from the adjacent reach of the Altamaha River (Southern 2007a).

The construction of new nuclear units at Plant Hatch could be viewed from offsite at certain locations, but the addition of another facility would not substantially change the view which results from the current units. There would be a need to construct cooling-water intake and discharge structures at the site. Additional mechanical or natural draft cooling towers would be required. The operation of two new nuclear units probably would have visual impacts similar to those of the existing Plant Hatch units, with the addition of more visible plumes from cooling towers. The NRC staff concludes that the marginal impacts of construction and operation of new nuclear units at Plant Hatch on aesthetics would be SMALL. However, depending on the specific routing, the aesthetic impact of a new 60-m (200-ft)-wide, 80-km (50-mi)-long transmission line right-of-way could be MODERATE.

Demography

The Plant Hatch site is located in Appling and Toombs Counties, near the town of Baxley, Georgia. The population distribution around the site is relatively low and dispersed with typical rural characteristics. In the year 2000, U.S. Census data indicates that Appling County had a population of 17,419 and Toombs County had a population of 26,067. The total population within 80 km (50 mi) of the site was approximately 387,582 people (19.3 persons per km^2), and the population within 32 km (20 mi) of the site was 58,752 people (18.3 persons per km^2). The nearest large population center (as defined in 10 CFR 100.3), is Savannah, Georgia, (population approximately 131,510) located approximately 108 km (67 mi) northeast of the Plant Hatch site (Southern 2007a).

Based on the analysis of construction impacts presented in Section 4.5.2 of this EIS, construction of new nuclear units at Plant Hatch would increase the population in the 80-km (50-mi) region during the construction phase by approximately 6700 people (Southern 2007a). The majority of the current Plant Hatch workforce lives in Appling (30 percent) or Toombs (41 percent) Counties. The remaining employee residences are distributed throughout 28 counties, mostly within 80 km (50 mi) of the site. Southern assumes that the residential distribution of the construction workforce would resemble the residential distribution of the current Plant Hatch workforce. Of the total population increase, 2010 people (30 percent of 6700) would settle in Appling County and 2747 people would settle in Toombs County. These numbers constitute 11.5 percent and 10.5 percent of the 2000 populations of Appling and Toombs Counties, respectively.

Impacts are generally considered to be small if plant-related population growth is less than 5 percent of the study area's total population and moderate if growth is between 5 and 20 percent (NRC 2001). The construction employees and their families would represent MODERATE increases to population in Appling and Toombs Counties and SMALL elsewhere in the 80-km (50-mi) region.

Southern assumes that operation of new units at the VEGP site (see Section 5.5.2) would increase the population by 1750 people in the 80-km (50-mi) region. Once again, assuming that approximately 30 percent would settle in Appling County and 41 percent would settle in Toombs County, the resulting population increase in the region resulting from plant operation would represent a 3 percent increase for Appling County and a 2.8 percent increase for Toombs County and current population levels. The demographic impacts associated with operation of the two new units would be SMALL.

Social and Economic Impacts

Economy

Based on 2000 census data, within the region surrounding Plant Hatch, 55,445 persons are in the labor force. Appling County's business profile is led by manufacturing (18.4 percent of the county's total employment), followed by educational, health, and social services (17.9 percent), and construction (11.7 percent). The unemployment rate for Appling County in 2004 was 6.1 percent, compared with 4.6 percent for the State of Georgia. In neighboring Toombs County, the business profile is led by educational, health, and social services (18.4 percent of the county's total employment), followed by manufacturing (14.9 percent), and retail trade (9.9 percent). The unemployment rate in Toombs County was 6.0 percent in 2004 (Southern 2007a).

Economic impacts would be spread across the 80-km (50-mi) region but would be greatest in Appling and Toombs Counties. Impacts are generally considered small if plant-related employment is less than 5 percent of the study area's total employment and moderate if employment is between 5 and 10 percent (NRC 1996). During the construction of the new units, up to 4400 construction workers would be required to build the plant (at the peak construction phase) and most of these would need to in-migrate to the region. The peak construction workforce would represent more than 5 percent of the current workforce in the region and NRC staff concludes that the impacts of construction on the economy of the region would be MODERATE and beneficial, but temporary.

The wages and salaries of the operating and construction workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors. This would have a positive impact on the business community and could provide opportunities for new businesses to get started, and increased job opportunities for local residents.

Once the new units are operational, approximately 660 new operations jobs would be added to the local economy. Southern assumes that all of these new operations workers would have to move to the region from outside the region. These new jobs would constitute a small percentage of the total number of jobs in the region (1 percent within 80 km [50 mi] of the plant).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that a significant number of construction laborers would need to in-migrate to the area and the number of jobs added to the region during the construction phase would have MODERATE impacts on the local economy. Once the new units are operational, 660 jobs would be added to the local economy; however, this would only constitute a small growth rate in jobs relative to the total number of existing jobs in the region, and the economic impacts would be SMALL and beneficial.

Taxes

As with new proposed units at the VEGP site (Sections 4.5.3 and 5.5.3), there would be some positive sales, use, income, and corporate tax revenue benefits that would be generated as a result of the construction and operation of new units at Plant Hatch. Sales, use, income, and corporate taxes would be paid directly to the State general fund; thus, the regional marginal impacts would be minimal. The primary tax impacts would occur once the new units become valued as property assets and property tax revenues are collected by Appling County according to the millage rate negotiated on value of the plant. Southern anticipates that it would begin paying annual property taxes to Appling County for new units at Plant Hatch during construction of the project. Assuming a 40-year operational life, property taxes to Appling County could average between $20,000,000 and $29,000,000 annually during the first decade of operation and between $3,500,000 and $5,000,000 annually during the last decade of operation, based on the changing value of the plant (Southern 2007a). The current Plant Hatch property taxes made up 68 percent of Appling County's total property tax revenues in 1998 (NRC 2001). The NRC staff concludes that the potential beneficial impacts of taxes collected during construction would be MODERATE and beneficial and LARGE and beneficial during operation in Appling County, and SMALL and beneficial in the remainder of the 80-km (50-mi) region, assuming Georgia tax law remains unchanged.

Summary of Social and Economic Impacts

Based on the information provided by Southern, and NRC's own independent review, the staff concludes that the overall socioeconomic impacts of construction and operation of two new units at the Plant Hatch site would be LARGE and beneficial to Appling County, MODERATE and beneficial in Toombs County, and SMALL and beneficial elsewhere in the 80-km (50-mi) region.

Infractructure and Community Services

Transportation

Road access to Plant Hatch is via U.S. Highway 1, the major north-south highway route bisecting Appling and Toombs Counties. U.S. Highway 1 is a four-lane highway from Baxley past Plant Hatch where it enters Toombs County and becomes a two-lane road north of Plant Hatch to Interstate 16. Interstate 16 is the major east-west freeway serving the area. In 2004, the annual average daily traffic count for the highway was 5050 vehicles south of the Plant Hatch site and 4700 vehicles north of the site. The State plans to widen the entire highway to four lanes, which would provide four-lane access from Baxley all the way to Interstate 16 (GDOT 2006). Right-of-way acquisition for the widening project is anticipated to begin in 2007, and construction would begin after 2008 (Southern 2007a).

Assuming construction shifts as described in Section 4.5.3.3, an additional 2200 cars could be on the highway during shift change, causing potential congestion. Also, the traffic of hauling construction materials (100 trucks per day) to the site could cause additional congestion on U.S. Highway 1 during certain times of the day. Heavy congestion and delays could be experienced if planned road improvements on U.S. Highway 1 occur during construction of new nuclear units at Plant Hatch. Transportation impacts are expected to be MODERATE when increases in traffic begins to cause delays or other operational problems. Overall, impacts of construction on transportation would likely be MODERATE and some mitigating actions would need to be undertaken. With respect to operation of the facility, adding an additional 600 cars during the afternoon shift (see shift assumptions in Section 5.5.3.3) to the existing traffic on the road would not strain current road capacity. Shift changes for the current units and new nuclear units at Plant Hatch could be staggered so that the traffic increase would not cause congestion, which would be particularly important during the outage periods when nearly 1000 additional temporary contract workers would be employed to perform outage operations. Impacts of the operations workforce would be SMALL once the two new units are operational.

Recreation

Recreational facilities located within the boundaries of the Plant Hatch site include a 40-ha (100-ac) tract of land west of U.S. Highway 1 used as a Boy Scout Camp, a wayside park, an employee recreation area, and the Plant Hatch Visitors Center. Other recreational facilities within 16 km (10 mi) of Plant Hatch include the Altamaha River, the Bullard Creek Wildlife Management Area, Grays Landing, and miscellaneous parks and sports facilities operated by the city of Baxley. During construction of new nuclear units at Plant Hatch, it is anticipated that access to onsite recreational facilities could be interrupted during periods of peak activity but other recreational facilities in the region could accommodate typical users of the onsite facilities. The attractiveness of the Altamaha River for sport fishing and other recreational uses could be impacted during construction of intake and discharge structures. Other recreational facilities could be affected by increased traffic on area roads during peak travel periods, but impacts could be minimized by informing the public of any potential traffic issues and notable construction activities (Southern 2007a). The NRC staff concludes that the likely impacts of plant construction and operation on tourism and recreation would be SMALL.

Housing

According to 2000 U.S. Census data, Appling County had 7854 housing units, 1248 of which (15.9 percent) were vacant. Toombs County had 11,371 housing units, 1494 of which (13.1 percent) were vacant. Jeff Davis County had 5581 housing units, 753 of which (13.5 percent) were vacant. Montgomery County had 3492 housing units, 573 of which (16.4 percent) were vacant, and Tattnall County had 8578 housing units, 1521 of which (17.7 percent) were vacant (Southern 2007a).

Based on the analysis in Section 4.5.2, approximately 6700 construction workers and their families would in-migrate to the 80-km (50-mi) region during the construction of two new units at Plant Hatch. Currently, available housing in the two-county area (Appling and Toombs Counties) is minimally adequate to accommodate the expected influx of workers. Workers could also find housing in other parts of the 80-km (50-mi) region or construct new housing; however, the impacts of in-migrating workers would likely be MODERATE in terms impacting housing demand and prices and rental rates in Appling and Toombs Counties and possibly other neighboring counties, depending on settlement patterns.

Southern assumes that operation of new nuclear units at Plant Hatch would increase the population in the 80-km (50-mi) region by 1750 people (see Section 5.5.2). Assuming approximately 30 percent would settle in Appling County and 41 percent would settle in Toombs County, the current housing supply in each respective county could accommodate all the new families expected in Appling and Toombs Counties. The impact of operating the new units on housing is therefore likely to be SMALL.

Public Services

Construction and plant operations would not draw water or produce wastewater that would use municipal systems; however, the influx of construction workers and plant operations staff settling in the region would impact local municipal water and water treatment facilities. In Appling County, the municipalities of Baxley and Surrency are the only county areas served by public water supply systems. Baxley provides water service within the city and outside the city limits in certain areas through a distribution system that currently uses four wells screened to the Floridan Aquifer. According to data collected in 2000, the wells can produce approximately 11.7 million liters per day (L/d) (3.1 million gpd). The estimated demand on the wells is 2.3 million L/d (600,000 gpd). Considering this estimated demand, Baxley has approximately 9.5 million L/d (2.5 million gpd) of available capacity. The town of Surrency has two wells also pumping from the Floridan Aquifer. In 2000, these wells were capable of producing 1.1 million L/d (290,000 gpd). Toombs County has three municipal water systems: Vidalia, Lyons, and Santa Claus. All three municipalities withdraw their water from the Floridan Aquifer. According to data collected in 2000, Lyons has a capacity of 16.3 L/d (4.3 million gpd), with an estimated demand of 2.6 million L/d (700,000 gpd). This leaves a reserve capacity of 13.6 million L/d (3.6 million gpd). Vidalia has the capacity to pump 18.5 million L/d (4.9 million gpd) and estimated demand requires 7.6 million L/d (2.0 million gpd), leaving a reserve capacity of approximately 11.0 million L/d (2.9 million gpd). Santa Claus is served by one well, for which capacity and demand data are not available (NRC 2001). Considering the excess capacity in these systems, the influx of the construction and operations workforce would only have a SMALL marginal impact on these public services.

For a relatively small community, the major influx of construction workers may produce moderate impacts on police and fire services, commensurate with demographic and housing impacts in Appling and Toombs Counties. Medical services would also be expected to be limited in the region; however, Southern could mitigate use of the local medical systems during the construction phase of the project by providing extensive first aid onsite to treat minor injuries and ailments. The employment of additional construction workers and operations staff would not be expected to significantly strain the social services provided in the region.

Considering the excess capacity in the current water and waste treatment system the public utility system could easily accommodate the influx of workers to the region. The impacts on public utilities would likely be SMALL. For many of the other public services provided in the region, the overall impact would be expected to be SMALL.

Education

Appling County has four elementary schools, one middle school, and one high school. Total enrollment in all the schools was approximately 3400 during the 2006 school year. Toombs County has three elementary schools, one middle school, and one high school. Total enrollment for 2006 was 2840 students. The city of Vidalia has its own school system, including primary, elementary, and middle schools, and one high school. Total enrollment in the Vidalia school system for the 2006 school year for preschool through grade twelve was 2606 students (NCES 2007).

Based on the analysis in Section 4.5.3.7, new nuclear units at Plant Hatch would increase the school-aged population in the 80-km (50-mi) region by 1500 during the peak of the construction phase. Assuming that 30 percent would settle in Appling County and 41 percent would settle in Toombs County, the student population would increase by 450 in Appling County and by 615 in Toombs County, representing roughly 13 percent of total 2006 enrollment in Appling County and 12 percent in Toombs County. There may potentially be MODERATE impacts on the local school system during the construction phase of the project at Plant Hatch; however, considering the corresponding tax benefits that would be received in Appling, it is possible some of these impacts could be mitigated, depending on the time these benefits are generated and received by the county.

Based on the analysis in Section 5.5.3.7, Southern assumes that operation of new nuclear units at Plant Hatch would increase the school-aged population in the 80-km (50-mi) region by 464 people. Approximately 30 percent would settle in Appling County and 41 percent would settle in Toombs County. The Appling County student population would increase by 3.2 percent and the Toombs County student population would increase by 2.8 percent. These increases in student population are below 4 percent of the total student populations in Appling and Toombs Counties, hence project-related enrollment increases would constitute a SMALL impact on the education systems.

Summary of Infrastructure and Community Services

Based on the information provided by Southern and NRC staff's independent review, the staff concludes that impacts on infrastructure and community services from construction and operation of two new nuclear units at Plant Hatch would be SMALL to MODERATE and adverse during the construction phase of the project. During the operation phase of the ESP project, community service and infrastructure impacts would likely be SMALL.

Summary of Socioeconomics

In summary, on the basis of information provided by Southern and NRC's own independent review, the staff concludes that the impacts of the construction and operations at the Plant Hatch site on socioeconomics would be MODERATE adverse impacts in terms of transportation, housing, public service, and educational impacts during construction phase. The impacts on the Appling County economy and tax base during plant operatoin likely would be beneficial and LARGE. A portion of the tax increase could be used to improve local transportation infrastructure and educational facilities to accommodate the population growth.

9.5.1.6 Historic and Cultural Resources

The likley footprint for new nuclear units at Plant Hatch does not appear to have any historic properties located within areas likely to be impacted by new construction and operations. Miscellaneous archaeological surveys conducted over the years in the area indicate that while sites may exist on the premises, either the sites are not eligible for listing on the National Register of Historic Places or are located away from likely areas of new construction. Protective measures would be put in place in the event that historic or archaeological materials are discovered during construction or during operations. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the Georgia SHPO and would consult with them in conducting an assessment of the discovery to determine if additional work is needed. The impacts on historical and cultural resources are predicted to be SMALL at the Plant Hatch site.

9.5.1.7 Environmental Justice

The 2000 Census and block groups were used for ascertaining minority and low-income populations in the area. There are 337 block groups within an 80-km (50-mi) radius of Plant Hatch. Black minority populations exist in 55 block groups; "Aggregate of Minority Races" populations exist in 63 block groups; "Hispanic Ethnicity" minority populations exist in 5 block groups; and "All Other Single Minorities" exist in 3 block groups. No other minority populations exist in the geographic area. The Census Bureau data characterize 12.64 percent of Georgia households as low income. There are 41 block groups out of the possible 337 that contain a low-income population percentage that exceed that State's average by 20 percent or more. There are no minority or low-income populations within a 10-km (6-mi) radius of Plant Hatch.

Construction activities (noise, fugitive dust, air emissions, traffic) would not disproportionately adversely affect minority populations because of their distance from Plant Hatch. Minority and low-income populations would most likely benefit from construction activities through an increase in construction-related jobs in the region. The operation of the proposed project at Plant Hatch is also unlikely to have a disproportionate impact on minority or low-income populations. In the Plant Hatch License Renewal EIS, the NRC noted that no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately adversely affected have been identified. In addition, no location-dependent disproportionate adverse impacts affecting these minority and low-income populations have been identified or observed (NRC 2001).

The impacts associated with construction and operation of two new units at Plant Hatch on minority and low-income populations is expected to be SMALL. See Section 5.7 for more information on environmental justice impacts.

9.5.2 Plant Farley

This section covers the staff's evaluation of the potential environmental impacts of siting new nuclear units at Plant Farley.

9.5.2.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

Plant Farley is located in Houston County, Alabama (Figure 9-2). The plant is located on the west side of the Chattahoochee River about 10 km (6 mi) north of the intersection of U.S. Highway 84 and State Highway 95. The Plant Farley site encompasses approximately 749 ha (1850 ac) (Southern 2007a). Approximately 200 ha (500 ac) are used for nuclear power generation and maintenance facilities, laydown areas, parking lots, and roads. The remainder of the site consists of forested areas, ponds, wetlands, and open fields. Approximately 200 ha (500 ac) of the existing Plant Farley site would be needed if new nuclear reactor units were located at Plant Farley (Southern 2007a).

The land in the vicinity of Plant Farley is rural and is forested or used as farmland. The Plant Farley site is not subject to the Alabama Coastal Zone Program because the Program only applies in Baldwin and Mobile Counties (ADEM 2005).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that the land-use impacts of constructing and operating new nuclear reactor units at the Plant Farley site would be SMALL.

There are six transmission lines that exit the Plant Farley site. The rights-of-way pass through rolling hills that are primarily a mixture of forests and farmland. Southern assumed that if two new nuclear generating units were located at Plant Farley, one new 500-kV transmission line would be needed (Southern 2007a). The new transmission line would be installed in a new 60-m (200-ft)-wide right-of-way and would be approximately 16 km (10 mi) long. Southern would obtain needed State and Federal permits related to construction of a new transmission line (NRC 2007). Based on the information it has available, the staff concludes that the transmission line

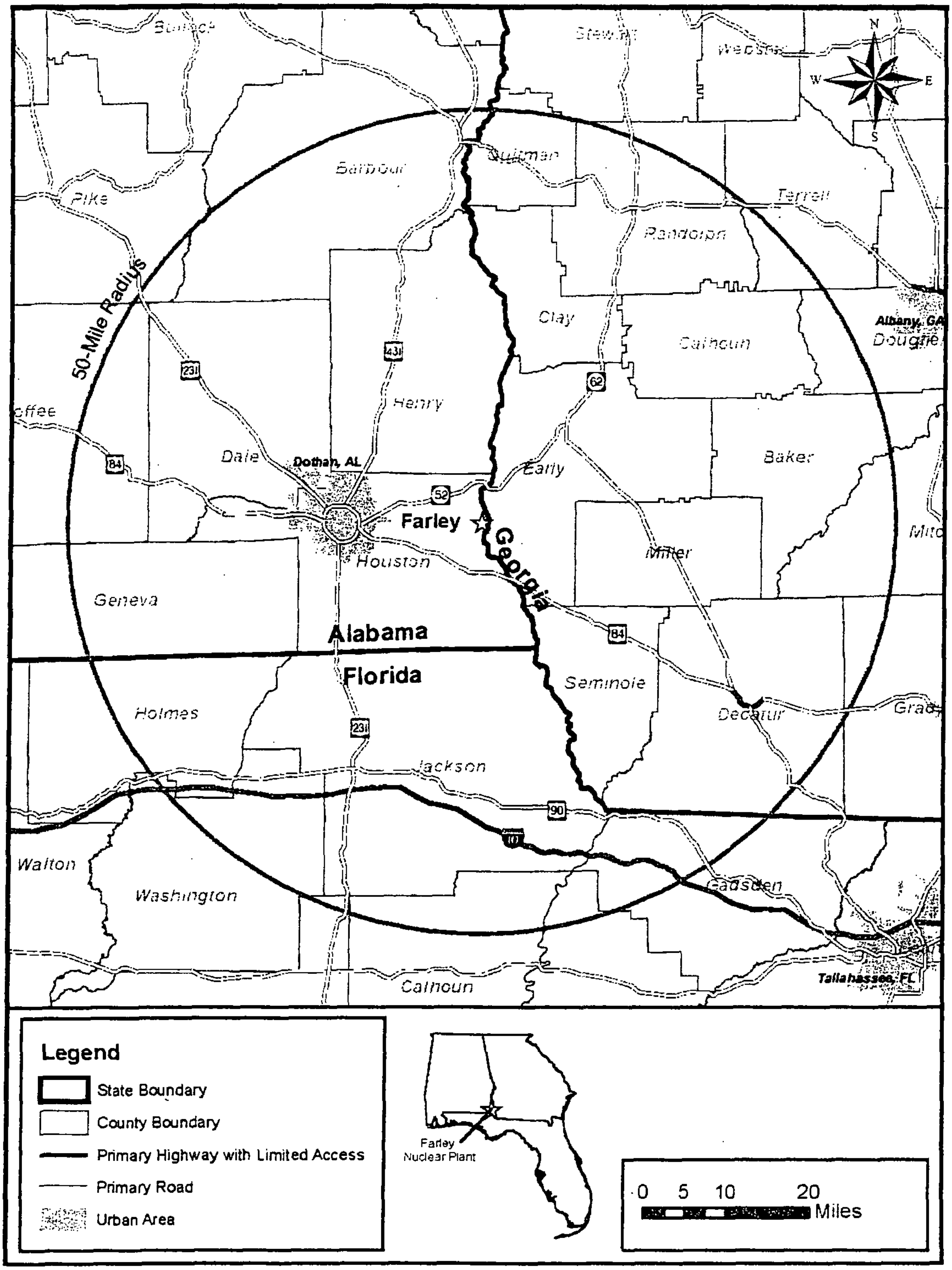


Figure 9-2. Plant Farley 80-km (50-mi) Vicinity (Southern 2007a)

right-of-way land-use impacts of constructing two new nuclear reactor units at the Plant Farley site would be MODERATE. Operational impacts would be SMALL.

Similar to Burke County, Georgia, where the VEGP site is located, Houston County is designated as being unclassified or in attainment with the National Ambient Air Quality Standards (40 CFR 81.301). The air-quality impacts of constructing and operating two new nuclear reactor units at Plant Farley would be similar to the air-quality impacts at the VEGP site. The staff concludes that the air-quality impacts of constructing and operating two new nuclear reactor units at the Plant Farley site would be SMALL.

9.5.2.2 Water Use and Quality

The staff assumed that two new nuclear units at Plant Farley would withdraw make-up water from the Chattahoochee River, and that facility cooling water demands would be satisfied with wet towers. The staff computed the 7Q10 and the 30Q2 based on data from USGS stream gage 02343801 (Chattahoochee River near Columbia, Alabama). Data collected from October 1975 to September 2005 were used to estimate the 7Q10 and 30Q2 values. This gage is approximately 3 km (2 mi) south of Columbia, and the drainage area upstream of the flow gage was reported by the USGS to be 21,264 km^2 (8210 mi^2). The 7Q10 and 30Q2 values computed by the staff were 56.4 m^3/s (1990 cfs) and 119 m^3/s (4200 cfs), respectively. For the calendar years 1976 through 2005, the average annual-mean discharge at the gage was 308.60 m^3/s (10,898 cfs), and the minimum annual-mean discharge was 140.17 m^3/s (4950 cfs).

The net consumptive water loss for the wet towers proposed at the VEGP site would be 1.76 m^3/s (62 cfs) (Southern 2007a). Expressed as a percentage of the 7Q10 and 30Q2, the consumptive water loss for two additional units sited at Plant Farley represents 3 and 1 percent, respectively, of the total flow in the Chattahoochee River. Southern (2007a) estimated cumulative consumption net loss for the existing and two new units at 2.5 m^3/s (90 cfs), which represents 5 and 2 percent, respectively, of the 7Q10 and 30Q2 flows in the Chattahoochee River.

Any releases of contaminants to the waters of the State of Alabama would be regulated by the Alabama Department of Environmental Management (ADEM) through the NPDES permit process to ensure that water quality is protected.

Based on the requirements of the NPDES permit and the above analysis, the staff concludes that the water-use and water-quality impacts of two additional units at Plant Farley would be SMALL.

9.5.2.3 Terrestrial Resources Including Endangered Species

Plant Farley encompasses approximately 749 ha (1850 ac) on the west bank of the Chattahoochee River. It is located near the boundary of the Dougherty Plain and Southern Red Hills physiographic regions of the east Gulf Coastal Plain. Two major topographical subdivisions occur at the site: (1) gently rolling upland west of the Chattahoochee River Valley and (2) the river terraces and floodplain of the Chattahoochee River. This contributes to a diverse distribution of habitats, with diverse wildlife and plant species. Habitats at Plant Farley consist of a river bluff forest, ravine forest, flood plain forest, pine-mixed hardwood forest, pine forest, non-flood plain wetlands and mowed grassy areas (NRC 2005).

Approximately 200 ha (500 ac) of the site are used for nuclear power generation and maintenance facilities. The developed areas are primarily located on a plateau approximately one-half mile west of the river, with the area adjacent to the river mostly undeveloped. The remainder of the site consists of forested areas, ponds, wetlands, and open fields. Alabama Power Company manages about 530 ha (1300 ac) of this land as a wildlife preserve. Construction of the proposed project at Plant Farley would require that a portion (up to 223 ha [550 ac]) of the wildlife preserve be cleared for development (Southern 2007a). The Farley Wildlife Management Plan strategies include managing vegetation to promote and protect diverse habitats, periodic thinning or logging of pine timber stands, mowing grassy areas, and installing nest boxes. The Wildlife Habitat Council has recognized Plant Farley as a certified corporate wildlife habitat for its wildlife and land management efforts since 1992 (NRC 2005).

Most of the floodplain forests are dominated by high floodplain or ridge floodplain species. On the ridges and in the high floodplains, willow oak (*Quercus phellos*), shumard oak (*Q. shumardii*), bitternut hickory (*Carya cordiformis*), sweetgum (*Liquidambar styraciflua*), swamp chestnut oak (*Q. michauxii*), and American cherrybark oak (*Q. pagoda*) are present. Along the river in early successional areas, sycamore (*Platanus occidentalis*), silver maple (*Acer saccharinum*), and black willow (*Salix nigra*) dominate. In sloughs, backwaters, and poorly-drained areas, bald cypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), red maple (*Acer rubrum*), and laurel oak (*Q. laurifolia*) are commonly found (NRC 2005).

Several non-floodplain wetlands occur on the Plant Farley site. Most of these are generally weedy marsh areas with scattered red maple, sweetgum, black willow, and buttonbush (*Cephalanthus occidentalis*) woody species. Plume grass (*Erianthus* sp.), woolgrass bulrush (*Scirpus cyperinus*), needlerushes (*Juncus* spp.), and other wet-site emergent, non-woody species are also found in these wetlands. One wetlands area has a broad expanse of open water dominated by water lillies (*Nuphar lutea* and *Nymphaea odorata*), water shield (*Brasenia schreberi*), and non-woody marsh grasses such as woolgrass bulrush and common needlerush (*Juncus effusus*) (NRC 2005).

The hardwood bottoms in the vicinity of the river include species such as the water oak (*Q. nigra*), white oak (*Q. alba*), and tuliptree (*Liriodendron tulipifera*). The hardwood areas and mixed pine-hardwood areas along the streams and in the upland areas consist of various oaks, sweetgum, and poplar (NRC 2005).

The forested portions of the site contain terrestrial wildlife species typically found in similar habitats in southern Alabama. Common mammals at the site include the gray squirrel (*Sciurus carolinensis*), raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), armadillo (*Dasypus novemcinctus*), eastern cottontail (*Sylvilagus floridanus*), and white-tailed deer (*Odocoileus virginianus*). Wading birds (egrets and herons) occur in wetlands, along the edges of ponds, and along the Chattahoochee River. Numerous bird species (e.g., common bobwhite [*Colinus virginianus*], blue jay [*Cyanocitta cristata*], and various warblers), and several reptile and amphibian species, including the Alabama State-protected gopher tortoise (*Gopherus polyphemus*) occur at the site (Southern 2007a).

Six transmission lines connect the Plant Farley site to the transmission grid. These include approximately 525 km (326 mi) of lines that occupy approximately 2403 ha (5938 ac) of the transmission line rights-of-way (Southern 2007a). The transmission line rights-of-way are located primarily within the east Gulf Coastal Plain physiographic province. The region is characterized by sandy soils and flat to gently rolling terrain. The transmission line rights-of-way traverses primarily forests or farmland. There are no areas designated by the FWS as critical habitat for endangered species at the Plant Farley site or adjacent to any of the associated transmission line rights-of-way. The Raccoon Creek-Tifton transmission line right-of-way crosses Elmodel Wildlife Management Area in western Georgia. The South Bainbridge right-of-way crosses the Lake Seminole Wildlife Management Area in southwestern Georgia. The lines do not cross any other State or Federal parks, National wildlife refuges, or State wildlife management areas (Southern 2007a; NRC 2005).

Two State-listed plant species (Thorne's [swamp] buckthorn [*Sideroxylon thornei*] and Florida willow [*Salix floridana*]), and two plant species listed as unusual by GDNR (yellow pitcher plant [*Sarracenia flava*] and hooded pitcher plant [*Sarracenia minor*]) were found in plant surveys conducted on the Plant Farley site and related transmission line rights-of-way in 2001 to 2002. Both species of pitcher plants were found along the Farley-Raccoon Creek-Tifton transmission line. No other State-listed plant species were observed on the transmission line rights-of-way during the surveys (NRC 2005).

State-listed animal species observed on the Farley site and related transmission line rights-of-way during recent surveys include the gopher tortoise (*Gopherus polyphemus*), eastern coachwhip snake (*Masticophis flagellum flagellum*), dusky gopher frog (*Rana capito*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and southeastern pocket gopher (*Geomys pinetis*). In addition, Bachman's sparrow (*Aimophila aestivalis*), listed as rare in Georgia, and the little blue heron (*Egretta caerulea*) listed as a species of special concern in Florida, have been observed on Plant Farley transmission line rights-of-way. Bachman's sparrows were heard singing at two locations on the Farley-South Bainbridge right-of-way. The little blue heron was observed foraging in a marsh on the Farley-Sinai Cemetery right-of-way (NRC 2005).

Construction Impacts

Southern assumed that the construction of the proposed project at Plant Farley would require the addition of one 500-kV transmission line requiring a 60-m (200-ft)-wide transmission line right-of-way. This line would be 16 km (10 mi) long and connect to the Webb Substation and would require an additional 96.3 ha (238 ac) of transmission line right-of-way (NRC 2007). The land in the vicinity of the Farley-Webb transmission line right-of-way is mainly agricultural with a few portions of the transmission line right-of-way traversing small isolated wetlands and forested areas. Widening this transmission line right-of-way by 61 m (200 ft) would not result in the crossing of any additional State or Federal lands or other conservation areas (Southern 2007a).

With the exception of the transmission line rights-of-way, all construction activities associated with the new units at the Plant Farley site would occur on the existing property. During construction of the proposed project at the Plant Farley site, wildlife would be permanently displaced from 121 ha (300 ac) dedicated to the project and associated support facilities and temporarily displaced from an additional 101 ha (250 ac). Currently maintained as a wildlife preserve by Alabama Power Company, clearing this area would result in a reduction of wildlife habitat onsite. Approximately 320 ha (800 ac) of wildlife preserve would remain at the Plant Farley site (Southern 2007a).

Based on the lack of available information regarding the habitats that would be removed during construction onsite and for the new transmission line right-of-way, information provided by Southern, and NRC's own independent review, the staff concludes that the impacts on terrestrial resources from construction of two new nuclear units at the Plant Farley site would be MODERATE and construction associated with the new transmission line right-of-way could be SMALL to MODERATE.

Operational Impacts

Impacts on terrestrial ecological resources from operation of two new nuclear units at Plant Farley site include those associated with cooling towers and transmission lines. Impacts resulting from the operation of cooling towers and transmission lines would be of similar magnitude at all the alternative sites and, thus, cannot be used to discriminate between them. Therefore, operational impacts are discussed generically in Section 9.6.1.

Threatened and Endangered Species

Thirteen Federally listed threatened and endangered terrestrial species are known to occur in the vicinity of the Plant Farley site or its transmission lines: the endangered gray bat (*Myotis* *grisescens*), the endangered Indiana bat (*Myotis sodalis*), the endangered wood stork (*Mycteria americana*), the endangered red-cockaded woodpecker (*Picoides borealis*), the threatened (due to similarity of appearance) American alligator (*Alligator mississippiensis*), the threatened Eastern indigo snake (*Drymarchon corais couperi*), the endangered flatwoods salamander (*Ambystoma cingulatum*), the threatened crystal lake nailwort (*Paronychia chartacea minima*), the endangered chaffseed (*Schwalbea americana*), the endangered fringed campion (*Silene polypetala*), the endangered gentian pinkroot (*Spigelia gentianoides*), the endangered Florida torreya (*Torreya taxifolia*), and the endangered relict trillium (*Trillium reliquum*)(Southern 2007a).

Land disturbance required to site the proposed nuclear power plants at the Plant Farley site would take place in Houston County. Two Federally listed terrestrial species are known to occur in Houston County: the Eastern indigo snake and the flatwoods salamander. Suitable habitat for the Eastern indigo snake exists at the Plant Farley site and this species could potentially exist onsite. Before construction activities begin, Southern would perform a detailed survey to ensure protection of the endangered Eastern indigo snake (Southern 2007a).

In fall 2006, the NRC contacted the FWS (Daphne, Alabama) regarding the potential presence of threatened and endangered species at the VEGP site and three alternative sites for two new units. The FWS responded that they had recently reviewed listed species present on the Plant Farley site and along existing transmission lines in Alabama, as part of Southern's efforts to extend the operating license of Plant Farley Units 1 and 2. The FWS stated as long as new units at the Plant Farley alternative site would be constructed on the existing Plant Farley property and that the facility would continue to follow FWS guidelines for protecting wildlife and habitat, Federally listed threatened and endangered (T&E) species would not likely be adversely affected. FWS requested that Southern evaluate whether appropriate habitat may exist for the bald eagle and flatwoods salamander in any newly proposed transmission line right-of-way (FWS 2006).

Southern stated that habitat preferred by the flatwoods salamander does not exist at the Plant Farley site or along the Webb transmission line right-of-way and with the exception of the Eastern indigo snake, it is unlikely that any other Federally listed wildlife species occur at the Plant Farley site or along the Farley-Webb transmission line right-of-way (Southern 2007a). Based on the lack of information regarding the actual habitats that would be removed during construction onsite and for the new transmission corridor, information provided by Southern, and NRC's own independent review, the staff concludes that the impacts to threatened and endangered species from construction of two new nuclear units at the Plant Farley site and construction associated with the addition of a transmission line right-of-way could be SMALL to MODERATE.

9.5.2.4 Aquatic Resources Including Endangered Species

Southern currently withdraws water from the lower Chattahoochee River for Plant Farley. The principal aquatic resources at the site are associated with the Chattahoochee River. Other important aquatic habitats include the 44.1-ha (108-ac) service and make-up water pond (on the Plant Farley site) and a few small creeks onsite (NRC 2005).

The fish community of the Chattahoochee River in vicinity of the Plant Farley site is diverse, composed of a mix of common southeastern stream species (many of which adapt well to reservoir conditions), species typically found in swamps and backwaters of rivers, and a small number of migratory and semi-migratory species. Approximately 92 species are known to occur in the Chattahoochee River system and approximately two-thirds of these species can be found in the lower Chattahoochee (NRC 2005). Some of the fishes commonly observed or collected in the lower Chattahoochee near the Plant Farley site include longnose gar (*Lepisosteus osseus*), redfin pickerel (*Esox americanus*), river redhorse (*Moxostoma carinatum*), greater jumprock (*Moxostoma. lachneri*), green sunfish (*Lepomis cyanellus*), redbreast sunfish (*L. auritus*), channel catfish (*Ictalurus punctatus*), several common minnow species (*Notropis spp.*), bowfin (*Amia calva*), spotted sucker (*Minytrema melanops*), chain pickerel (*Esox niger*) and flier (*Centrarchus macropterus*). Several other fish species found in the Chattahoochee River in the vicinity of the Plant Farley site are adapted to a range of environmental conditions and are abundant in the rivers, lakes, reservoirs, and swamps across the Southeast. These include gizzard shad (*Dorosoma cepedianum*), common carp (*Cyprinus carpio*), blacktail shiner (*Cyprinella venusta*), bluegill (*L. machrochirus*), and largemouth bass (*Micropterus salmoides*) (NRC 2005).

Recreational fisheries in the area harvest several species of bass, including striped bass (*Morone saxatilis*), white bass (*M. chrysops*) and hybrid bass (the palmetto bass, *M. chrysops x saxatillis*).

Small numbers of catadromous American eels (*Anguilla rostrata*) are also found in the lower Chattahoochee River in vicinity of the Plant Farley site. Catadromous species live in freshwater habitat, and migrate to saltwater to spawn. Small numbers are found year-round in the Chattahoochee River in the vicinity of the Plant Farley site (NRC 2005).

Studies of the benthic populations in the river indicate that species diversity and abundance of freshwater mussels have declined since the early 20th century and dramatically over the last several decades. The decline has been attributed to erosion and sedimentation (from land clearing and intensive farming in the area), dredging, snag removal, channel modifications (for navigation), introduction of dams and associated impoundments, runoff of agricultural chemicals and animal wastes (chiefly poultry), mining activities, and wastewater treatment facility discharges (NRC 2005).

During the 2004 mussel survey below the Plant Farley outflow, it was noted that the loose sandy substrate did not provide anchoring for native mussels and that in the total search, only a few old shells of mussels, and no live specimens, were found (Yokley 2004). The wide-variety of mussel species that were once abundant in the Chattahoochee River are apparently now restricted to remnant and isolated populations in small headwater streams, and common, single-species populations in impoundments on the river (Brim Box and Williams 2000). In addition, the Asiatic clam (*Corbicula fluminea*) has become established in the Chattahoochee River system and is competing with the native mussel populations for resources. The Asiatic clam is a highly invasive, non-native mussel species that crowds out desirable endemic species. It has a higher tolerance to pollutants and is known to clog intake pipes, damage industrial water systems, alter aquatic habitat, and disrupt irrigation canals.

Construction

Construction of a new cooling water intake for two additional units, would result in temporary displacement of aquatic biota within the Chattahoochee River. It is expected that the disturbance to aquatic resources would be localized and of short duration and that the aquatic biota would return to the area once construction is complete. Sedimentation due to disturbances of the river bank and bottom could impact local benthic populations. However, the impacts on aquatic organisms would be temporary and largely mitigable through the use of BMP. Based on the information provided by Southern and NRC's own independent review of additional information, the staff concludes that the depending on the method of construction and any need for dredging, the impact on aquatic resources at Plant Farley could be SMALL to MODERATE.

It is assumed that the proposed project would require the addition of one 500-kV transmission line requiring a new 60-m (200-ft)-wide transmission line right-of-way. This line would connect to the Webb Substation and would require an additional 96.3 ha (238 ac) of transmission line right-of-way. The land in the vicinity of the Farley-Webb transmission line right-of-way is largely agricultural with a few portions of the transmission line right-of-way traversing small isolated wetlands and forested areas (Southern 2007a). The exact location of the transmission line right-of-way is not currently known. Because no information on routing has been provided, the impacts to the aquatic ecosystem in water bodies that would be crossed by the new right-of-way is not known. However, assuming the use of BMP during construction, the staff concludes that the impacts would be SMALL to MODERATE depending on the specific routing of the right-of-way.

Operation

Impingement and entrainment of aquatic organisms from the Chattahoochee River would be the most likely impacts that could occur from operation of two new units at Plant Farley. The NRC has found that entrainment and impingement of fish and shellfish has not been a problem at facilities that use the type of cooling system found at Plant Farley (closed-cycle with cooling towers).

During license renewal at Plant Farley, the staff determined that the impacts to aquatic resources from issues such as water use, entrainment and impingement of fish and shellfish, thermal plume barrier, and low dissolved oxygen, would be SMALL; no new and significant information had been identified during the analysis that would have given a different conclusion (NRC 2005). Assuming (1) a closed-cycle cooling system, (2) a maximum through-screen velocity of 0.15 m/s (0.5 ft/s) at the cooling water intake, (3) an intake flow of less than or equal to 5 percent of the mean annual flow of the Chattahoochee River, and (4) a design and location of the new intake that is consistent with the existing intake, the anticipated impacts to aquatic populations from entrainment and impingement are expected to be SMALL. After reviewing the recent NRC staff assessment for license renewal at the Farley site and the additional information provided by Southern, the staff concludes that the potential for adverse operational impacts to aquatic resources from two additional units at Plant Farley would be SMALL.

The staff also concludes that the operational impacts to aquatic biota from the transmission lines would also be SMALL, assuming BMP are used for right-of-way maintenance.

Threatened and Endangered Species

Several Federally or State-listed protected species are currently or historically located within the two counties associated with the Plant Farley site. The site itself is located within Houston County, Alabama, and the section of the Chattahoochee River adjacent to the site is located within Early County, Georgia. Both states and the FWS were contacted regarding the presence of threatened and endangered species located within those two counties. The species identified by the agencies are provided in Table 9-5. Based on the limited scientific information available, it appears that most, if not all, of these species have been extirpated from this section of the river due to damming of the river, habitat loss and degradation, siltation, and sedimentation. Though activities at the Plant Farley site would not directly impact any of these species, site activities could affect the ability of a species to reestablish itself in the area. Some species on the list, although known to currently exist within the said counties, are located in other parts of the county far outside the area of impact.

As part of its review of Southern's application to renew the Plant Farley operating licenses, the NRC submitted a biological assessment to the FWS (NRC 2004b). The FWS concurred that renewal of the operating license was not likely to adversely affect any Federally listed threatened and endangered species (FWS 2004).

In the fall of 2006, the FWS was again contacted by the NRC regarding the potential presence of threatened and endangered species at Plant Farley for two new units. The Daphne, Alabama, field office responded that they had recently reviewed listed species present on the site, in the mixing zone of the Chattahoochee River, and along existing transmission lines in Alabama, as part of Plant Farley's relicensing efforts. The FWS concurred with the NRC finding that reissuance of the operating license for Plant Farley was not likely to adversely affect any Federally listed threatened and endangered species in Alabama or in the Chattahoochee River. Based on the assumption that new units at the Plant Farley alternative site would be constructed

Table 9-5. Aquatic Threatened and Endangered Species within Vicinity of the Plant Farley Site

Species	Alabama State Status (Houston Co.)	Georgia State Status (Early Co.)	Federal Status
Fish			
Alabama shad *Alosa alabamae*	Protected		
bluenose shiner *Pteronotropis welaka*		Threatened	
Gulf sturgeon *Acipenser oxyrinchus desotoi*	Protected		Threatened
Invertebrates			
Choctaw bean *Villosa choctawensis*	Protected	Candidate	Candidate
delicate spike *Elliptio arctata*		Endangered	
Gulf moccasinshell *Medionidus penicillatus*	Protected	Endangered	Endangered
inflated spike *Elliptio purpurella*		Threatened	
oval pigtoe *Pleurobema pyriforme*	Protected	Endangered	Endangered
shiny rayed pocketbook *Hamiota subangulata*	Protected	Endangered	Endangered
southern sandshell *Lampsilis australis*	Protected		Candidate

ALNHP 2007; GDNR 2007b; FWS 2007a, b

on the existing Plant Farley property and that the facility would continue to follow FWS guidelines for protecting wildlife and habitat, the FWS stated that they could again concur with a "not likely to adversely affect determination" for Alabama listed species (FWS 2006).

If the new units at Plant Farley were to require expansion of the mixing zone or an increase in discharge volumes, the FWS requested that surveys be conducted for the presence of the Southern sandshell (*Lampsilis australis*) and Choctaw bean (*Villosa choctawensis*), if suitable habitat exists within the area of impact. These two species are currently candidate species. Candidate species are not afforded protection through the Endangered Species Act, however, it is possible that their listing status could change before completion of the permitting process and beginning of construction. The FWS further requested that habitat surveys for Federally listed species be conducted for any new transmission line rights-of-way (FWS 2006).

Based on the information provided by Southern and NRC's own independent review of the Plant Farley operating license renewal EIS and associated studies, and opinion from the FWS, the staff concludes that the overall impact to Federally listed threatened and endangered species from construction and operation of two new nuclear units at the Plant Farley site would be SMALL.

9.5.2.5 Socioeconomics

In evaluating the socioeconomic impacts of construction at Plant Farley, Southern undertook a "reconnaissance" survey of the site using readily obtainable data from the Internet or published sources. The NRC staff performed its own review of the data. The socioeconomic subsections follow the organizational structure of the socioeconomic discussions in Sections 2.8, 4.5, and 5.5. The impacts expected from both construction and station operation are discussed.

Physical Impacts

The potential construction activities associated with constructing two new units at Plant Farley could potentially cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways and waterways would be necessary to transport construction materials and equipment. All construction activities would occur within the existing Plant Farley site. Offsite areas that would support construction activities (for example, borrow pits, quarries, and disposal sites) are expected to be already permitted and operational. Impacts on those facilities from construction of new nuclear units would be small incremental impacts associated with their normal operation (Southern 2007a).

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions. New nuclear units would produce noise from the operation of pumps, fans, transformers, turbines, generators, and switchyard equipment. Traffic at the site would also be a source of noise. However, noise attenuates quickly so ambient noise levels would be minimal at the site boundary. Also, Plant Farley is located in a rural area surrounded by forests and agricultural land, so residents in the area are sparse. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the site (Southern 2007a).

New nuclear units would have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, the proposed project would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce.

Construction activities would be temporary and would occur mainly within the boundaries of the Plant Farley site. Offsite impacts would represent small incremental changes to offsite services. During station operations, ambient noise levels would be minimal at the site boundary. Air--quality permits would be required for the diesel generators, and chemical use would be limited, which would limit odors. Therefore, based on the information provided by Southern and NRC's own independent review, the staff concludes that the physical impacts of construction and operation would be SMALL.

Aesthetics

The developed areas at Plant Farley are primarily located on a plateau approximately one-half mile west of the Chattahoochee River, with the area immediately adjacent to the river mostly undeveloped. The remainder of the site consists of forested areas, ponds, wetlands, and open fields. Two major topographical subdivisions exist at the site: (1) gently rolling upland west of the Chattahoochee River Valley and (2) the river terraces and flood plain of the Chattahoochee River. Habitats at the Plant Farley site consist of river bluff, forest, ravine forest, flood plain forest, pine-mixed hardwood forest, pine forest, non-flood plain wetlands, and mechanically maintained grassy areas (NRC 2005).

Construction of new nuclear units at Plant Farley could be viewed from offsite at certain locations, but the addition of new units would not substantially change the view given the existence of the current units. There would be a need to construct cooling-water intake and discharge structures at the site. Additional mechanical or natural draft cooling towers would be required. The operation of new nuclear units would have visual impacts similar to those of the existing Plant Farley units, with the addition of more visible plumes from cooling towers. Impacts of construction and operation of new nuclear units on aesthetics near Plant Farley would be expected to be SMALL. However, depending on the specific routing, the aesthetic impact of the new transmission line could be MODERATE.

Demography

Plant Farley is in Houston County, Alabama on the Chattahoochee River approximately 160 km (100 mi) southeast of Montgomery, Alabama. Based on 2000 Census data, Geneva County, located southwest of the plant, had a population of 25,764; Henry County, located north of the plant, had a population of 16,310; and Houston County had a population of 88,787 (Southern 2007a). The population within 80 km (50 mi) of the site was approximately 393,639 people (20 persons per km^2). The city of Dothan, located 27 km (17 mi) from Plant Farley, which is the city where most Plant Farley employees live, had a population of 57,737 (Southern 2007a). The population within 32 km (20 mi) of the site was 93,120 people (29 persons per km^2).

Based on the analysis construction impacts presented in Section 4.5.2 of this EIS, new nuclear units at Plant Farley would increase the population in the 80-km (50-mi) region during the construction phase by approximately 6700 people (Southern 2007a). The majority of the Plant Farley workforce lives in Houston County (77 percent) and the remaining employee residences are distributed across 22 counties in Alabama, Georgia, and Florida, mostly within 80 km (50 mi) of the site. Assuming the residential distribution of the construction workforce would resemble the residential distribution of the current Plant Farley workforce, approximately 5160 people (77 percent of 6700) or 6 percent of the 2000 population would settle in Houston County. Overall, the population increase from in-migration of construction workers would constitute 1.7 percent of the 2000 population of the 80-km (50-mi) region. The NRC staff concludes that the impacts of plant construction on increases in population could potentially be MODERATE in Houston County; however, given that it is likely that most of the in-migrating construction employees would choose to live in and around Dothan, and considering that a portion of the suburban growth in Dothan is now spreading into Dale and Henry Counties, it is more likely that this impact would be dispersed over these three counties and the impacts would be SMALL. The demographic impacts are considered SMALL in the remainder of the 80-km (50-mi) region.

Based on the analysis in Section 5.4.2, Southern assumes that operation of new nuclear units at Plant Farley would increase the population in the 80-km (50-mi) region by 1750 people. Once again, assuming that approximately 77 percent would settle in Houston County, the addition of the new employees and their families would equate to a 1.5 percent increase for Houston County. Overall, the potential increases in population would represent a SMALL increase in the total population.

Social and Economic Impacts

<u>Economy</u>

According to a 2006 report produced by the Southeast Alabama Regional Planning and Development Commission (SEARPDC), the southeast Alabama region where Plant Farley is located, has experienced a reduction in labor force due to numerous industrial plant closings in recent years. These closings primarily affected low-skill textile workers with limited opportunities elsewhere. The economy has also been negatively impacted by the General Agreement on Tariffs and Trade, which increased competition in the peanut industry with importation of foreign peanuts into the United States. Layoffs, downsizing, and closures have eliminated thousands of jobs in the region (SEARPDC 2006). Houston County's economy has seen a major shift from manufacturing to services and retail trade and the service sector now comprises a much larger percentage of the county's earnings than does manufacturing. Dothan, in Houston County, remains a regional retail and medical services center. Henry County has shown strong growth in employment and earnings attributable to manufacturing. While the percentage of employees in the manufacturing sector has decreased, the number employed has increased. Income earnings from farming continue to decrease throughout the region with the exception of Geneva County, which has benefitted from its economically profitable poultry production in recent years (SEARPDC 2006).

The total number of employees in 2000 for Houston County was nearly 60,000. Henry and Geneva Counties had 6822 and 9606, respectively (Southern 2007a). The economic impacts would likely be spread across the 80-km (50-mi) region, but would be greatest in Houston County, particularly around Dothan. During the construction of the new units, up to 4400 construction workers would be required to build the plant (at the peak construction phase) and most of these would need to in-migrate to the region. The peak construction workforce would represent approximately 7 percent of the current workforce in the region and the NRC staff concludes that the impacts of construction on the economy of the region would be MODERATE and beneficial, but temporary.

The wages and salaries of the operating and construction workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors. This would have a positive impact on the business community and could provide opportunities for new businesses to get started, and increased job opportunities for local residents.

Once the new units are operational, approximately 660 new operations jobs would be added to the local economy. Southern assumes that all of these new operations workers would have to move to the region from outside the region. These new jobs would constitute a small percentage of the total number of jobs in the region (1 percent of Houston County jobs).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that a significant number of construction laborers would need to in-migrate to the area and the number of jobs added to the region during the construction phase would have MODERATE and beneficial impacts on the local economy. Once the new units are operational, 660 jobs would be added to the local economy; however, this would only constitute a small growth rate in jobs relative to the total number of existing jobs in the region, and the economic impacts would be SMALL and beneficial.

<u>Taxes</u>

As with the new proposed units at the VEGP site (Sections 4.5.3 and 5.5.3), there would be some positive sales, use, income, and corporate tax revenue benefits that would be generated as the result of the construction and operation of new units at Plant Farley. These benefits, however, would be paid directly to the State general fund, and thus the marginal regional impacts would be minimal. The primary tax impacts would occur once the new units become valued as property assets and property tax revenues are collected by Houston County, according to the millage rate negotiated on value of the plant. Southern anticipates that it would begin paying annual property taxes to Houston County during construction of the proposed project at Plant Farley. Assuming a 40-year operational life, property taxes to Houston County could average between $20 million and $29 million annually during the first decade of operation and between $3.5 million and $5 million during the last decade of operation, based on the changing value of the plant (Southern 2007a). The current Plant Farley property taxes produced between 31 and 39 percent of Houston County's tax revenue base between 1995 and 2002 (NRC 2005). The NRC staff concludes that the potential beneficial impacts of taxes collected during construction would be MODERATE and beneficial. During operation the impacts would be LARGE and beneficial in Houston County and SMALL in the remainder of the 80-km (50-mi) region, assuming Alabama tax law remains unchanged.

Summary of Social and Economic Impacts

Based on information provided by Southern and NRC staff's independent review, the staff concludes that impacts on social and economic resources from construction and operation of two new nuclear units at the Plant Farley site would be MODERATE to LARGE beneficial impacts in Houston County and SMALL in the remainder of the 80-km (50-mi) region around the plant.

Infrastructure and Community Services

Transportation

Road access to Plant Farley is via State Road 95, a two-lane paved road with a north-south orientation. State Road 95 passes through the towns of Columbia to the north and Gordon to the south. Employees traveling from Dothan, Alabama, use either U.S. 84 or State Road 52. U.S. 84 is a four-lane highway that intersects State Road 95 near Gordon. State Road 52 crosses State Road 95 southwest of Columbia. The Alabama Department of Transportation does not maintain level-of-service designation for roadways in the State. However, a daily average of 870 cars traveled State Road 95 near Plant Farley in 2004 (Southern 2007a).

Assuming construction shifts as described in Section 4.5.3.3, an additional 2200 cars could be on the highway during shift change, causing potential congestion. Also, the traffic of hauling construction materials (100 trucks per day) to the site could cause additional congestion to State Road 95, and State Road 52 and U.S. Route 84 from Dothan during certain times of the day. Transportation impacts are generally considered SMALL when increases in traffic do not result in delays or other operational problems, and MODERATE when increases in traffic begin to cause delays or other operational problems (NRC 2005). Therefore, the NRC staff concludes that impacts of construction on transportation would be MODERATE during the peak construction period because delays or other operational problems are anticipated.

With respect to operation of the facility, adding an additional 600 cars during the afternoon shift (see shift assumptions Section 5.5.3.3) to the existing traffic on the road would not strain current road capacity. Shift changes for the current units and new units at Plant Farley could be staggered so that the traffic increase would not cause congestion, which would be particularly important during the outage periods when nearly 1000 additional temporary contract workers are employed to perform outage operations. Impacts of the commuting workforce on transportation would be SMALL during operation of the plant.

Recreation

Three U.S. Army Corps of Engineers reservoirs are in the vicinity of Plant Farley: Walter F. George Lake, George W. Andrews Lake, and Lake Seminole. All have recreational uses in including camping, boat ramps, marinas, picnic areas, playgrounds, swimming areas, and trails (Southern 2007a). Walter F. George Lake and George W. Andrews Lake are located more than 30 mi upstream of Plant Farley in Henry and Barbour Counties, Alabama, and Clay, Quitman, and Stewart Counties, Georgia. Seminole Lake is located almost 40 km (25 mi) downstream of Plant Farley on the border of Georgia and Florida, in Jackson County, Florida and Seminole and Decatur Counties, Georgia. Construction and operation of new nuclear units at Plant Farley would not impact these recreation areas because of their distance from Plant Farley. Therefore, the impacts of facility construction and operation on recreation would be SMALL.

Housing

In 2005, Houston County had 42,220 housing units, 4536 of which (10.7 percent) were vacant. In 2000, Henry County had 8037 housing units, 1512 of which (18.8 percent) were vacant, and Geneva County had 10,477 housing units with 1638 vacant (13.5 percent) (USCB 2007a). Based on the analysis in Section 4.5.2, approximately 6700 construction workers and their families would in-migrate to the 80-km (50-mi) region. Currently, available housing in the three-county area is adequate to accommodate the expected influx of workers. Workers could also find housing in other parts of the 80-km (50-mi) region or construct new housing. Given this increased demand for housing, prices of existing housing could rise; however, the overall dispersed impacts on housing within the 80-km (50-mi) region are expected to be SMALL.

Southern assumes that operation of the new units at Plant Farley would increase the population in the 80-km (50-mi) region by 1750 people, and approximately 77 percent would settle in Houston County. The current housing supply in Houston County could accommodate all the new families expected to settle in this county. The impact of operating the new units on housing is therefore likely to be SMALL.

Public Services

According to studies commissioned by SEARPDC, water related resource problems pose potential barriers to future development in Houston County due to both residential and industrial demand. Over the past 20 years, groundwater overdraft areas have developed within the region. The potentiometric surface in the vicinity of Dothan, Ft. Rucker (Dale County), and Enterprise (approximately 40 km [25 mi] west of Dothan and 50 km [31 mi] from Plant Farley) have experienced significant declines in the Nanafalia-Clayton aquifer, which is the major water supply in the area. The city of Dothan has reported a decline of 30 m (100 ft) in the depth of the aquifer, and a recommendation has been made by the U.S. Department of Agriculture, the U.S. Natural Resources Conservation Service, and the U.S. Forest Service that all water systems in the area develop a 10- to 20-year plan for additional water supplies (NRC 2005). Dothan, which is the nearest urban area to Plant Farley, is serviced by Dothan Utilities, the largest potable water supplier in Houston County. Water is pumped from various shallow and deep groundwater wells located throughout the Dothan area. As the city grows and new development occurs, water mains are constructed and extended to meet the increased demand. Dothan likely would need additional water sources and conservation measures by as early as 2020. One of the options the city is considering is constructing, by 2011, a 38 million L/d (10 million gallons per day [gpd]) surface-water treatment plant on the Chattahoochee River upstream of Plant Farley between Columbia and Plant Farley. This treatment plant would be expandable to 76 million L/d (20 million gpd). The plant would connect to the city via a 91-cm (36-in) pipe (NRC 2005).

Construction and operation of new nuclear units at the Plant Farley site would not require municipal water and treatment systems. The planned water system expansions would already be underway by the time new units would be constructed at Plant Farley, however, it is likely, considering the current system capacity constraints, that a major influx of construction workers could temporarily strain the system and impacts could be MODERATE. When the new units become operational, the minor population increase from the 660 construction workers and families would likely have SMALL impacts on the public utility system.

Dothan is equipped with police and fire protection services that are currently adequately funded and keeping up with growth in the county, in part, due to tax revenue benefits from the existing plant. Thus, the marginal impacts on these services from construction and operation workers and their families are expected to be minor. Dothan serves as the regional medical center for parts of Florida, Georgia, and southeastern Alabama; thus, Houston County is well served with medical services (NRC 2005). In addition, any of the minor injuries incurred during construction of the units could be treated onsite; thus the construction and operation of new units at Plant Farley would not be expected to overburden the local medical system. The employment of additional construction workers and operations staff would not be expected to significantly strain the social services provided in the region, and therefore such impacts are considered SMALL.

Education

In 2006, 14,870 students attended Houston County mainstream public schools. The Dothan City district is served with 18 schools (including 10 elementary schools, 3 middle schools, 2 high schools, 2 magnet schools and 1 vocational school) with enrollment at 8652, while the Houston County School District has 11 schools (including four elementary schools, one middle school, four high schools, an alternative school and a vocational school) with enrollment at 6218 (NCES 2007).

Based on the analysis in Section 4.5.3.7, new nuclear units at Plant Farley would increase the school-aged population in the 80-km (50-mi) region by 1500 during the peak of the construction phase. Assuming that 77 percent would settle in Houston County, enrollment could increase by approximately 1155 in Houston County Schools during the peak construction period. MODERATE impacts on local school systems could be expected during peak construction, because enrollment could increase as much as 8 percent over current enrollment levels; however, this county would potentially receive additional tax revenue benefits from Southern during the construction phase, which could mitigate these impacts.

Based on the analysis in Section 5.8.3.7, Southern assumes that operation of new nuclear units at Plant Farley would increase the school-aged population in the 80-km (50-mi) region by 464 people. Assuming approximately 77 percent would settle in Houston County, enrollment would only increase by 3 percent over current enrollment levels; therefore, impacts would be expected to be SMALL.

Summary of Infrastructure and Community Services

Based on the information provided by Southern and NRC's own independent review, the staff concludes that impacts on infrastructure and community services from construction and operation of two new nuclear units at the Plant Farley site would be MODERATE. Once the two new units are operational, these impacts on community services and infrastructure would likely be SMALL.

Summary of Socioeconomics

In summary, based on the information provided by Southern and NRC's own independent review, the staff concludes that the socioeconomic impacts of constructing two new nuclear units on the Plant Farley site would be SMALL, except in Houston County. In Houston County, the exceptions are as follows: the impacts on the tax base during operations would be beneficial and MODERATE; the impacts on the economy of Houston County would likely be beneficial and MODERATE, local transportation could be adversely affected and the effect is likely to be MODERATE and, similarly, social services could be strained during construction of the plant such that the impacts would be MODERATE. Schools would see a significant enrollment increase during the construction phase, which may produce MODERATE adverse impacts; however, depending on when the beneficial tax revenues from the plant begin to be paid to the county, these impacts could be fully mitigated. Once the two new reactors are operational, the socioeconomic impacts on the region would be SMALL, except in Houston County where the economic and tax impacts would likely be MODERATE to LARGE and beneficial.

9.5.2.6 Historic and Cultural Resources

The likely footprint for the construction of two new nuclear units at Plant Farley does not appear to have any historic properties located within areas likely to be impacted by new construction and operations. Miscellaneous archaeological surveys conducted over the years in the area indicate that while sites may exist on the premises, either the sites are not eligible for listing on the

National Register of Historic Places or are located away from likely areas of new construction. Protective measures would be put in place in the event that historic or archaeological materials are discovered during construction or during operations. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the Georgia SHPO and would consult with them in conducting an assessment of the discovery to determine if additional work is needed. The impacts to historic and cultural resources are predicted to be SMALL at the Plant Farley site.

9.5.2.7 Environmental Justice

The 2000 Census data and block groups were used for ascertaining minority and low-income populations in the area. Minority populations exist in the vicinity of Plant Farley, including block groups with significant black races and hispanic ethnicity populations. Low-income populations also exist in the 80-km (50-mi) radius. In Houston County, black minority and low-income minority populations exist in Dothan, approximately 27 km (17 mi) west of Plant Farley. Black minority and low-income populations also exist in Early County, Georgia, bordering Plant Farley to the east across the Chattahoochee River. The only block group with a significant hispanic ethnicity minority population is located in Gadsden County, Florida, approximately 80 km (50 mi) from Plant Farley. No significant minority or low-income populations exist within 10 km (6 mi) of Plant Farley (Southern 2007a).

Construction activities (noise, fugitive dust, air emissions, traffic, impacts to housing or public services) would not disproportionately adversely affect minority populations because of their distance from Plant Farley.

Operation of the proposed project at Plant Farley is also unlikely to have a disproportionate adverse impact on minority or low-income populations. No unusual resource dependencies, such as subsistence agriculture, hunting, or fishing were identified during the license renewal process for Plant Farley (NRC 2005). Offsite impacts from operation of the proposed project at Plant Farley to minority and low-income populations would be SMALL.

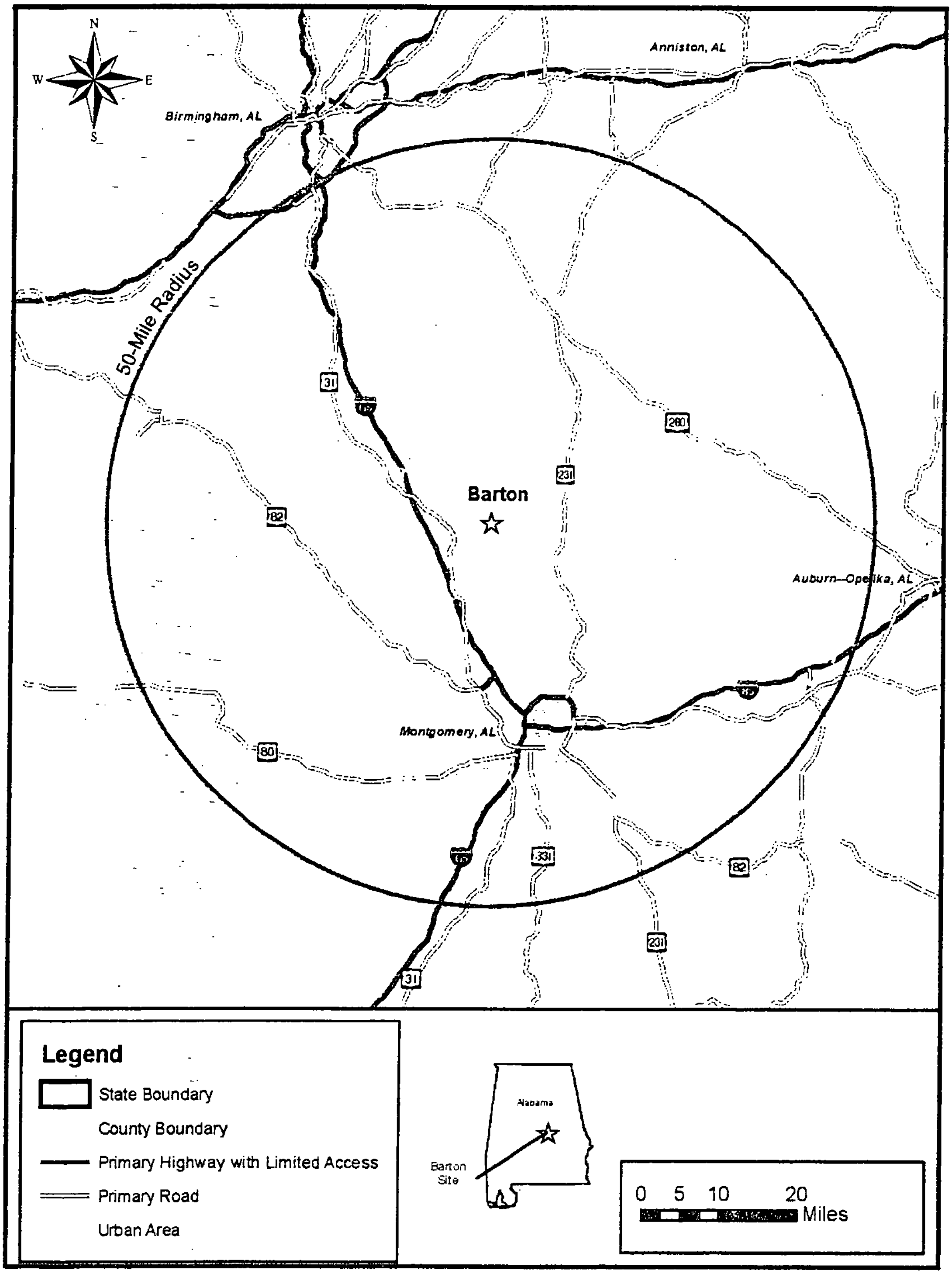
9.5.3 Barton Site

This section covers the staff's evaluation of the potential environmental impacts of siting new nuclear units at the Barton site.

9.5.3.1 Land Use, Air Quality, and Transmission Line Rights-of-Way

Southern's undeveloped Barton site is located in Chilton and Elmore Counties, Alabama (Figure 9-3). The site is located on the west side of the Coosa River between Chestnut Creek to the north and Jake Creek to the south. The Barton site encompasses approximately 1130 ha (2800 ac) (Southern 2007a). The site is mainly forested and is characterized by moderately rolling hills.

1



2 **Figure 9-3.** The Barton Site 80-km (50-mi) Vicinity (Southern 2007a)

The footprint of a new generating plant at the Barton site would be approximately 160 ha (400 ac) and an additional 61 ha (150 ac) would be required for temporary facilities and laydown yards (Southern 2007a). Because the site is undeveloped, additional land would be required for roads, parking lots, and a switchyard. State Road 22 passes approximately 6 km (4 mi) north of the Barton site at its closest point. A 6.4 km (4 mi) paved road with a 30-m (100-ft) right-of-way would be constructed to State Road 22 to provide vehicle access to the site. Development of the road would require approximately 20 ha (50 ac). A CSX Transportation railroad line passes approximately 9 km (6 mi) southwest of the Barton site at its closest point (Southern 2007c). A connecting rail spur, requiring approximately 49 ha (120 ac), would be constructed to transport materials and equipment to the site.

The land in the vicinity of the Barton site is predominately wooded, with some agricultural land and a small amount urban. The Barton site is not subject to the Alabama Coastal Zone Program because the Program only applies in Baldwin and Mobile Counties (ADEM 2005).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that the land-use impacts of constructing two new nuclear units at the Barton site would be MODERATE. Operational impacts would be SMALL.

Southern assumed that two 500-kV transmission lines requiring a 90-m (300-ft)-wide right-of-way would be needed to connect new generating units at the Barton site to Alabama Power Company's transmission system (Southern 2007a). Southern assumed that the lines would connect to the substation at the Gaston Generating Plant, which is approximately 56 km (35 mi) north of the Barton site. Routing the new transmission lines to the Gaston Generating Plant would require about 515.2 ha (1273 ac) of transmission line right-of-way (Southern 2007a). Southern would give consideration to avoiding possible conflicts with any natural or man-made areas where important environmental resources are located (Southern 2007a). Route selection would also avoid populated areas and residences to the extent possible. Lands which are currently used for forests or timber production would be altered. Trees would be replaced by grasses and other low-growing types of ground cover. The new transmission line right-of-way would not be expected to permanently affect agricultural areas, but has the potential to affect residents and forested land along the right-of-way. Southern would obtain needed State and Federal permits related to construction of a new transmission line. Based on the information it has available, the staff concludes that the transmission line land-use impacts of constructing new nuclear units at the Barton site would be MODERATE, and the operational impacts would be SMALL.

Chilton and Elmore Counties are designated as being unclassified or in attainment with the National Ambient Air Quality Standards (40 CFR 81.301). The air-quality impacts of constructing and operating two new nuclear units at the Barton site would be similar to the air-quality impacts at the VEGP site. The staff concludes that the air-quality impacts of constructing and operating two new nuclear units at the Barton site would be SMALL.

9.5.3.2 Water Use and Quality

The staff assumed that a new nuclear facility at the Barton site would withdraw all water required for the plant from the Coosa River upstream from Jordan Dam because groundwater yields at the site are very small. The staff computed the 7Q10 and 30Q2 based on data from USGS stream gage 02411100 (Coosa River at Jordan Dam near Wetumpka, Alabama). Data for the period from October 1974 to September 2005 were used to estimate the 7Q10 and 30Q2 values. The drainage area upstream of the flow gage was reported by the USGS to be 10,102 mi^2. The 7Q10 and 30Q2 values computed by the staff were 58.9 m^3/s (2080 cfs) and 111 m^3/s (3920 cfs), respectively. For the calendar years 1975 through 2005, the average annual mean discharge at the gage was 464.68 m^3/s (16,410 cfs), and the minimum annual mean discharge was 152.97 m^3/s (5402 cfs).

The net consumptive water loss for the site was assumed to be sum of the total groundwater withdrawal for the two nuclear units (0.20 m^3/s [7 cfs; 3,140 gpm]) and the proposed wet tower consumptive use 1.76 m^3/s (62 cfs), or a total of 1.95 m^3/s (69 cfs). Expressed as a percentage of the 7Q10 and 30Q2, the consumptive water loss represents 3 percent and 2 percent, respectively, of the total flow in the Coosa River.

Any releases of contaminants to the waters of the State of Alabama would be regulated by the ADEM through the NPDES permit process to ensure that water quality is protected.

Based on the requirements of the NPDES permit and the above analysis, the staff concludes that the water-use and water-quality impacts of two nuclear units at the Barton site would be SMALL.

9.5.3.3 Terrestrial Resources Including Endangered Species

The Barton site is approximately 1130 ha (2800 ac) on the west bank of Jordan Reservoir between Chestnut Creek to the north and Jake Creek to the south. Land on this site is undeveloped and predominantly forested. Habitat consists of hardwoods, pines, and mixed hardwood/pine.

Forested habitats occupy the area for about 3.2 km (2 mi) surrounding the site, and land beyond 3.2 km (2 mi) of the site is predominately a mixture of forest and agriculture. Animal species that occur on the Barton site are those typically found in similar habitats in central Alabama, such as the opossum (*Didelphis virginiana*), eastern cottontail (*Sylvilagus floridanus*), gray squirrel (*Sciurus carolinensis*), raccoon (*Procyon lotor*), white-tailed deer (*Odocoileus virginianus*), and various reptiles, amphibians, and birds. Southern assumed that at least 223 ha (550 ac) of forest would have to be cleared for the construction of the Barton Nuclear Plant and associated facilities (Southern 2007a).

There are 13 State-listed species that occur in counties within 16 km (10 mi) of the Barton site (Autauga, Chilton, Coosa, Elmore Counties) or in Talledaga County, which the transmission line right-of-way would also presumably pass through. The following State-protected species occur in these counties: seal salamander (*Desmognathus monticola*), bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), osprey (*Pandion haliaetus*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), southeastern pocket gopher (*Geomys pinetis*), southeastern bat (*Myotis austroriparius*), meadow jumping mouse (*Zapus hudsonius*), American alligator (*Alligator mississippiensis*), black-knobbed map turtle (*Graptemys nigrinoda*), Alabama map turtle (*Graptemys pulchra*), southern hognose snake (*Heterodon simus*), and alligator snapping turtle (*Macroclemys temminckii*) (ALNHP 2007).

Construction Impacts

The footprint of a new plant would be approximately 160 ha (400 ac) and an additional 61 ha (150 ac) would be required for temporary facilities and laydown yards. In addition, acreage would be required for roads, parking lots, and a switchyard. A 6.4 km (4 mi) paved road with a 30 m (100 ft) right-of-way would be constructed to provide vehicle access from State Road 22 to the Barton site. Development of the road would require approximately 20 ha (50 ac). A 9.7 km (6 mi) connecting rail spur, requiring approximately 49 ha (120 ac), would also be constructed to transport materials and equipment to the site (Southern 2007a). The land surrounding the site is predominately forested and the staff assumes a large portion of the acreage needed for roads and the rail spur would require removal of forest habitat.

Southern assumed that two 500-kV transmission lines requiring a 90-m (300-ft)-wide transmission line right-of-way would be needed to connect new generating units at the Barton site to Alabama Power Company's transmission system. These lines would connect to the substation at the Gaston Generating Plant, which is approximately 56 km (35 mi) north of the Barton site near Wilsonville, Alabama. Routing the new transmission lines to the Gaston Generating Plant would require about 515.2 ha (1273 ac) of transmission line right-of-way. During routing, consideration would be given to avoiding possible conflicts with any natural or man-made areas where important environmental resources are located (Southern 2007a).

Southern stated that land clearing associated with construction of the plant and transmission lines would be conducted according to Federal and State regulations, permit conditions, existing Southern procedures, good construction practices, and established BMP (Southern 2007a).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that the impacts to terrestrial resources from construction of two new nuclear units at the Barton site would be MODERATE and construction associated with the creation of a new transmission line right-of-way impacts could be MODERATE.

Operational Impacts

Impacts on terrestrial ecological resources from operation of two new nuclear units at the Barton site include those associated with cooling towers and transmission lines. Impacts resulting from the operation of cooling towers and transmission lines would be of similar magnitude at all the alternative sites and cannot be used to discriminate between them. Therefore, operational impacts are discussed generically in Section 9.6.1.

Threatened and Endangered Species Impacts

Formal surveys for threatened and endangered species on the Barton site (Autauga, Chilton, Coosa, Elmore Counties) have not been conducted. However, Southern is not aware of any known occurrences of Federally listed threatened and endangered species onsite (Southern 2007a). There are 13 Federally listed terrestrial plant and animal species recorded in counties within 16 km (10 mi) of the Barton site as well as Talledaga County, through which transmission lines from the Barton site would presumably pass. The following Federally listed terrestrial species occur in these counties: red-cockaded woodpecker (*Picoides borealis*), wood stork (*Mycteria americana*), Eastern indigo snake (*Drymarchon corais couperi*), Price's potato-bean (*Apios priceana*), Georgia rockcress (*Arabis georgiana*), Kral's water-plantain (*Sagittaria secundifolia*), green pitcherplant (*Sarracenia oreophila*), and Alabama canebrake pitcherplant (*Sarracenia rubra alabamensis*) (FWS 2007c). In addition, a query of the Alabama State Element Occurrence database found the American alligator (*Alligator mississippiensis*), least tern (*Sterna antillarum*), grey bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), and the Georgia aster (*Symphyotrichum georgianum*) as occurring in these counties (ALNHP 2007).

The NRC contacted the FWS (Daphne, Alabama) field office concerning Federally listed threatened and endangered species in the vicinity of the Barton site. The FWS provided preliminary comments on potential impacts to protected species by construction of two units at the site and the associated transmission lines (FWS 2006).

The FWS requested that surveys for Federally listed threatened and endangered species be conducted in suitable habitat that may be impacted by construction of the proposed project at the Barton site, including the new transmission line rights-of-way. Plant surveys need to be conducted when identifiable above-ground parts are present. These surveys should be conducted by a qualified botanist prior to any clearing or vegetative maintenance activity in the proposed transmission line right-of-way (FWS 2006).

Southern stated that field surveys would be conducted for Federally listed and State-protected species as part of the permitting process before any clearing or construction activities at the site and along associated transmission line rights-of-way and additional access roads. Land clearing associated with construction of the plant (including access roads) and transmission lines would be conducted according to Federal and State regulations, permit conditions, existing procedures implemented by Southern, good construction practices, and established BMP (Southern 2007a). Based on the information provided by Southern and NRC's own independent review, the staff concludes that the impacts to threatened and endangered species from construction of two new nuclear units at the Barton site and construction associated with addition of a new transmission line right-of-way could be SMALL to MODERATE.

9.5.3.4 Aquatic Resources Including Endangered Species

The Barton site is located on the Jordan Reservoir, a 6800-ac impoundment on the Coosa River. The lake was created in 1928 by the Alabama Power Company to provide flood control and hydroelectric power.

The Jordan Reservoir is popular for various types of recreation including boating, swimming, and fishing. Common sports fish found in Lake Jordan include the Alabama spotted bass (*Micropterus punctatus*), largemouth bass (*M. salmoides*), hybrid striped bass (*Morone chrysops x saxatilis*), bluegill (*Lepomis macrochirus*), readear sunfish (*L. microlophus*), and black (*Pomoxis nigromaculatus*) and white crappie (*P. annularis*). Additional non-game fish include channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), and flathead catfish (*Pylodictis olivaris*). The Alabama Wildlife and Freshwater Fisheries Division regularly stocks Jordan Reservoir with several bass species (ADCNR 2007).

A portion of Chestnut Creek runs through the northern section of the 1050-ha (2600-ac) Barton site and the entire site lies within the Chestnut Creek watershed. The *Lower Coosa River Basin Management Plan* (Delaney 2005) designates the Chestnut Creek watershed as a "high-priority watershed." The designation of "high priority" means that a watershed has the greatest number of features that could have a negative impact on the water quality within the watershed and typically the highest number of features to be protected. The classification is based on an 18-factor rating system that considers features such as land-use character, housing density, impaired waterbodies, and endangered species. The Chestnut Creek watershed scored the highest (negative impact) in the following areas: water-quality monitoring data, land-use character, soil suitability for development, increase in traffic volume, presence of a dam, housing density, septic system density, and number of endangered species.

The watershed also has water-quality issues associated with high nutrient levels and low dissolved oxygen (Delaney 2005). High nutrient levels can have a negative impact on oxygen levels necessary to sustain a healthy aquatic ecosystem. Excessive nutrient levels in a water-body can result in excessive plant growth. The plants then consume more oxygen than they produce leading to depleted dissolved oxygen levels which in turn taxes the aquatic species that are dependent on oxygen for survival. Jordan Reservoir has developed this "eutrophic" characteristic, in spite of the water movement through the reservoir system (Hearn 1997; Delaney 2005)

Construction

If the proposed reactors were to be constructed at the Barton site, it is assumed that Jordan Reservoir would be used as a source for cooling water. Construction of a cooling water intake structure would result in temporary displacement of fish within the vicinity of the intake construction area. It is expected that these fish would return to the area once construction was complete. Sedimentation due to disturbances of the river bank and bottom could impact local benthic species, such as mussels. Surveys of the area of disturbance would be conducted before construction to characterize the impacted populations and create a plan to mitigate the temporary construction impacts (Southern 2007a). Based on information provided by Southern and NRC's own independent review, the staff concludes that if BMP are used, construction impacts to aquatic resources at Barton site would be SMALL.

Construction of two 500-kV transmission lines requiring a 90-m (300-ft)-wide right-of-way could have impacts to aquatic habitats along the right-of-way. Because no information on the routing has been provided, the impacts to the aquatic ecosystem in waterbodies crossed by the new right-of-way is not known. However, Southern has indicated that field surveys would be conducted and BMP adhered to during right-of-way construction. Based on this information and NRC's own independent review, the staff concludes that construction impacts to aquatic resources during transmission line construction would be SMALL to MODERATE, depending on the transmission right-of-way routing.

Operation

The aquatic impact most likely to occur from operation of a new facility on the Barton site would be entrainment and impingement of organisms from Jordan Reservoir. Assuming (1) a closed-cycle cooling system, (2) a maximum through-screen velocity of 0.15 m/s (0.5 ft/s) at the cooling water intake, (3) an intake flow of less than or equal to 5 percent of the mean annual flow of the Coosa River, and (4) a design and location of the new intake that is consistent with the existing intake, the anticipated impacts to aquatic populations from entrainment and impingement ar expected to be minor. Operational impacts associated with water use and discharge cannot be determined without additional detailed analysis. However, based on the information provided by Southern and NRC's own independent review of reconnaissance-level information, the staff concludes that with proper design, the impacts to aquatic resources from operation of two new nuclear units at the Barton site would likely be SMALL.

The staff also concludes that operational impacts to aquatic biota from the transmission lines would also be SMALL assuming that BMP are used for maintenance.

Threatened and endangered Species

The FWS and Alabama Natural Heritage Program (ALNHP) list several protected species of fish, snails, and mussels within the three counties encompassed by the site and counties in which transmission lines would traverse (Table 9-6). However, none of these species is recently known to occur within an area that would be directly impacted by the Barton facility construction. Protected species known to currently inhabit the Coosa River or associated creeks, are found in areas below the Jordan Dam or above the Mitchell Dam.

The NRC contacted the FWS (Daphne, Alabama) field office concerning Federally listed threatened and endangered species in the vicinity of the Barton site. The FWS provided preliminary comments on potential impacts to protected species by construction of two units at the site and the associated transmission lines (FWS 2006). The area of greatest concern to the FWS is within the Coosa River, downstream of Jordan Dam. This reach of the river is a high-priority restoration area for the FWS and State of Alabama and is considered a classic example of "big river" habitat. The FWS, State, and Alabama Power Company spent many years coordinating efforts to ensure stabilization of habitat downstream of the dam with hopes of recolonization or reintroduction of species. This reach of the river is also habitat for several protected species and is designated as a critical habitat for nine mussel species. Critical habitat is a specific geographic area that provides essential elements necessary for survival of a threatened and endangered species. These habitats can be currently occupied by a protected species or used for reintroduction of a species to aid in its recovery.

Water-quality impacts to aquatic populations downstream of the Jordan Dam cannot fully be determined without additional detailed analysis. Such analysis would be conducted if the Barton site were selected for the new units. However, based on the location of the threatened and endangered species in the area (downstream of Jordan Dam) and because no new construction would occur in that area, and operational impacts are anticipated to be SMALL in general, the NRC staff concludes that the impacts to threatened and endangered species from construction or operation at the Barton site would be SMALL.

9.5.3.5 Socioeconomics

In evaluating the socioeconomic impacts of construction at the Barton site, Southern undertook a "reconnaissance" survey of the site using readily obtainable data from the Internet or published sources. The staff conducted some local interviews with knowledgeable local officials. The socioeconomic subsections follow the organizational structure of the socioeconomic discussions in Sections 2.8, 4.5, and 5.5. The impacts expected from both construction and station operation are discussed.

Table 9-6. Aquatic Threatened and Endangered Species Within Vicinity of the Barton Site

Species		Alabama State Status	Federal Status	County of Occurrence
Fish				
Alabama sturgeon	*Scaphirhynchus suttkusi*	Protected	Endangered	Autauga, Elmore
Alabama shad	*Alosa alabamae*	Protected		Elmore
blue shiner	*Cyprinella caerulea*	Protected	Threatened	Coosa, Talladega
coldwater darter	*Etheostoma ditrema*	Protected		Chilton, Coosa, Talladega
crystal darter	*Crystallaria asprella*	Protected		Elmore
paddlefish	*Polyodon spathula*	Protected		Elmore
slackwater darter	*Etheostoma boschungi*	Protected	Threatened	Talladega
Invertebrates				
Coosa moccasinshell mussel	*Medionidus parvulus*	Protected	Endangered	Talladega
fine-lined pocketbook mussel	*Lampsilis altilis*	Protected	Threatened	Chilton, Coosa, Elmore, Talladega
interrupted rocksnail	*Leptoxis formani*	Protected	Candidate	Elmore
lacy elimia	*Elimia crenatella*	Protected	Threatened	Talladega
painted rocksnail	*Leptoxis taeniata*	Protected	Threatened	Chilton, Elmore, Talladega
rough hornsnail	*Pleurocera foremani*	Protected	Candidate	Elmore
silt elimia	*Elimia haysiana*	Protected		Elmore
southern clubshell	*Pleurobema decisum*	Protected	Endangered	Talladega
southern pigtoe	*Pleurobema georgianum*	Protected	Endangered	Coosa, Talladega
spotted rocksnail	*Leptoxis picta*	Protected		Elmore
triangular kidneyshell	*Ptychobranchus greenii*	Protected	Endangered	Talladega
tulotoma snail	*Tulotoma magnifica*	Protected	Endangered	Coosa, Elmore, Talladega
Plant				
Kral's water-plaintain	*Sagittara secondifolia*		Threatened	Coosa

FWS 2007c; ALNHP 2007

Physical Impacts

Construction activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, and railways would be necessary to transport construction materials and equipment. The majority of construction activities would occur within the boundaries of the Barton site. However, an access road and a connecting rail spur (requiring about 69 ha [170 ac]) would be constructed on lands adjacent to the site. These new transportation rights-of-way would be routed to avoid residences and populated areas. Offsite areas that would support construction activities (for example, borrow pits, quarries, and disposal sites) are expected to be already permitted and operational. Impacts on those facilities from construction of new nuclear units would be small incremental impacts associated with their normal operation (Southern 2007a).

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and visual intrusions. The proposed project would produce noise from the operation of pumps, fans, transformers, turbines, generators, and switchyard equipment. Traffic at the site would also be a source of noise. However, noise attenuates quickly so ambient noise levels would be minimal at the site boundary. Also, the Barton site is located in a rural area surrounded by forests and agricultural land, with few residents in the area. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the site (Southern 2007a).

New nuclear units would have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, the nuclear units would not use a significant quantity of chemicals that could generate odors that exceed odor threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce. Construction activities would be temporary and would occur mainly within the boundaries of the Barton site. Offsite impacts would represent small incremental changes to offsite services supporting the construction activities. During station operations, ambient noise levels would be minimal at the site boundary. Air-quality permits would be required for the diesel generators, and chemical use would be limited, which should limit odors. Therefore, the physical impacts of construction and operation would be SMALL.

Aesthetics

The construction and operation of new nuclear units at the Barton site would have impacts on aesthetic and scenic resources. With the exception of the intake and outfall structures, which would be located on the west bank of the Jordan Reservoir, all facility structures would be built near the center of the site, which is relatively hidden from view of the public with trees and other foliage. From Jordan Reservoir, the plant may be visible from certain angles, although from most points the structures would be hidden by elevated terrain, trees, and other foliage. The intake and outfall would be visible from portions of the reservoir that are near the site.

The upper portions of facility structures may be visible from elevated areas near the site. There would be occasional visible plumes associated with the cooling towers. The visibility of the plumes would be dependent upon the weather and wind patterns, and the location of the viewer within the general topography of the area.

Southern assumed that two 500-kV transmission lines, requiring a 90-m (300-ft) wide right-of-way would be needed to connect new generating units at the Barton site to Alabama Power Company's transmission system(Southern 2007a). MODERATE aesthetic impacts are expected as a result of building and operating the new transmission line that would be installed in a 515-ha (1273-ac) right-of-way to connect to the substation at Gaston Generating Plant, approximately 56 km (35 mi) north of the Barton site. Impacts on aesthetic resources are considered to be moderate if some complaints arise about diminution in the enjoyment of the physical environment and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes. Construction and operation of an industrial facility on a previously undeveloped site and new transmission lines would likely result in some complaints from the affected public regarding diminution in the enjoyment of the physical environment (Southern 2007a). Therefore, impacts of construction and operation of the proposed project at the Barton site and additional transmission lines on aesthetics would be MODERATE and could warrant mitigation.

Demography

The Barton site is a greenfield site located in Chilton and Elmore Counties, Alabama. The population distribution around the site is relatively low and dispersed with typical rural characteristics. Based on the 2000 Census data, the total population of the four counties in the site region was approximately 161,340: 43,671 in Autauga County, 39,593 in Chilton County, 12,202 in Coosa County and 65,874 in Elmore County. The population within 80 km (50 mi) of the site was 735,226 (36.6 persons per km^2), and the population within 32 km (20 mi) of the site was 90,677 (28.2 persons per km^2). The nearest population center, as defined in 10 CFR 100.3 is Montgomery, Alabama, (population 201,568) located approximately 43 km (27 mi) south of the site (Southern 2007a).

Due to the proximity of the Barton site to Montgomery as well as to Birmingham (approximately 80 km [50 mi] to the northwest with a population of 242,820), the most populous metropolitan areas in Alabama, it is expected that a significant number of the construction workers could be drawn from the regional labor pool (USCB 2007b). It would also be expected that most of the in-migrating construction workers would choose to locate in or near these larger cities, because they are within commuter distance to the plant, and the housing and amenities would be relatively plentiful. Some employees relocating to region would also choose to reside in more rural locations; however, there is no reason to believe they would concentrate in any particular region; thus, the population impacts would be dispersed. Even when assuming the relatively high in-migration estimates presented in 4.5.2 (6700), the total influx of workers would only represent a 1 percent increase in population in the 80-km (50-mi) region; therefore, the NRC staff concludes that the demographic impacts of constructing two new units at the Barton site would be SMALL.

Approximately 800 workers (660 operations personnel plus 140 security personnel) would be required for the operation of new generating units at the Barton site (Southern 2007a). Most employees relocating to the region would likely move to the larger metropolitan areas and the remainder would be scattered throughout the counties in the region. If all 800 employees and their families were to come from outside the region, the potential increase in population in the most impacted counties would not be substantial. Overall, the potential increases in population would represent a SMALL increase in the total population for the most impacted counties.

Social and Economic Impacts

Economy

Based on 2000 census data within the four counties surrounding the Barton site, 74,683 persons are in the labor force. The overall unemployment rate for the region is lower than that of the State, which is 6.2 percent. Elmore County's business profile is led by educational, health, and social services (16.8 percent of the county's total employment), followed by manufacturing (14.5 percent), and retail trade (12.0 percent). The unemployment rate for Elmore County in 2000 was 5.0 percent. In neighboring Chilton County, the business profile is led by manufacturing (16.9 percent of the county's total employment), followed by educational, health, and social services (14.7 percent), and construction (13.1 percent). The unemployment rate in Chilton County was 4.3 percent in 2000 (Southern 2007a).

The wages and salaries of the operating workforce would have a multiplier effect that could result in increases in business activity, particularly in the retail and service sectors. This would have a positive impact on the business community and could provide opportunities for new businesses to get started, and increased job opportunities for local residents. The economic effect on the 80-km (50-mi) region would be beneficial. It is likely that the marginal impacts associated with construction of two new units at the Barton site would be beneficial to the region; however, considering that the region is relatively economically diverse, with a plentiful job supply, these impacts would be SMALL and beneficial as a result of interacting with a relatively robust economic base in the region.

Taxes

Southern anticipates that it would pay annual property taxes to Chilton and Elmore Counties, beginning during construction of the proposed project at the Barton site. Alabama assesses property at 30 percent of its value. Assuming a 40-year operational life, property taxes that would be split between Chilton and Elmore Counties could average between $15,000,000 and $21,500,000 annually for the first decade of operations and between $3,000,000 and $4,000,000 for the last decade of operations, based on the changing value of the plant (Southern 2007a). Chilton and Elmore Counties have experienced rapid growth over the past few years, consequently it is difficult to predict the degree of impact that the Barton site would have on the tax base for these counties. Assuming that the valuation of the new nuclear units at the Barton site would be similar to the Plant Farley Nuclear Plant in Houston County, tax payments for the site could represent 20 to 30 percent of the tax revenue for these counties (Southern 2007a). Therefore, the NRC staff concludes that the potential beneficial impacts of taxes collected during construction and operation of the proposed project at the Barton site would be MODERATE and beneficial in Chilton and Elmore Counties and SMALL and beneficial in the remainder of the 80-km (50-mi) region.

Summary of Social and Economic Impacts

Based on information provided by Southern and NRC's own independent review, the staff concludes that impacts on social and economic resources from construction and operation of two new nuclear units at the Barton site would be MODERATE and beneficial in Chilton and Elmore Counties and SMALL and beneficial elsewhere in the 80-km (50-mi) region.

Infrastructure and Community Services

Transportation

Road access to the Barton site would be via State Road 22, which has an east-west orientation. State Road 22 passes through the town of Rockford, Alabama to the east and merges with U.S. Highway 31 about one mile north of the town of Verbena, Alabama. Employees traveling from Birmingham and other towns north of the site would access State Road 22 from U.S. Highway 31. Employees traveling from Montgomery, Alabama and other towns south of the site would access State Road 22 from U.S. Highway 31 via State Road 111 or State Road 143. All roads on these travel routes are two-lane paved roads. The Alabama Department of Transportation does not maintain level-of-service designation for roadways in the State. However, a daily average of 1580 cars traveled State Road 22 near the Barton site in 2004. Assuming construction shifts as described in Section 4.5.3.3, an additional 2200 cars could be on a two-lane highway during shift changes, causing potential congestion. Also, the traffic of hauling construction materials (100 trucks per day) to the site could bring additional congestion to State Road 22, U.S. Highway 31 and State Roads 111 and 143 during certain times of the day (Southern 2007a).

Impacts of construction on transportation would be MODERATE and some mitigating actions would be needed.

With respect to the operations of the facility, adding at most an additional 800 cars (assuming a single occupant per car and shift changes assumed in Section 5.5.3.3) to the existing 1580 cars per day on the road would not materially congest the highway (Southern 2007a). Shift changes for the proposed project at the Barton site could be staggered so that the traffic increase would not cause congestion, which would be particularly important during the outage periods when nearly 1000 additional temporary contract workers are employed to perform outage operations. Impacts of the commuting workforce on transportation would be MODERATE during the construction phase and SMALL during the operation of the plant.

Recreation

The Barton site is currently undeveloped and is a popular area for hunters. Construction and operation of new nuclear units on the site would exclude the entire 1130 ha (2800 ac) from hunting and other recreational use for at least the estimated 40-year life of the plant.

The developed areas at the Barton site would be located near the center of the property, with the area immediately adjacent to the Jordan Reservoir mostly undeveloped. The remainder of the site would consist of forested areas, ponds, and open fields. The Jordan Reservoir is relatively undeveloped, particularly in the upper half of the reservoir, where the Barton site is located; however, there are some higher-end homes immediately adjacent to the Barton site. The reservoir offers opportunities for wildlife viewing, camping, boating, fishing, and other recreation (Southern 2007a).

Two Alabama Power Company reservoirs are in the vicinity of the Barton site in addition to the Jordan Reservoir: Lay Lake and Mitchell Lake. Both reservoirs have recreational uses including camping, boat ramps, marinas, picnic areas, playgrounds, swimming areas, and trails. Mitchell Lake is located about 7.2 km (4.5 mi) upstream of the Barton site in Chilton and Coosa Counties, Alabama. The upper portions of facility structures and occasional plumes from the cooling towers may be visible from elevated areas near Mitchell Dam. No other impacts on Mitchell Lake's recreation areas would be expected. Lay Lake is located more than 29 km (18 mi) upstream of the Barton site in Chilton, Coosa, and Shelby Counties, Alabama. Construction and operation of the proposed project at the Barton site would not impact recreation areas on Lay Lake because of its distance from the Barton site (Southern 2007a). Impacts on tourism and recreation are considered small if current facilities are adequate to handle local levels of demand. Therefore, impacts of facility construction and operation would be SMALL.

Housing

In 2000, the U.S. Census reported that Chilton County had 17,651 housing units, 2364 of which (13.4 percent) were vacant. Elmore County had 8037 housing units, 1512 of which (18.8 percent) were vacant, Autauga County had 17,660 housing units with 1659 vacant (9.4 percent), and Coosa County had 6142 housing units with 1460 vacant (23.8 percent).

Assuming that the construction workforce would commute from the area within an 80-km (50-mi) radius of the Barton site, which has a population of 735,226, there would be few discernible impacts on housing availability, rental rates or housing values, or housing construction or conversion. Those who choose to relocate to the region would find adequate housing available (Southern 2007a). Therefore, NRC staff concludes that impacts on housing in the region from constructing and operating two new reactors on the Barton site would be SMALL.

Public Services

Public services include water supply and wastewater treatment facilities; police, fire and medical facilities; and social services. It is likely that new operations and construction employees relocating from outside the region would live in residentially developed areas with well established public utilities and community services. Beyond Birmingham and Montgomery (the two largest cities in the region), there are several mid-sized communities with public utility and community services from which an in-migrating family could choose to settle including Clanton (population 7800) in Chilton County, Milbrook (population 10,386) in Autauga County, Alexander City (population 15,008) in Tellapoosa County, and Sylacauga (population 12,616) in Talldega County (USCB 2007b). The construction and operation of new nuclear units at the Barton site would not likely use municipal water and treatment systems. It is not expected that public services would be materially impacted by the influx of construction or operations workers and their families and public service impacts are considered SMALL.

Education

Chilton County has 12 schools with a total enrollment of 7210, while Elmore County has two school districts with 18 schools between them and a total enrollment of 12,136. In addition, the neighboring Montgomery school district has 63 schools with a total enrollment of 31,985 (NCES 2007). It is unlikely that the influx of construction workers, even assuming the relatively high in-migration estimates from 4.5.3.7 (1500 school-aged children), would noticeably impact this region due to the number of schools and educational resources in the region. Likewise, the smaller influx of workers and families that would move into the region to operate the plant would only impose SMALL impacts on education.

Summary of Infrastructure and Community Services

Based on information provided by Southern and NRC's own independent review, the staff concludes that impacts on infrastructure and community services from construction and operation of two new nuclear reactors at the Barton site would be SMALL to MODERATE.

Summary of Socioeconomics

In summary, based on the information provided by Southern and NRC's own independent review, the staff concludes that the socioeconomic impacts of the construction and operations on the region surrounding the Barton site would be SMALL with the following exceptions. The impacts on the tax revenue impacts of Chilton and Elmore Counties would be MODERATE and beneficial. The impacts on transportation near the plant during construction would likely be MODERATE during construction. Some additional transportation upgrades may be necessary. Impacts to aesthetic and recreational resources would be MODERATE and occur during both construction and operation of the new reactors.

9.5.3.6 Historic and Cultural Resources

The likely footprint for the proposed plant at the Barton greenfield site does not appear to have any historic properties located within areas likely to be impacted by new construction and operations. Miscellaneous archaeological surveys conducted over the years in the area indicate that while sites may exist on the premises, either the sites are not eligible for listing on the National Register of Historic Places or are located away from likely areas of new construction. Protective measures would be put in place in the event that historic or archaeological materials are discovered during construction or during operations. In the event that an unanticipated discovery is made, site personnel would be instructed to notify the SHPO and would consult with them in conducting an assessment of the discovery to determine if additional work is needed. The impacts to historical and cultural resources are predicted to be SMALL at the Barton site.

9.5.3.7 Environmental Justice

The 2000 Census and block groups were used for ascertaining minority and low-income populations in the area. There are 577 block groups within an 80-km (50-mi) radius of the Barton site. Black minority populations exist in 207 block groups; and "Aggregate of Minority Races" populations exist in 200 block groups. No other minority populations exist in the geographic area. The Census Bureau data characterize 16.67 percent of Alabama households as low income. There are 59 block groups that contain a low-income population percentage that exceeds the State average by 20 percent. There are no minority or low-income populations within a 10-km (6-mi) radius of the Barton site (Southern 2007a).

Construction activities (noise, fugitive dust, air emissions, traffic) would not disproportionately impact minority populations because of their distance from the Barton site. Operation of the proposed project at the Barton site is also unlikely to have a disproportionate impact on minority or low-income populations. A review of environmental assessments and planning documents for projects in the Coosa River basin and adjacent lands identified no unusual resource dependencies or practices, such as subsistence agriculture, hunting, or fishing through which the populations could be disproportionately affected. In addition, no location-dependent disproportionate impacts affecting these minority and low-income populations have been identified (Southern 2007a).

Based on the information provided by Southern and NRC's own independent review, the staff concludes that the offsite impacts of construction and operation of one or more new units at the Barton site to minority and low-income populations would be SMALL. No adverse and disproportionately high impacts were identified.

9.6 Issues Among Sites Handled Generically

In evaluating the alternative sites, the staff found certain impacts would not vary among sites, and, as a result, would not affect the evaluation of whether an alternative site is environmentally preferable to the proposed site. These impacts include some operational terrestrial impacts, some areas of socioeconomics; nonradiological and radiological effects on members of the public, workforce, and biota; postulated accidents. As a result, the impacts of these five impact categories are not evaluated as part of the site-specific alternatives analysis. Additionally, there were generic aspects of other impact categories that were not included in the discussions of each site. Instead, they are discussed generically in the following subsections.

9.6.1 Terrestrial Ecology

Terrestrial ecological impacts that may result from operation of new nuclear units at the alternative sites include those associated with cooling towers, transmission system structures, and maintenance of transmission line rights-of-way. An evaluation of impacts resulting from operation of cooling towers and transmission lines and transmission line right-of-way maintenance cannot be conducted in any detail due to missing information, such as the type, number, and specific location of cooling towers at each alternative site, and locations of any new rights-of-way that could result from transmission system upgrades. Consequently, conclusions in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437 (NRC 1996) were used to assess terrestrial impacts resulting from the operation of cooling towers and impacts from transmission line rights-of-way maintenance and operation.

NUREG-1437 (NRC 1996) evaluated terrestrial ecological impacts resulting from operation of existing nuclear power plants. Because the types of terrestrial ecological impacts resulting from operation of new nuclear units would be similar to those of existing nuclear power plants, NUREG-1437 (NRC 1996) is useful for this analysis.

For impacts resulting from transmission line operation and transmission line right-of-way maintenance, the staff assumed that the existing transmission lines at the Plant Farley and Plant Hatch sites would not have the capacity to carry the power that would be generated by new nuclear units. Construction of the proposed project at either site would require the addition of a new transmission line that would result in either an expansion of the existing rights-of-way or construction of a new transmission line right-of-way. Barton is a greenfield site and new transmission line rights-of-way would be required. Given these assumptions, conclusions in NUREG-1437 (NRC 1996) were used for impacts resulting from transmission line operation and transmission line right-of-way maintenance.

9.6.1.1 Cooling Towers

Impacts on crops, ornamental vegetation, and native plants from cooling tower drift cannot be evaluated in detail in the absence of information on the type (mechanical or natural draft), number, and specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information on the type (mechanical or natural draft for a wet cooling system; dry for a dry system) and number of cooling towers at each alternative site. The impacts of cooling tower drift and bird collisions for existing power plants were evaluated in NUREG-1437 (NRC 1996) and found to be of minor significance for all plants, including those with various numbers and types of cooling towers. On this basis, the staff concludes, for the purpose of comparing the alternative sites, that the impacts of cooling tower drift and bird collisions with cooling towers resulting from operation of new nuclear units at all of the alternative sites would be minor.

For natural draft cooling towers, the anticipated noise level from cooling tower operation is anticipated to be 55 dBA at 300 m (1000 ft) (Southern 2007a). This noise level is well below the 80 to 85 dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at any of the alternative sites would not be likely to disturb wildlife beyond 300 m (1000 ft) from the source. Consequently, the staff concludes that the impacts of cooling tower noise on wildlife would be minimal at all the alternative sites.

Transmission Lines

The impacts associated with transmission line operation consist of bird collisions with transmission lines and electromagnetic field (EMF) effects on flora and fauna. The impacts associated with right-of-way maintenance activities are alternation of habitat due to cutting and herbicide application, and similar related impacts where rights-of-way cross floodplains and wetlands.

Bird collisions with transmission lines are of minor significance at operating nuclear power plants, including transmission line rights-of-way with variable numbers of power lines (NRC 1996). Although additional transmission lines would be required for new nuclear units at the alternative sites, increases in bird collisions would be minor and these would likely not be expected to cause a measurable reduction in local bird populations. Consequently, the incremental number of bird collisions posed by the addition of new transmission lines for new nuclear units would be negligible at all the alternative sites.

EMFs are unlike other agents that have an adverse impact (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 1996). A careful review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures (NRC 1996). The impacts of EMFs on terrestrial flora and fauna are of small significance at operating nuclear power plants, including transmission systems with variable numbers of power lines (NRC 1996). Since 1997, more than a dozen studies have been published that looked at cancer in animals that were exposed to EMFs for all or most of their lives (Moulder 2005). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2005). Therefore, the incremental EMF impact posed by addition of new transmission lines for new nuclear units would be negligible at all the alternative sites.

Existing roads providing access to the existing transmission line rights-of-way at the alternative sites would likely be sufficient for use in any expanded rights-of-way, however new roads would be required during the construction of new transmission line right-of-way. Transmission line right-of-way management activities (cutting and herbicide application) and related impacts to floodplains and wetlands in transmission line rights-of-way are of minor significance at operating nuclear power plants, including those with transmission line rights-of-way of variable widths (NRC 1996). Consequently, the incremental effects of transmission line right-of-way maintenance and associated impacts to floodplains and wetlands posed by expanding existing rights-of-way or the addition of a new transmission line right-of-way for new nuclear units would be negligible at all the alternative sites.

Conclusion

Based on information provided by Southern and NRC's own independent review, the staff concludes that the impacts from operation of new nuclear units (including cooling towers, transmission lines, and transmission line rights-of-way) at any of the alternative sites would be SMALL.

9.6.2 Socioeconomics

There are several physical impacts with socioeconomic consequences where generic treatment of issues related to construction and operation of new nuclear units is appropriate.

9.6.2.1 Physical Impacts

Many of the physical impacts of construction and operation would be similar regardless of the sites. People who work or live around the alternative sites could be exposed to noise, fugitive dust, and gaseous emissions from construction activities. Construction workers and personnel working onsite could be the most impacted. Air-pollution emissions are expected to be controlled by applicable BMP and Federal, State, and local regulations. During station operation, standby diesel generators used for auxiliary power would have air-pollution emissions. It is expected that these generators would see limited use and, if used, would be used for only short time periods. Applicable Federal, State, and local air-pollution requirements would apply to all fuel-burning engines. At the site boundary for most sites, the annual average exposure from gaseous emission sources is anticipated not to exceed applicable regulations during normal operations. The impacts of station operations on air quality are expected to be minimal. As with construction impacts, potential offsite receptors are generally located well away from the site boundaries.

Residential and commercial areas are located away from the alternative site boundaries, applicable air-pollution regulations would have to be met by Southern, and applicable BMP would be put in place. Therefore, based on information provided by Southern and NRC's own independent review of reconnaissance-level information, the staff concludes that the physical impacts of station construction and operation on workers and the local public would be SMALL.

Construction activities and station operations are not expected to impact any offsite buildings. Most buildings not located onsite are well removed from the site boundaries. Buildings most vulnerable to shock and vibration from pile-driving and other related activities are those located on the alternative sites. No physical impacts to structures, including any residences near the site boundaries, would be expected. Therefore, based on NRC's own independent review of reconnaissance-level information, the staff concludes that the physical impacts of station construction and operation on offsite buildings would be SMALL.

Roads

During construction, additional cars and trucks were assumed to use the roads in the vicinity of each alternative site. This is in addition to the existing operations workforce at most of the alternative sites and the approximately 1000 temporary workers hired during refueling outages. Heavy loads of construction materials and equipment and the increased traffic might necessitate additional maintenance and repair of roads. Certain road upgrades, such as such installing turn lanes, staggering workforce shifts, and providing incentives to car pool, could mitigate some of these impacts. Based on NRC's own independent review of reconnaissance-level information, including visits to the alternative sites, the staff concludes that the physical impacts of construction on roads in the vicinity of the alternative sites would be MODERATE unless at least some of the identified mitigation measures are implemented.

During station operations, the roads and highways within the vicinity of the alternative sites would experience an increase from the addition of operations personnel. This is in addition to the existing operations workforce at the current operating units at each of the sites, except for the Barton site, which is a greenfield site. In addition, approximately 1000 temporary workers are hired for refueling outages. In all cases, the increase in road traffic due to the additional operations workforce would be well below current road capacities; therefore, the staff concludes that the physical impacts of operations on roads would be SMALL, and that mitigation would not be warranted.

Aesthetics

Construction at all the alternative sites could be viewed from outside the sites at certain locations. All sites are located in rural areas with sparse residential or commercial development near the site. Construction of cooling-water intake structures could impact the body of water within which the construction takes place. The impacts could increase suspended solids concentrations in the waterbodies and fish species might be temporarily displaced as a result of minor disturbances associated with construction activities, including noise, dredging, etc. This in turn could impact recreation and recreational opportunities such as fishing. However, such impacts are transitory and are not expected to have any long-term, permanent consequences. Onsite erosion and stormwater runoff control measures would be expected to be implemented in accordance with State and Federal regulations. Any construction impacts on the view would be temporary. Based on NRC's own independent review of reconnaissance-level information, including visits to the alternative sites, the staff concludes that the impacts of construction on aesthetics would be SMALL at all sites.

Demography, Infrastructure, and Community Impacts

Because of the dissimilarities among the sites, the demographic, infrastructure and community impacts of each of the alternative sites has been covered in the site-specific discussions.

9.6.3 Nonradiological Health Impacts

Nonradiological health impacts from construction of two new nuclear units on the construction workers at the alternative sites would be similar to those evaluated in Section 4.8. They include occupational injuries, noise, odor, vehicle exhaust, and dust. Applicable Federal and State regulations on air quality and noise would be complied with during the plant construction phase. None of the alternative sites have site characteristics that would be expected to lead to fewer or more construction accidents than would be expected for any of the other alternative sites. All the alternative sites are in rural areas and construction impacts would likely be minimal on the surrounding populations that are classified as medium and low population areas. The staff concludes that health impacts to construction workers resulting from the construction of two new nuclear units at any of the alternative sites would be SMALL.

Occupational health impacts to operational employees would likely be the same for all the alternative sites. Thermophilic microorganisms would not be a concern at the alternative sites using a closed-cycle, wet cooling system with natural draft cooling towers. Health impacts to workers from occupational injuries, noise, and electric fields would be similar. None of the alternative sites has site characteristics that would be expected to lead to fewer or more operational accidents than would be expected for any of the other alternative sites. Noise and electric fields would be monitored and controlled in accordance with applicable Occupational Safety and Health Administration regulations.

The staff expects that the occupational health impacts to operations employees of two new nuclear units at any of the alternative sites would be SMALL. Similarly, impacts to public health of two new nuclear units' operation at the VEGP site or any of the alternative sites would be expected to be minimal. The staff concludes that the public health impacts would be SMALL.

9.6.4 Radiological Impacts of Normal Operations

Exposure pathways for gaseous and liquid effluents from two new nuclear units on the ESP site or an alternative site would be similar. Gaseous effluent pathways include external exposure to the airborne plume, external exposure to contaminated ground, inhalation of airborne activity, and ingestion of contaminated agricultural products. Liquid effluent pathways include ingestion of aquatic foods, ingestion of drinking water, external exposure to shoreline sediments, and external exposure to water through boating and swimming.

Section 5.9 discusses the estimates of doses to the maximally exposed individual and the general population for two new nuclear units at the proposed VEGP site for both liquid effluent and gaseous-effluent pathways. The estimated doses to the maximally exposed individual were well within the design objectives of 10 CFR Part 50, Appendix I. The same bounding liquid and gaseous effluent releases would be used to evaluate doses to the maximally exposed individual and the population at each alternative site. Even with differences in pathways, atmospheric and water dispersion factors, and population, doses estimated to the maximally exposed individual for the alternative sites would be expected to be well within the Appendix I design objectives. Population doses within 80 km (50 mi) of the proposed facility would be similar for the alternative sites because the VEGP site and the three alternative sites are each medium or low population areas; however, they would still be small compared to the population dose from natural background radiation. Therefore, the staff concludes that radiation doses and resultant health impacts from two new nuclear unit's operations would be SMALL at all of the alternative sites.

Occupational doses to workers at the new units would be the same for the alternative sites as they would be for the proposed site. The Westinghouse AP1000 advanced reactor design of the new units would likely result in less occupational exposure annually than from current operating plants. The staff concludes that the occupational radiation doses from two new nuclear units' operation would be SMALL for all of the candidate sites.

Table 5-5 provides the annual total body dose estimates to surrogate biota species for a new nuclear unit. The annual dose for no surrogate species exceeded the dose standard in 40 CFR Part 190. The 40 CFR Part 190 standards apply to members of the public in unrestricted areas and not specifically to biota. The estimates are conservative because they not do consider dilution or decay of liquid effluents during transit. Actual doses to biota are likely to be much lower. The staff reviewed the available information relative to the radiological impact on biota other than humans, and performed an independent estimate of dose to the biota. The staff concludes that no measurable radiological impact on biota is expected from the radiation and radioactive material released to the environment as a result of the routine operation of new nuclear units and that the impacts to biota of radiation doses at any one of the alternative sites would be SMALL.

9.6.5 Postulated Accidents

In Section 5.10, the staff considered a suite of design-basis accidents for a new nuclear unit at the VEGP site. The evaluation involved calculation of doses for specified periods at the exclusion area and low-population zone boundaries, and comparison of those doses with doses based on regulatory limits and guidelines. Similar analyses have not been conducted for the alternative sites. Had such evaluations been conducted, the differences in the results would only have been the result of meteorological conditions and the distances to the site boundaries. The release characteristics would have been the same at all sites.

For the VEGP site and meteorology, the doses for each accident sequence considered were well below the corresponding regulatory limits and guidelines. The general climatological conditions at the alternative sites are sufficiently similar to the conditions at the proposed site that it is highly unlikely that differences in local meteorological conditions would be sufficient to cause doses from design-basis accidents for a new nuclear unit at any of the alternative sites to exceed regulatory limits or guidelines. Similarly, because two of the alternative sites are located at existing nuclear power plant sites and the third in a rural area with relatively low population, it is unlikely that differences in distances to the exclusion area and low-population zone boundaries would be sufficient to cause doses from design-basis accidents for a new nuclear unit at any of the alternative sites to exceed regulatory limits or guidelines. Therefore, the staff concludes that for the purposes of consideration of alternative sites, the impact of design basis accidents at each of the alternative sites would be SMALL.

Section 5.10 also includes a detailed analysis of the potential consequences of severe accidents for the postulated plants for the VEGP site. Similar analyses have not been conducted for the alternative sites. Had such evaluations been conducted, the differences in the results would only have been the result of site-specific factors such as meteorological conditions, population distribution, and land-use distribution. The release characteristics would have been the same at all sites.

The probability-weighted consequences estimated for severe accidents for new nuclear units at the proposed VEGP site are well below the consequences estimated for severe accidents at current generation reactors (see Section 5.10). This result suggests that the consequences of severe accidents at the any of the alternative sites would be less than the consequences of a severe accident at an existing plant at the site. The Commission has determined that the probability-weighted consequences of severe accidents are SMALL for all existing plants (10 CFR 51, Subpart B, Table B-1). On this basis, the staff concludes that, for the purposes of consideration of alternative sites, the impact of severe accidents at each of the alternative sites likely would be SMALL

9.7 Summary of Alternative Site Impacts

Southern selected three sites as alternative sites to the proposed VEGP site. The three sites selected for detailed review are

- Plant Hatch, located in Appling and Toombs Counties, Georgia
- Plant Farley, located in Houston County, Alabama
- The Barton greenfield site, located in Chilton and Elmore Counties, Alabama.

A summary of the staff's characterizations of locating Southern's proposed nuclear units at each alternative site is in Section 9.7.1 for construction impacts and Section 9.7.2 for operational impacts.

9.7.1 Summary of Alternative Site Construction Impacts

The staff's characterizations of the environmental impacts of constructing two new nuclear power units at the three alternatives sites are provided in Table 9-7.

Table 9-7. Characterization of Construction Impacts at the Alternative ESP Sites

Category	Plant Hatch	Plant Farley	Barton Site
Land-Use Impacts			
The site and vicinity	SMALL	SMALL	MODERATE
Transmission line rights-of-way	SMALL to MODERATE	MODERATE	MODERATE
Air quality	SMALL	SMALL	SMALL
Water-Related Impacts			
Water use	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL
Ecological Impacts			
Terrestrial ecosystems			
Site	SMALL	MODERATE	MODERATE
Transmission line right-of-way	SMALL to MODERATE[a]	SMALL to MODERATE[a]	MODERATE
Aquatic ecosystems			
Site	SMALL	SMALL to MODERATE	SMALL
Transmission line right-of-way	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]

Table 9-7. (Cont.)

Category	Plant Hatch	Plant Farley	Barton Site
Threatened and endangered species	SMALL to MODERATE[(a)]	SMALL	SMALL
Socioeconomic Impacts			
Physical Impacts	SMALL	SMALL	SMALL
Aesthetics	SMALL to MODERATE	SMALL to MODERATE	MODERATE
Demography	SMALL to MODERATE[(b)]	SMALL to MODERATE[(c)]	SMALL
Impacts to the Community - Social and Economic			
Economy	MODERATE Beneficial	MODERATE Beneficial	SMALL Beneficial
Taxes	SMALL to MODERATE Beneficial[(d)]	MODERATE Beneficial[(e)]	SMALL to MODERATE Beneficial[(f)]
Impacts to the Community - Infrastructure and Community			
Transportation	MODERATE	MODERATE	MODERATE
Recreation	SMALL	SMALL	SMALL
Housing	MODERATE[(g)]	SMALL	SMALL
Public and social services and infrastructure	SMALL	MODERATE	SMALL
Education	MODERATE	MODERATE	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL

(a) Related to transmission system upgrades.
(b) MODERATE impact in Appling and Toombs Counties, SMALL elsewhere.
(c) MODERATE impact in Houston County, SMALL elsewhere.
(d) MODERATE beneficial in Appling County, SMALL beneficial elsewhere.
(e) MODERATE in Houston County, SMALL elsewhere.
(f) MODERATE and beneficial in Chilton and Elmore Counties, SMALL elsewhere.
(g) MODERATE in Appling and Toombs Counties; SMALL elsewhere.

9.7.2 Summary of Alternative Site Operation Impacts

The staff's characterizations of the environmental impacts of operating two new nuclear power units at the three alternatives sites are provided in Table 9-8.

Table 9-8. Characterization of Operational Impacts at the Alternative ESP Sites

Category	Plant Hatch	Plant Farley	Barton Site
Land-Use Impacts			
Site and vicinity	SMALL	SMALL	SMALL
Transmission line rights-of-way	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL
Water-Related Impacts			
Water use	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL
Ecological Impacts			
Terrestrial ecosystems	SMALL	SMALL	SMALL
Aquatic ecosystems	SMALL	SMALL	SMALL
Threatened and endangered species	SMALL	SMALL	SMALL
Socioeconomic Impacts			
Physical Impacts	SMALL	SMALL	SMALL
Aesthetics	SMALL to MODERATE[d]	SMALL to MODERATE[e]	MODERATE
Demography	SMALL	SMALL	SMALL
Impacts to the Community - Social and Economic			
Economy	SMALL Beneficial	SMALL Beneficial	SMALL Beneficial
Taxes	SMALL Beneficial to LARGE Beneficial[a]	SMALL Beneficial to LARGE Beneficial[b]	SMALL Beneficial to MODERATE Beneficial[c]
Impacts to the Community - Infrastructure and Community			
Transportation	SMALL	SMALL	SMALL
Recreation	SMALL	SMALL	SMALL
Housing	SMALL	SMALL	SMALL
Public and social services and infrastructure	SMALL	SMALL	SMALL
Education	SMALL	SMALL	SMALL
Historic and cultural resources	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL

Table 9-8. (cont.)

Postulated Accidents			
Design-basis accidents	SMALL	SMALL	SMALL
Severe accidents	SMALL	SMALL	SMALL

(a) LARGE beneficial in Appling County, SMALL beneficial elsewhere.
(b) LARGE beneficial in Houston County, SMALL beneficial elsewhere.
(c) MODERATE beneficial in Chilton and Elmore Counties, SMALL beneficial elsewhere.
(d) SMALL at Plant Hatch site, MODERATE along transmission lines.
(e) SMALL at Plant Farley site, MODERATE along transmission lines.

9.8 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy*, Part 100, "Reactor Site Criteria."

40 CFR Part 50. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR Part 63. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 63, "National Emission Standards for Hazardous Air Pollutants for Source Categories."

40 CFR Part 81. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

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10.0 Comparison of the Impacts of the Proposed Action and the Alternative Sites

The need to compare the proposed site with alternative sites arises from the requirement in Section 102(2)(c)(iii), 42 USC 4332 of the National Environmental Policy Act of 1969 (NEPA) that environmental impact statements include an analysis of alternatives to the proposed action. The U.S. Nuclear Regulatory Commission (NRC) criteria to be employed in assessing whether a proposed site is to be rejected in favor of an alternative site is based on whether the alternative site is "obviously superior" to the site proposed by the applicant (Public Service Co. of New Hampshire 1977). An alternative site is "obviously superior" to the proposed site if it is "clearly and substantially" superior to the proposed site (Rochester Gas & Electric Corp. 1978). The standard of obviously superior "...is designed to guarantee that a proposed site will not be rejected in favor of an alternate unless, on the basis of appropriate study, the Commission can be confident that such action is called for (New England Coalition on Nuclear Pollution 1978)."

The "obviously superior" test is appropriate for two reasons. First, the analysis performed by the NRC in evaluating alternative sites is necessarily imprecise. Key factors considered in the alternative site analysis, such as population distribution and density, hydrology, air quality, aquatic and terrestrial ecological resources, aesthetics, land use, and socioeconomics are difficult to quantify in common metrics. Given this difficulty, any evaluation of a particular site must have a wide range of uncertainty. Second, the applicant's proposed site has been analyzed in detail, with the expectation that most adverse environmental impacts associated with the site have been identified. The alternative sites have not undergone a comparable level of detailed study. For these reasons, a proposed site may not be rejected in favor of an alternative site when the alternative site is marginally better than the proposed site, but only when it is obviously superior (Rochester Gas & Electric Corp. 1978). NEPA does not require that a nuclear plant be constructed on the single best site for environmental purposes. Rather, "...all that NEPA requires is that alternative sites be considered and that the effects on the environment of building the plant at the alternative sites be carefully studied and factored into the ultimate decision (New England Coalition on Nuclear Pollution 1978)."

The NRC staff's review of alternative sites consists of a two-part sequential test (NRC 2000). The first part of the test determines whether any environmentally preferred sites are among the candidate sites. The staff considers whether the applicant has (1) reasonably identified candidate sites, (2) evaluated the likely environmental impacts of construction and operation at these sites, and (3) used a logical means of comparing sites that led to the applicant's selection of the proposed site. Based on NRC's own independent review, the staff then determines whether any of the alternative sites are environmentally preferable to the applicant's proposed site. If the staff determines that one or more alternative sites are environmentally preferable, then it would compare the estimated costs (i.e., environmental, economic, and time) of constructing the proposed plant at the proposed site and at the environmentally preferable site or sites (NRC 2000). The second part of the test determines if an alternative site is obviously superior to the proposed site. The staff must determine that (1) one or more important aspects, either singly or in combination, of a reasonably available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site, and (2) the alternative site does not have offsetting deficiencies in other important areas. A staff conclusion that an alternative site is obviously superior to the applicant's proposed site would normally lead to a recommendation that the application for the permit be denied.

10.1 Comparison of the Proposed Site with the Alternative Sites

The staff reviewed the Environmental Report submitted by Southern Nuclear Operating Company, Inc. (Southern 2007) and supporting documentation and conducted site visits at the Vogtle Electric Generating Plant (VEGP) site and the alternative sites. The staff found that Southern had reasonably identified alternative sites, evaluated the environmental impacts of construction and operation, and used a logical means of comparing sites. The following section summarizes NRC's own independent assessment of the proposed and alternative sites.

The staff's characterization of the expected environmental impacts of constructing and operating new units at the VEGP site and alternative sites are summarized in Tables 10-1 and 10-2. Table 10-1 compares the alternatives' construction impacts, and Table 10-2 the operational impacts. Full explanations for the particular characterizations are in Chapters 4 and 5 for the proposed site and in Sections 9.5 and 9.6 for the alternative sites. In the following analysis, the staff indicated a likely impact level based on professional judgement, experience, and consideration of controls likely to be imposed under required Federal, State, or local permits that would not be acquired until an application for a construction permit or combined construction and operating license is underway. These considerations and assumptions were similarly applied at each of the alternative sites to provide a common basis for comparison.

Some environmental impacts considered are generic to all sites and, therefore, do not influence the comparison of impacts between the applicant's proposed site and the alternative sites. The generic environmental impacts common to all sites are nonradiological and radiological health impacts, environmental impacts from postulated accidents, and some aspects of ecology and socioeconomics.

The environmental impact areas shown in Tables 10-1 and 10-2 have been evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B:

SMALL – Environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.

Table 10-1. Comparison of Construction Impacts at the VEGP Site and Alternative Sites

Category	VEGP	Plant Hatch	Plant Farley	Barton Site
Land-Use Impacts				
The site and vicinity	SMALL	SMALL	SMALL	MODERATE
Transmission line	MODERATE	SMALL to MODERATE	MODERATE	MODERATE
Air quality	SMALL	SMALL	SMALL	SMALL
Water-Related Impacts				
Water use	SMALL	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL	SMALL
Ecological Impacts				
Terrestrial ecosystems				
Site and vicinity	SMALL	SMALL	MODERATE	MODERATE
Transmission line	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]	MODERATE
Aquatic ecosystems				
Site and vicinity	SMALL	SMALL	SMALL to MODERATE[b]	SMALL
Transmission line	SMALL	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]
Threatened and endangered species				
Site and vicinity	SMALL	SMALL[b]	SMALL	SMALL
Transmission line	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]
Socioeconomic Impacts				
Physical impacts	SMALL	SMALL	SMALL	SMALL
Aesthetics	SMALL to MODERATE[c]	SMALL to MODERATE[c]	SMALL to MODERATE[c]	MODERATE
Demography	SMALL to MODERATE[d]	SMALL to MODERATE[e]	SMALL to MODERATE[f]	SMALL
Impacts to the Community - Social and Economic				
Economy	SMALL to MODERATE beneficial[d]	MODERATE beneficial[e]	MODERATE beneficial[f]	SMALL beneficial
Taxes	SMALL to MODERATE beneficial[d]	SMALL to MODERATE beneficial[e]	MODERATE beneficial[f]	SMALL to MODERATE beneficial[g]
Impacts to the Community - Infrastructure and Community				
Transportation	MODERATE	MODERATE	MODERATE	MODERATE
Recreation	SMALL	SMALL	SMALL	SMALL
Housing	SMALL	MODERATE	SMALL	SMALL
Public and social services and infrastructure	SMALL	SMALL	MODERATE	SMALL
Education	SMALL	MODERATE	MODERATE	SMALL

Table 10-1. (contd)

Category	VEGP	Plant Hatch	Plant Farley	Barton Site
Historic and cultural resources	MODERATE	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL

(a) Depends on location of transmission line right-of-way
(b) MODERATE if dredging is needed
(c) SMALL at plant site MODERATE along transmission right-of-way
(d) MODERATE in Burke County, SMALL elsewhere
(e) MODERATE in Appling and Toombs Counties, SMALL elsewhere
(f) MODERATE in Houston County, SMALL elsewhere
(g) MODERATE in Chilton and Elmore Counties, SMALL elsewhere

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The staff determined that the impact level from construction for most of the environmental categories at most of the sites is SMALL (See Table 10-1). However, transmission line land use is MODERATE and terrestrial ecosystems is SMALL to MODERATE for all sites because of potential changes in the transmission systems at all sites. Aesthetic impacts of transmission lines is likely to be MODERATE at all sites. Land-use impacts at the Barton site would be greater than at the proposed VEGP site or the other two alternative sites. More detailed information on these issues is presented in Chapter 4 for the VEGP site, and in Chapter 9 for the alternative sites.

Similarly, the staff found that the impact level from operations from most of the environmental issues at most sites is SMALL (see Table 10-2).

10.2 Environmentally Preferable Sites

10.2.1 Construction

The impacts of construction at the VEGP site are generally SMALL for most impact categories. However, as noted in Chapter 4, there could be a MODERATE land-use, ecological, and aesthetic impacts associated with the new transmission line rights-of-way. In addition, as noted in Section 4.5, there are some impact subcategories under infrastructure and community services (i.e., transportation, recreation, housing, public services, and education) for which the impacts could be MODERATE if most of the construction workers move into Burke County.

Table 10-2. Comparison of Operational Impacts at the VEGP Site and Alternative Sites

Category	VEGP	Plant Hatch	Plant Farley	Barton Site
Land-use Impacts				
The site and vicinity	SMALL	SMALL	SMALL	SMALL
Transmission-line rights-of-way	SMALL	SMALL	SMALL	SMALL
Air quality	SMALL	SMALL	SMALL	SMALL
Water-related Impacts				
Water use	SMALL	SMALL	SMALL	SMALL
Water quality	SMALL	SMALL	SMALL	SMALL
Ecological Impacts				
Terrestrial ecosystems	SMALL	SMALL	SMALL	SMALL
Aquatic ecosystems	SMALL	SMALL	SMALL	SMALL
Threatened and endangered species	SMALL	SMALL	SMALL	SMALL
Socioeconomic Impacts				
Physical Impacts	SMALL	SMALL	SMALL	SMALL
Aesthetics	SMALL to MODERATE[a]	SMALL to MODERATE[a]	SMALL to MODERATE[a]	MODERATE
Demography	SMALL	SMALL	SMALL	SMALL
Impacts to the Community - Social and Economic				
Economy	SMALL beneficial to MODERATE beneficial[b]	SMALL beneficial	SMALL beneficial	SMALL beneficial
Taxes	SMALL beneficial to LARGE beneficial[c]	SMALL beneficial to LARGE beneficial[d]	SMALL beneficial to LARGE beneficial[e]	SMALL beneficial to MODERATE beneficial[f]
Impacts to the Community - Infrastructure and Community				
Transportation	SMALL	SMALL	SMALL	SMALL
Recreation	SMALL	SMALL	SMALL	SMALL
Housing	SMALL	SMALL	SMALL	SMALL
Public and social services and infrastructure	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL	SMALL	SMALL

Table 10-2. (contd)

Category	VEGP	Plant Hatch	Plant Farley	Barton Site
Historic and Cultural resources	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL
Nonradiological health	SMALL	SMALL	SMALL	SMALL
Radiological health	SMALL	SMALL	SMALL	SMALL
Postulated Accidents				
Design-basis accidents	SMALL	SMALL	SMALL	SMALL
Severe accidents	SMALL	SMALL	SMALL	SMALL

(a) Aesthetics impact at the plant site would be SMALL, but the impact would be MODERATE along new transmission line right-of-way.
(b) MODERATE beneficial in Burke County, SMALL beneficial elsewhere
(c) LARGE beneficial in Burke County, SMALL beneficial elsewhere
(d) LARGE beneficial in Appling County, SMALL beneficial elsewhere
(e) LARGE beneficial in Houston County, SMALL elsewhere
(f) MODERATE beneficial in Chilton and Elmore Counties, SMALL elsewhere

Although SMALL in most surrounding counties, the tax and economic benefits to Burke County during the construction phase could be beneficially MODERATE. The installation of the water intake pipeline may result in MODERATE impacts to archeological resources.

The impacts of construction at the Plant Hatch alternative site are considered SMALL for most impact categories except land-use and aesthetic impacts of the transmission line rights-of-way which may be MODERATE, terrestrial ecosystems including threatened and endangered species along the transmission rights-of-way, which could be MODERATE, and some impact categories under socioeconomic impacts (i.e., demography, transportation, public services, and education), which could be MODERATE if a significant number of the construction workers move into Appling County. Although SMALL in most of the affected counties, the overall economic benefits in Appling County during the construction phase would be beneficially MODERATE and the tax benefits in Appling County from construction would be beneficially LARGE, as noted in Section 9.5.1.5.

The impacts of construction at the Plant Farley alternative site are considered SMALL for most impact categories except land-use and aesthetic impacts of new transmission line rights-of-way which may be MODERATE, terrestrial ecosystems which may be MODERATE impact, and some impact categories under socioeconomic impacts (i.e., demography, transportation, public and social services, and education), which could be MODERATE in Houston County. Although the impacts to the economy and taxes would be SMALL in most counties near the Plant Farley site, the impacts to the economy would be beneficially MODERATE and the impact on taxes would be MODERATE to LARGE in Houston County during construction, as noted in Section 9.5.2.5.

The impacts of construction at the Barton site are considered SMALL for most impact categories except the land use at site and vicinity, the land-use impacts of new transmission line rights-of-way, terrestrial ecosystems, including threatened and endangered species, transportation, and aesthetics, which could be MODERATE. Although the tax impacts of construction in most counties near the Barton site would be SMALL, in Chilton and Elmore Counties tax benefits would be beneficially MODERATE, as noted in Section 9.5.3.5.

Although there are some differences in the environmental impacts of construction at the VEGP site and the alternative sites, the staff concludes that none of these differences is sufficient to determine that any of the alternative sites is environmentally preferable to the proposed VEGP site.

10.2.2 Operations

The impacts of operations at the VEGP site would be SMALL for all major impact categories except for the SMALL to MODERATE beneficial impacts on the economy, the SMALL to LARGE beneficial impacts on taxes (discussed in Section 5.5.3), and a MODERATE aesthetic impacts along the new transmission line.

The impacts of operations at the Plant Hatch alternative site would be SMALL for almost all impact categories. The impact on the economy and taxes would be SMALL beneficial except in Appling County, which would experience LARGE beneficial impacts, as noted in Section 9.5.1.5. The aesthetic impact along the new transmission line is likely to be MODERATE.

The impacts of operations at the Plant Farley alternative site would be SMALL for almost all impact categories. The impact on taxes would be SMALL beneficial except in Houston County, where it could be LARGE beneficial, as noted in Section 9.5.2.5. The aesthetic impact along the new transmission line would likely be MODERATE.

The impacts of operations at the Barton alternative site would be SMALL for all impact categories except aesthetics,which could be MODERATE, as discussed in Section 9.5.3.5. The impact on taxes would be SMALL beneficial except in Chilton and Elmore Counties, where it could be MODERATE beneficial, as noted in Section 9.5.3.5.

Although there would be some differences in the environmental impacts of operation at the VEGP site and the alternative sites, the staff concludes that none of these differences is sufficient to determine that any of the alternative sites are environmentally preferable to the VEGP site.

10.3 Obviously Superior Sites

None of the alternative sites were determined to be environmentally preferable to the VEGP site. Therefore, none of the alternative sites is obviously superior to the VEGP site.

10.4 Comparison with the No-Action Alternative

The no-action alternative refers to a scenario in which NRC denies the applicant's request. If the application for the proposed VEGP ESP were denied, the impacts of the site-preparation and preliminary construction activities would not occur. Further, denial of the application would prevent early resolution of safety and environmental issues for the site. These issues would have to be addressed during a future licensing action (i.e., ESP, construction permit, or combined license), should the applicant decide to pursue construction and operation activities for a nuclear facility at the site at a later time.

In the event that the NRC denies the ESP application, the applicant could follow any of several paths to satisfy its electric power needs. The following paths could be pursued individually or in combination, and each would have associated environmental impacts.

- Reapply with a revised application for the same proposed site.

- Seek an ESP, a construction permit, or combined license for a new nuclear unit for a different location.

- Purchase power from other electricity providers.

- Establish conservation and demand-side management programs.

- Construct new generation facilities other than nuclear at the currently proposed site.

- Construct new generation facilities at other locations.

- Delay retirement of existing generating facilities.

- Reactivate previously retired generating facilities.

The activities that are permissible under an ESP are limited to site-preparation and preliminary construction activities allowed by 10 CFR 50.10(e)(1). Site-preparation activities are permissible only if the final environmental impact statement concludes that the activities would not result in any significant environmental impacts that could not be redressed. The results of the staff's assessment of the site redress plan are discussed in Section 4.11. As discussed in that section, the staff concludes that the potential site-preparation activities described in Southern's site redress plan would not result in any significant adverse impacts that could not be redressed.

10.5 References

10 CFR Part 50. Code of Federal Regulations. Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

National Environmental Policy Act of 1969 (NEPA). 42 USC 4321, et seq.

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11.0 Conclusions and Recommendations

On August 14, 2006, the U.S. Nuclear Regulatory Commission (NRC) received an application from Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP) for a site adjacent to the Vogtle Electric Generating Plant (VEGP), in Burke County, Georgia. This application has been revised through Revision 2, which was submitted to NRC on May 7, 2007. The site is located approximately 24 km (15 mi) east northeast of Waynesboro, Georgia, and 42 km (26 mi) southeast of Augusta, Georgia. An ESP is a Commission approval of a location for the siting of one or more nuclear power facilities, and is a separate action from the filing of an application for a construction permit (CP) or combined license (COL) for such a facility. An ESP application may refer to a reactor's or reactors' characteristics or plant parameter envelope, which is a set of postulated design parameters that bound the characteristics of a reactor or reactors that might be built at a selected site; alternatively, an ESP may refer to a detailed reactor design. In its application, Southern specified the Westinghouse AP1000 as the proposed reactor design for the VEGP site. An ESP is not a license to build a nuclear power plant; rather, the application for an ESP initiates a process undertaken to assess whether a proposed site is suitable should the applicant receive an ESP and later decide to pursue a CP or COL.

Section 102 of the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321 et seq.) directs that an environmental impact statement (EIS) is required for major Federal actions that significantly affect the quality of the human environment. Subpart A of Title 10 of the Code of Federal Regulations (CFR) Part 52 contains the NRC regulations related to ESPs. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. As set forth in 10 CFR 52.18, the Commission has determined that an EIS would be prepared during the review of an application for an ESP. The purpose of Southern's requested action, issuance of the ESP, is for the NRC to determine whether the VEGP site is suitable for two new nuclear units by resolving certain safety and environmental issues before Southern incurs the substantial additional time and expense of designing and seeking approval to construct such facilities at the site. Part 52 of CFR Title 10 describes the ESP as a "partial construction permit." An applicant for a CP or COL for a nuclear power plant or plants to be located at the site for which an ESP was issued can reference the ESP, thus reducing the need to review siting issues at that stage of the licensing process. However, issuance of a CP or COL to construct and operate a nuclear power plant is a major Federal action and would require an EIS to be issued in accordance with 10 CFR Part 51.

Three primary issues – site safety, environmental impacts, and emergency planning – must be addressed in an ESP application. Likewise, in its review of the application, the NRC assesses the applicant's proposal in relation to these issues and determines if the application meets the requirements of the Atomic Energy Act of 1954 and the NRC regulations. This EIS addresses the potential environmental impacts resulting from the construction and operation of two new nuclear units at the proposed ESP site.

In its application, Southern requested authorization to perform certain site-preparation and preliminary construction activities if an ESP is issued. The application, therefore, includes a site redress plan that specifies how the applicant would stabilize and restore the site to its preconstruction condition (or conditions consistent with an alternative use) in the event a nuclear power plant is not constructed on the ESP site. Although it is not required in an ESP application (10 CFR 52.17(a)(2)), Southern chose to address the benefits of the proposed action (e.g., the need for power).

Upon acceptance of the VEGP site application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing in the *Federal Register* a Notice of Intent to prepare an EIS and conduct scoping (71 FR 58882). The staff held a public scoping meeting in Waynesboro, Georgia, on October 19, 2006, and visited the VEGP site on October 17-19, 2006. Subsequent to the site visit and the scoping meeting and in accordance with NEPA and 10 CFR Part 51, the staff determined and evaluated the potential environmental impacts of constructing and operating two new nuclear units at the VEGP site.

Included in this EIS are (1) the results of the NRC staff's preliminary analyses, which consider and weigh the environmental effects of the proposed action and of constructing and operating a two new nuclear units at the VEGP site, (2) mitigation measures for reducing or avoiding adverse effects, (3) the environmental impacts of alternatives to the proposed action, and (4) the staff's recommendation regarding the proposed action based on its environmental review.

During the course of preparing this EIS, the staff reviewed the Environmental Report (ER) submitted by Southern (Southern 2007); consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in RS-002, *Processing Applications for Early Site Permits* (NRC 2004), to conduct an independent review of the issues. The review standard draws from the previously published NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* (NRC 1987), and NUREG-1555, *Environmental Standard Review Plans* (NRC 2000). In addition, the NRC considered the public comments related to the environmental review received during the scoping process. These comments are provided in Appendix D of this EIS.

Following the practice of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) (NRC 1996) and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance – SMALL, MODERATE, or LARGE – developed by NRC using guidelines from the Council on Environmental Quality (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

> SMALL – Environmental effects are not detectable or are so minor that they would neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections. During its environmental review, the staff considered planned activities and actions that Southern indicates it and others would likely take should Southern receive an ESP and later decide to apply for a CP or COL. In addition, Southern provided estimates of the environmental impacts resulting from the construction and operation of two new nuclear units on the ESP site.

Section 102(2)(C) of NEPA requires that an EIS include information on:

- the environmental impact of the proposed action

- any adverse environmental effects that cannot be avoided should the proposal be implemented

- alternatives to the proposed action

- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity

- any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented.

Activities permitted under an ESP that includes a site redress plan are preparation of the site for construction of the facility, installation of temporary construction facilities, excavation for facility structures, construction of service facilities, and construction of certain structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents. These activities are identified in the site redress plan. However, the following discussions of the NEPA requirements address the impacts of construction and operation of up to two new nuclear units at the VEGP site. The construction impacts bound any impacts of the site-preparation activities and preliminary construction activities allowed under 10 CFR 52.25(a).

11.1 Impacts of the Proposed Action

Impacts associated with construction of the proposed ESP facilities are discussed in Chapter 4 and are summarized in Table 4-6. Impacts associated with operation of the proposed facilities are discussed in Chapter 5 and are summarized in Table 5-17. Construction and operational impacts are discussed in the EIS to make an informed decision on siting. The impacts of operations would only occur if an operating license or COL is issued by the NRC.

The staff considered the potential cumulative impacts resulting from construction and operation of Units 3 and 4 at the VEGP site with past, present, and reasonably foreseeable future actions in the VEGP site area in Chapter 7 of this EIS. For each impact area, the staff's determination is that the potential cumulative impacts resulting from construction and operation would be SMALL and that mitigation would not be warranted. Several issues have the potential for MODERATE impacts, most of which would occur under temporary circumstances or as the result of a larger-than-expected concentration of construction workers settling near the VEGP site.

11.2 Unavoidable Adverse Environmental Impacts

Section 102(2)(C)(ii) of NEPA requires that an EIS include information on any adverse environmental effects that cannot be avoided should the proposal be implemented. Unavoidable adverse environmental impacts are those potential impacts of construction and operation of the two proposed new units that cannot be avoided and for which no practical means of mitigation are available.

There would be no unavoidable adverse environmental impacts associated with the granting of the ESP with the exception of impacts associated with the limited site-preparation and preliminary construction activities identified in the site redress plan. The impacts associated with the site-preparation and preliminary construction activities are bounded by the construction activities. However, there are unavoidable adverse environmental impacts associated with construction and operation of Units 3 and 4 at the VEGP site.

If granted, the only activities authorized by the ESP would be the following site-preparation activities, which have been sought by Southern:

- preparation of the site for construction of the facility (including such activities as clearing, grading, and construction of temporary access roads and borrow areas)

- installation of temporary construction support facilities (including such items as warehouse and shop facilities, utilities, concrete mixing plants, docking and unloading facilities, and construction support buildings)

- excavation for facility structures
- the construction of service facilities (including such facilities as roadways, paving, railroad spurs, fencing, exterior utility and lighting systems, and sanitary sewage treatment facilities)
- the construction of structures, systems, and components that do not prevent or mitigate the consequences of postulated accidents, which could cause undue risk to the health and safety of the public.

These activities are described in the volume of the application titled *Southern Nuclear Operating Company Early Site Permit Application for the Vogtle Electric Generating Plant, Part 4 Site Redress Plan* (Southern 2007) and enumerated in 10 CFR 50.10(e)(1).

If the ESP is granted to Southern and if Southern performs any or all of the activities described above but does not in the future seek a CP under 10 CFR Part 50 or a COL under 10 CFR Part 52, according to 10 CFR 52.17, Southern would need to redress the site according to the site redress plan included in the application (Southern 2007). The staff reviewed the list of allowed site-preparation and preliminary construction activities in the event that the ESP is granted and reviewed the full site redress plan submitted by Southern. In accordance with 10 CFR 52.17, the application demonstrated that there is reasonable assurance that redress carried out under the plan would achieve an environmentally stable and aesthetically acceptable site suitable for whatever non-nuclear use may conform with local zoning requirements. As a result of NRC's independent review as described in Section 4.11, the staff, in accordance with 10 CFR 52.25(a), preliminarily concludes that the potential site-preparation and preliminary construction activities described in Southern's site redress plan would not result in any significant adverse impacts that could not be redressed.

11.2.1 Unavoidable Adverse Impacts During Construction

Chapter 4 discusses in detail the potential impacts from construction of the proposed new nuclear units (Units 3 and 4) at the VEGP site. The unavoidable adverse impacts related to construction are listed in Table 11-1 and are summarized below. The primary unavoidable adverse environmental impacts during construction would be related to land use. All construction activities for VEGP Units 3 and 4, including ground-disturbing activities, would occur within the existing VEGP site boundary. According to Southern, the area that would be affected as a result of constructing and operating permanent facilities is approximately 125 ha (310 ac). Additional areas would be disturbed on a short-term basis as a result of temporary activities and facilities and laydown areas (Southern 2007).

Dewatering systems employed during excavation within the powerblock area would depress the water table in the general vicinity; however, the impacts would be localized and temporary. The alteration of the land surface at VEGP Units 3 and 4 would cause a localized change in the recharge rate to the Water Table aquifer.

Table 11-1. Unavoidable Adverse Environmental Impacts from Construction of VEGP Units 3 and 4

Impact Category	Adverse Impacts Based on Southern's Application	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land Use	Yes	Comply with requirements of applicable Federal, State, Tribal, and local permits	125 ha (310 ac) disturbed on a long-term basis; additional land disturbed on a temporary basis
Hydrological and Water Use	Yes	Obtain a CWA Section 401 Certification prior to site-preparation activities	Dewatering systems would depress the water table in the general vicinity, but the impacts would be localized and temporary
Ecological (Terrestrial)	Yes	Observe best management practices (BMP). Obtain a CWA Section 404 Permit, if applicable, prior to site-preparation activities	9 ha (22.5 ac) of wetlands, 113 ha (279 ac) of upland, and 1.6 ha (4 ac) of hardwood disturbed on a long-term basis on the VEGP site; new transmission line right-of-way would disturb additional terrestrial habitats
Aquatic	No	None	
Socioeconomic	Yes	Traffic control and management measures would protect any local roads during construction	Local traffic would increase during construction, available housing could be limited if workers concentrate in Burke County
Radiological	Yes	Use of as low as reasonably achievable principles	Dose to site-preparation workers
Air Quality	Yes	Implement actions to reduce fugitive dust	Equipment emissions and fugitive dust from operation of earth-moving equipment are sources of air pollution
Environmental Justice	No	None	None

Construction activities for the proposed 500-kV transmission line right-of-way would occur both onsite and offsite. The onsite land-use impacts are included in the 125 ha (310 ac). The approximate route is shown in Figure 4-1, but the exact route of the transmission line right-of-way has not been determined at this time. However, Southern stated in its ER that the transmission line right-of-way would be 46 m (150 ft) wide and 97 km (60 mi) long and traverse Burke, Warren, Jefferson, and McDuffie Counties.

An estimated 9.1 ha (22.5 ac) of wetlands habitat on the VEGP site would be lost to permanent structures and facilities associated with construction of the proposed ESP facility. Approximately 0.57 ha (1.4 ac) of land composed of pond and bottomland hardwood forest would be within the proposed 500-kV transmission line right-of-way. About 113 ha (279 ac) of upland habitat, including planted pines, previously disturbed areas and open fields, and approximately 1.6 ha (4 ac) of mixed hardwood and pine habitat, would be lost to permanent structures and facilities. Construction of the new transmission line could impact threatened and endangered species. Georgia Power Company (GPC) will site the transmission line in accordance with Georgia Code Title 22, Section 22-3-161. GPC's procedures for implementing this code include consultation with the Georgia Department of Natural Resources and U.S. Fish and Wildlife Service, as well as an evaluation of impacts to special habitats and threatened and endangered species. In addition, the GPC will comply with all applicable laws, regulations, and permit requirements, and will use good engineering and construction practices (Southern 2007). Socioeconomic impacts of construction include an increase in traffic from construction workers, and possible demand pressure on the local housing market if workers concentrate in Burke County. Atmospheric and meteorological impacts include fugitive dust from construction activities that can be mitigated by the dust-control plan. Radiological doses to construction workers from the adjacent units are expected to be well below regulatory limits. No unusual resource dependencies on minority and low-income populations in the region were identified. In addition, no environmental pathways related to construction and operation activities were found that would lead to adverse and disproportionate impacts on minority and low-income populations.

11.2.2 Unavoidable Adverse Impacts During Operation

Chapter 5 provides a detailed discussion of the potential impacts from operation of the proposed Units 3 and 4 at the VEGP site. The unavoidable adverse impacts related to operation are listed in Table 11-2 and are summarized below. The unavoidable adverse impacts from operation for land use would be small and further mitigation would not be warranted. Hydrological, water use, and water-quality impacts during operation would be small. Impacts from water are mitigated through the U.S. Army Corps of Engineers (USACE) Drought Contingency Plan (USACE 2006) for the basin and releases from J. Strom Thurmond Dam. Water-related impacts during operation would also be mitigated through Southern's adherence to State permits for water withdrawal and discharge. Terrestrial impacts would be small during operation, assuming BMP are followed. Aquatic impacts would be small during operation because Southern's adherence to the National Pollutant Discharge Elimination System permit would likely result in the maintenance of balanced aquatic populations. Socioeconomic impacts would primarily be increased demand for services, with the increase in tax revenue to support the increase in services. It is expected that air-quality impacts would be negligible and that pollutants emitted during operations would be insignificant.

Table 11-2. Unavoidable Adverse Environmental Impacts from Operation of VEGP Units 3 and 4

Impact Category	Adverse Impacts Based on Southern's Application	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land use	Yes	Local land management plans	Possible new housing and retail space added in vicinity because of potential growth
Hydrological and Water Use	Yes	Comply with State permit limits	Increased water use because of the addition of Units 3 and 4
Ecological			
Terrestrial	No	None	None
Aquatic	No	None	None
Socioeconomic	Yes	Increased tax revenues would offset impacts	Increased use of services
Radiological	Yes	Use of as low as reasonably achievable principles	Dose to workers, the public, and biota
Air Quality	No	None	None
Environmental Justice	No	None	None

11.3 Alternatives to the Proposed Action

Alternatives to the proposed actions are discussed in Chapter 9 of this EIS. Alternatives considered are the no-action alternative, energy production alternative, system design alternatives, and alternative sites.

The no-action alternative, described in Section 9.1, refers to a scenario in which the NRC would deny the ESP request. A comparison of the proposed action with the no-action alternative is provided in Section 10.4 of this EIS. All of the impacts of the no-action alternative are considered to be SMALL.

Alternative energy sources are described in Section 9.2 of this EIS. Detailed analyses of coal- and natural-gas-fired alternatives are provided in Section 9.2.2, other energy sources are discussed in Section 9.2.3, and alternatives that would not require additional generating capacity are described in Section 9.2.1. The staff concluded that none of the alternative power production options were both practical and environmentally preferable to the proposed action.

Alternative system designs are discussed in Section 9.3 of this EIS, focusing on alternative cooling system designs. The staff concluded that once-through cooling would not be practical at the VEGP site because of insufficient flow in the Savannah River. The staff concluded that the potential benefits of dry cooling towers or hybrid wet/dry cooling towers would not justify the expense and loss of efficiency that would result. The staff concludes that the impacts on water use and quality of the proposed wet tower cooling system would be SMALL, as described in Section 5.5.

Alternative sites are discussed in Section 9.5 of this EIS, and the impacts of construction and operation of the ESP facilities at the alternative sites are compared to the impacts at the proposed VEGP site in Chapter 10 of this EIS. Table 10-1 contains the staff's characterization of construction impacts at the proposed and alternative sites. The staff's characterization of operational impacts at the proposed and alternative sites is provided in Table 10-2. The staff concludes that while there are differences in construction on operational impacts at the proposed and alternative sites, none of the alternative sites is environmentally preferable or obviously superior to the proposed VEGP site.

11.4 Relationship between Short-Term Uses and Long-Term Productivity of the Human Environment

Section 102(2)(C)(iv) of NEPA requires that an EIS include information on the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. The only short-term use of the environment that could occur if the proposed action is implemented would be site-preparation activities conducted by Southern that would be authorized in an ESP. Any such activities are unlikely to adversely affect the long-term productivity of the environment. The evaluation of the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity for the construction and operation of the ESP units can be performed by discussing the benefits of operating the units. The principal benefit is the production of electricity. In accordance with 10 CFR 52.18, an EIS for an ESP does not need to include an assessment of the benefits of the proposed action. However, in its application, Southern elected to include in its ESP application a benefit-cost analysis of two new units at the VEGP site. Therefore, the staff prepared its own analysis, presented in Section 11.6. If new nuclear power plants are constructed on the VEGP site, power production would continue until the operating license or

COL expires or the licensee chooses to cease operation. Once the plants are shut down, they would be decommissioned according to NRC regulations. Once decommissioning is complete and the NRC license is terminated, the site would be available for other uses.

11.5 Irreversible and Irretrievable Commitments of Resources

Section 102(2)(C)(v) of NEPA requires that an EIS include information on any irreversible and irretrievable commitments of resources that would occur if the proposed action is implemented. The only irreversible and irretrievable commitments of resources that would be expended if the proposed action is implemented would be resources used by Southern for site-preparation and preliminary construction activities. If not used during the ESP stage, any such resource commitments for site-preparation activities would be used at the CP or COL stage or could be used for other activities even if Southern does not eventually seek a CP or a COL for the VEGP location.

Irretrievable commitments of resources during construction of the proposed new units generally would be similar to that of any major construction project. A study by the U.S. Department of Energy (DOE 2004) on new reactor construction estimated the following quantities of materials would be required for a new reactor: 9,357 m^3 (12,239 yd^3) of concrete, 2,819 MT (3,107 tons) of rebar, 4,000,000 m (13,000,000 ft) of cable, and 83,820 m (275,000 ft) of piping would be needed for a single reactor building. Therefore, twice these amounts would be needed for VEGP Units 3 and 4, and considerably more would be required for all the other site structures. The actual commitment of construction resources (concrete, steel, and other building materials) would depend on the final site design described at the CP or COL stage. However, only a portion of the total would be used during the ESP-authorized site-preparation and preliminary construction activities. Hazardous materials such as asbestos would not be used, if possible. If materials such as asbestos were used, it would be in accordance with applicable safety regulations and practices.

The staff expects that the use of construction materials in the quantities associated with those expected for Units 3 and 4 at the VEGP site, while irretrievable, would be of small consequence with respect to the availability of such resources.

The main resource that would be irretrievably committed during operation of the new nuclear units would be uranium. The availability of uranium ore and existing stockpiles of highly enriched uranium in the United States and Russia that could be processed into fuel is sufficient, so that the irreversible and irretrievable commitment would be of small consequence.

11.6 Benefit-Cost Balance

This section identifies the benefits and costs of constructing and operating two new nuclear generation units on the VEGP site. Although conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the intent of this section is to identify all potential societal benefits of the proposed activities and compare these to the potential internal (i.e., private) as well as external (i.e., societal) costs of the proposed activities. The purpose is to generally inform the ESP process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed activities outweigh the aggregate costs.

Although the NRC has requirements for licensees (10 CFR 50.75) to provide reasonable assurance that funds would be available for the decommissioning process, general issues related to Southern's financial viability are outside NRC's mission and authority and, thus, would not be considered in this EIS. It is not possible to quantify and assign a value to all benefits and costs associated with the proposed action. This analysis, however, attempts to identify, quantify, and provide monetary values for benefits and costs when reasonable estimates are available.

11.6.1 Benefits

The most apparent benefit from constructing and operating a power plant is that it would eventually generate power and provide thousands of residential, commercial, and industrial consumers with electricity. Few would dispute the social and economic importance of maintaining an adequate supply of electricity in any given region, because this resource is the foundation for economic stability and growth and fundamental to maintaining the standard of living individuals in the developed world have come to expect. In addition to nuclear power, however, there are a number of different power generation technology options that could meet this need, including natural-gas-powered plants, coal-fired generation, and hydroelectric plants. Because the focus of this EIS is on the proposed expansion of the VEGP site generating capacity, this section focuses primarily on the relative benefits of the VEGP option rather than the broader, more generic benefits of electricity supply.

11.6.1.1 Societal Benefits

In general, from a societal perspective, there are two primary benefits associated with nuclear power generation relative to most other alternative generating systems, which are described below.

1. Price Stability and Longevity. Because of relatively low and non-volatile fuel costs, nuclear energy is a dependable provider of electricity that can be provided at relatively stable prices to the consumer over a long period of time. Unlike some other energy sources, nuclear energy is generally not subject to unreliable weather or climate conditions, unpredictable cost fluctuations, or dependence on foreign suppliers.

For the production of electricity to be beneficial to a society, there must be a corresponding demand, or "need for power," in the region. Chapter 8 defines and discusses the need for power in more detail. The Georgia Public Service Commission (GPSC) regulates investor-owned utilities in the State of Georgia. As part of its mission to ensure that consumers receive safe, reliable, and reasonably priced electricity from financially viable entities, GPSC requires that all utilities under its jurisdiction submit Integrated Resource Plans (IRPs) every 3 years. The IRP provides GPSC with a means for consistently assessing a variety of demand and supply resources to cost effectively meet customer energy-service needs. It considers population growth, culture, lifestyle, the economy, the environment, available energy technology, and other factors and assesses many different ways to meet the forecasted demand with both supply-side and demand-management solutions. GPSC also ensures that the demand for power in the region is at a level that justifies additional power generation by investor-owned utilities and that the appropriate type of generation is chosen to meet this demand.

The GPC submits an IRP for GPSC approval every 3 years. The GPC submitted its 2007 IRP for review to the GPSC, and a final ruling on the 2007 IRP was made on July 12, 2007 (GPSC 2007). As part of the 2007 IRP, the GPC's mix study selected nuclear energy as the most cost-effective resource in the 2015/2016 time frame. VEGP Units 3 and 4 would each be designed to generate approximately 1117 MW(e) net, for a total of 2234 MW. Assuming a reasonably low capacity factor of 85 percent, the two-unit plant average annual electrical energy generation would be more than 16,000,000 MWh. A reasonably high-capacity factor of 93 percent would result in slightly more than 18,000,000 MWh of electricity.

2. <u>Energy Security and Fuel Diversity</u>. Currently, more than 70 percent of the electricity generated in the United States is generated with fossil-based technologies; thus, non-fossil-based generation, such as nuclear generation, are essential to maintaining diversity in the aggregate power generation fuel mix (DOE/EIA 2006). Nuclear power contributes to the diverse U.S. energy mix, hedging the risk of shortages and price fluctuations for any one generating system and reducing the nation's dependence on imported fossil fuels.

One of the goals of the IRP process is to ensure that a region's given electricity generation relies on a mix of different fuels. A diverse fuel mix helps to protect consumers from contingencies such as fuel shortages or disruptions, price fluctuations, and changes in regulatory practices. The GPC fuel mix is made up of approximately 72 percent coal, 19 percent nuclear, 3 percent hydroelectric, and just under 6 percent natural gas and oil (Southern 2007). The GPC IRP for 2004 shows a trend of increasing dependence on gas, and a corresponding decreasing dependence on nuclear, coal, and hydro energy (GPC 2004). In the past 15 years, virtually all new power plants built in Georgia have been fueled by natural gas. GPSC has raised concerns during the IRP approval process regarding the trend to rely more heavily on a relatively price-volatile fuel source for new electric generation, and has urged utilities to study the feasibility of building new nuclear plants (GPSC 2004). In response to the

2007 IRP, GPSC reaffirmed its conclusion that it was reasonable for GPC to investigate the opportunity to build nuclear units (GPSC 2007). The proposed expansion of the VEGP site generating capacity could provide additional nuclear power generation to the generation mix that could provide the region with a hedge against risks of future shortages and price fluctuations of alternative generating systems.

11.6.1.2 Regional Benefits

Tax Revenue Benefits

Southern's current tax payments to Burke County for the VEGP site represent approximately 80 percent of the total county property tax revenues. If two new units are operational at the VEGP site, there would be a significant regional tax revenue benefit realized by Burke County (see Section 5.5.3.2). The amount of property taxes that will be paid by the co-owners for the new units during operations depend on many factors, most of which are not known at this time; however, based on electrical output of 1117 MW(e) per unit and the estimated cost of each Westinghouse AP1000 reactor installed, the annual property tax revenues generated by the two new units could range from $20 to $29 million in the first 10 years of operation, and then decline as the value of the plant declines over time to around $3.5 to $5 million for Burke County.

Regional Productivity and Community Impacts

The new units would require a workforce of about 660 people. The multiplier effect would create additional indirect jobs. In total, approximately 1600[a] new jobs within about a 80-km (50-mi) radius of the plant would be created by the startup of the new units and would be maintained throughout the life of the plant. The economic multiplier effect of the increased spending by the direct and indirect workforce created as a result of two new units would increase the economic activity in the region, most noticeably in rural Burke County (Southern 2007). Sections 5.5.3.1 and 4.5.3.1 provide additional information on the economic impacts of constructing and operating Units 3 and 4 on the VEGP site.

The existence of the VEGP site has resulted in infrastructure improvements to the region, including upgrading and paving the road that leads to the plant. It is expected that there would be various other local infrastructure improvements that would be made during the construction of VEGP Units 3 and 4, including road improvements around the plant (Southern 2007).

NRC staff's interviews in surrounding VEGP communities revealed high perceived benefit to having both a "good corporate citizen" (Southern) in the region as well as the presence of

(a) 660 direct plus (660 x multiplier [660 x 1.42]) = 937.

significant groups of relatively well-paid and well-educated employees associated with the nuclear plant expansion. Local officials and service organization representatives all emphasized the philanthropic and service value that Southern and its employees brings to the community (PNNL 2006).

11.6.2 Costs

Internal costs to the applicant as well as external costs to the surrounding region and environment would be incurred during the construction and operation of two new units on the VEGP site. Internal costs include the costs to physically construct the power plant (capital costs), as well as operating and maintenance costs, fuel costs, waste disposal, and decommissioning costs. External costs include all costs imposed on the environment and region surrounding the plant and may include such things as a loss of regional productivity, environmental degradation, or loss of wildlife habitat.

11.6.2.1 Internal Costs

The most substantial monetary cost associated with nuclear energy is the cost of capital. Nuclear power plants typically have relatively high capital costs for building the plant, but very low fuel costs relative to alternative power generation systems. Because of the large capital costs for nuclear power, and the relatively long construction period before revenue is returned, servicing the capital costs of a nuclear power plant is the most important factor determining the economic competitiveness of nuclear energy. Construction delays can add significantly to the cost of a plant. Because a power plant does not yield profits during construction, the longer construction times translate directly into higher interest expenses on borrowed construction funds.

Construction Costs

In evaluating monetary costs related to constructing Units 3 and 4 at the VEGP site, Southern reviewed recent published literature, vendor information, internally generated financial information, and internally generated, site-specific information. The cost estimates reviewed were not based on nuclear plant construction experience in the United States, which is more than 20 years old, but rather construction costs overseas, which are more recent. General trends in construction costs indicate that overall capital expenses are declining, suggesting that the industry has learned from experience and is beginning to streamline and standardize construction (Southern 2007).

The phrase commonly used to describe the monetary cost of constructing a nuclear plant is "overnight capital cost." The capital costs are those incurred during construction, when the actual outlays for equipment and construction and engineering are expended. Overnight costs include engineering, procurement, and construction costs; however, it is presumed that the plant is constructed "overnight," thus interest is not included. Estimates of overnight capital costs for construction range from $1100 per kW to $2300 per kW, with $1500 to $2000 per kW being the most representative range (Southern 2007). Many factors account for the range: the specific technology and assumptions about the number of like units built, allocation of first-of-a-kind costs, site location and parity adjustments to allow comparison between counties, and allowances for contingencies are some examples. For purposes of its analysis in the ER, to avoid understating the cost, Southern chose to use the $2000-per-kW value. Together with an installed capacity of 2234 MW(e), $2000 per kW results in a construction cost for VEGP Units 3 and 4 of approximately $4.5 billion (Southern 2007).

Operation Costs

Operation costs are frequently expressed as levelized cost of electricity, which is the price per kWh of producing electricity, including the cost needed to cover operating costs and annualized capital costs. Overnight capital costs account for a third of the levelized cost, and interest costs on the overnight costs account for another 25 percent (University of Chicago 2004). Levelized cost estimates range from $36 to $83 per MWh (3.6 to 8.3 cents per kWh). Factors affecting the range include choices for discount rate, construction duration, plant life span, capacity factor, cost of debt and equity and split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty. Estimates include decommissioning but, due to the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the levelized cost. Using the same criteria as was used for construction costs, Southern concluded that $65 per MWh (6.5 cents per kWh) is a reasonably high-end levelized cost of electricity for nuclear generation. This compares well with preliminary cost information that the GPC filed with the GPSC (Southern 2007).

Fuel Costs

From the outset, the basic attraction of nuclear energy has been its low fuel costs compared with coal, oil and gas fired plants. Uranium, however, has to be processed, enriched, and fabricated into fuel elements, and about half of the cost is results from enrichment and fabrication. Allowances must also be made for the management of radioactive spent fuel and the ultimate disposal of this spent fuel or the wastes separated from it. But even with these costs included, the total fuel costs of a nuclear power plant are typically about a third of those for a coal-fired plant and between a quarter and a fifth of those for a natural gas combined-cycle plant (University of Chicago 2004).

Waste Disposal

The back-end costs of nuclear power contribute a very small share of total cost, both because of the long lifetime of a nuclear reactor and the fact that provisions for waste-related costs can be accumulated over that time. It should also be recognized, however, that radioactive nuclear waste also poses unique disposal challenges for long-term management. The United States and other countries have yet to implement final disposition of spent fuel or high-level radioactive waste streams created at various stages of the nuclear fuel cycle. Because these radioactive wastes present some danger to present and future generations, the public and its elected representatives, as well as prospective investors in nuclear power plants, properly expect continuing and substantial progress towards solution to the waste-disposal problem. Successful operation of the planned disposal facility at Yucca Mountain would ease, but not solve, the waste-disposal issue for the United States and other countries if nuclear power expands substantially (MIT 2003).

Decommissioning

The NRC has requirements for licensees at 10 CFR 50.75 to provide reasonable assurance that funds would be available for the decommissioning process. Because of the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the levelized cost of electricity generated by a nuclear power plant (WNA 2007).

11.6.2.2 External Costs

External costs are social and/or environmental effects caused by the proposed construction of and generation of power two new reactors at the VEGP site. This EIS includes the NRC staff's analysis that considers and weighs the environmental impacts of constructing and operating new nuclear units at the VEGP site or at alternative sites, and mitigation measures available for reducing or avoiding these adverse impacts. It also includes the staff's recommendation to the Commission regarding the proposed action.

Environmental and Social Costs

Unlike electricity generated from coal and natural gas, operation of a nuclear power plant does not result in any emissions of air pollutants associated with global warming and climate change (e.g., nitrogen oxides, sulfur dioxide, carbon dioxide) or methyl mercury. Combustion-based power plants are responsible for 36 percent of the carbon dioxide, 64 percent of the sulfur dioxide, 26 percent of the nitrogen oxide, and 13 percent of the mercury emissions from industrial sources in the United States (DOE/EIA 2006). The majority of the electric power industry's emissions are from coal-fired plants (Southern 2007). Chapter 9 of this EIS analyzes coal- and natural-gas-fired alternatives to the construction and operation of VEGP Units 3 and 4. Air emissions from these alternatives and nuclear power are summarized in Chapters 5 and 9.

Chapter 4 of this EIS describes the impacts of construction on the environment with respect to the land, water, ecology, socioeconomics, radiation exposure to construction workers, and measures and controls to limit adverse impacts during construction of the proposed new units at the VEGP site. Chapter 5 examines environmental issues associated with operation of the proposed new nuclear VEGP Units 3 and 4 for an initial 40-year period. Potential operational impacts on land use, air quality, water, terrestrial and aquatic ecosystems, socio-economics, historic and cultural resources, environmental justice, nonradiological and radiological health effects, postulated accidents, and applicable measures and controls that would limit the adverse impacts of station operation during the 40-year operating period are considered. In accordance with 10 CFR Part 51, all impacts identified in Chapters 4 and 5 have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) assigned. Chapter 6 addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of nuclear units at the VEGP site. Chapter 9 includes the NRC staff's review of alternative sites and alternative power generation systems. Section 11.2 identifies unavoidable adverse impacts of the proposed action (i.e., impacts after consideration of proposed mitigation actions), and Section 11.3 identifies irretrievable commitments of resources. In Chapter 10, impacts were also compared to the adverse impacts for the three alternative sites, Plant Farley, Plant Hatch, and the Barton Site.

Safety

For some people, nuclear power has perceived high risk associated with safety, environmental, and health effects, heightened by the 1979 Three Mile Island and 1986 Chernobyl reactor accidents, and also by accidents at fuel cycle facilities in the United States, Russia, and Japan. In recent years, there has also been growing concern about the safe and secure transportation of nuclear materials and the security of nuclear facilities from terrorist attack. It should be noted, however, that the intent of this EIS is to analyze and assess any potential adverse safety, environmental, and health effects; thus, NRC staff conclusions regarding these topics are found in Chapters 4, 5, and 6 of this EIS. It is further noted that NRC staff interviews with local officials and community members around the VEGP site did not reveal any significant perceived risk of safety, environmental, or health effects related to the operation of nuclear power plants in the region.

11.6.3 Summary of Benefits and Costs

Southern's business decision to pursue expansion of VEGP generating capacity by adding two additional nuclear reactors is an economic decision, based on private financial factors subject to regulation by the GPSC. Southern's decision to pursue this expansion implies that the company has already concluded that the private, or internal, benefits of the proposed facility outweigh the internal costs. Although no specific monetary values could reasonably be assigned to the identified societal benefits, it would appear that the potential societal benefits of the proposed expansion of VEGP are substantial. In comparison, the external socio-environmental costs imposed on the region appear to be relatively small.

Table 11-3 includes a summary of both internal and external costs of the proposed activities at VEGP, as well as the identified benefits. The table includes a reference to other sections of this EIS when more detailed analyses and when impact assessments are available for specific topics. These assessments are included in the table.

Table 11-3. Summary of Benefits and Costs of the Proposed Action

Benefit-Cost Category	Description (All costs in 2003 U.S. dollars)	Impact Assessment[(a)]
Benefits		
Electricity generated	16,000,000 to 18,000,000 MWh per year for the 40-year life of the plant	
Generating capacity	2234 MW (two units at 1117 MW each)	
Fuel diversity and energy security	Nuclear option provides diversity to coal- and natural-gas-fired baseload generation	
Tax revenues	Property tax revenues could range from approximately $29 million to $3.5 million annually over the 40-year life of the units (see Sections 4.5.3.2 and 5.5.3.2)	LARGE
Local economy	Increased jobs would benefit the area economically and increase economic diversity of region (see Sections 4.5.3.1 and 5.5.3.1)	SMALL to MODERATE
Transportation	Minor upgrades to roads around the VEGP site	
Public services and education	Additional tax revenues and philanthropic dollars to the community expected from Southern's corporate donations as well as donations of time and money from its employees (see Sections 4.5.4.4, 4.5.4.5, 5.5.4.4, 5.5.4.5, 4.7, and 5.7)	SMALL to MODERATE

Table 11-3. (contd)

Benefit-Cost Category	Description (All costs in 2003 U.S. dollars)	Impact Assessment[(a)]
Costs		
	Internal Costs[(d)]	
Construction cost	$4.5 billion (overnight capital cost)	
Operating cost	6.5 cents per kWh (levelized cost of electricity)	
Spent fuel management	0.1 cent/kWh (WNA 2007)[(b)]	
Decommissioning	0.1-0.2 cent/kWh (WNA 2007)[(c)]	
Material and resources	25,000 yds^3 concrete 6000 tons rebar 26,000,000 linear feet cable 550,000 feet of piping having a diameter of > 2.6 in. 981 MT uranium	
Tax payments	Corporate income, business, and property taxes must be paid by the VEGP site owners to the County and State. Although taxes associated with income and operation of the plant are not estimated, the tax payments on property assessment could range from $29 million to $3.5 million annually over the 40-year life of the units.	
Land use	125.5 ha (310 ac) occupied on a long-term basis by the two new nuclear reactors and associated infrastructure. Rights-of-way would need to be acquired and developed for transmission (see Sections 4.1 and 5.1).	
	External Costs	
Land use	The land acquired for new transmission line rights-of-way may be taken out of other productive or beneficial use (see Sections 4.1 and 5.1)	SMALL to MODERATE
Air-quality impacts	Negligible impacts (see Sections 4.2, 5.2, and 9.2). Avoidance of sulfur dioxide, nitrogen oxide, carbon monoxide, carbon dioxide, and particulate emissions.	SMALL

Table 11-3. (contd)

Benefit-Cost Category	Description (All costs in 2003 U.S. dollars)	Impact Assessment[a]
Water-related impacts	The impact would be small. Water effluents would be regulated by Georgia Department of Natural Resources Environmental Protection Division under an NPDES permit (see Sections 4.3 and 5.3).	SMALL
Ecological impacts	Terrestrial impacts expected to be small. Southern's adherence to the NPDES permit would likely result in balanced aquatic populations. Transmission line impacts would be greater. No threatened and endangered terrestrial or aquatic species known to inhabit area (see Sections 4.4 and 5.4).	SMALL to MODERATE
Physical impacts of plant construction and operation on community	Impacts limited primarily to boundaries of the site (see Sections 4.5.1 and 5.5.1)	SMALL
Housing	Potential short-term housing shortage (possibly driving up housing prices and rental rates) in Burke County during the 7-year construction period (see Section 4.5.4.3)	SMALL to MODERATE
Transportation	Temporary stress on road/local road network because of congestion during construction and potential degradation from construction and operation activities (see Sections 4.5.4.1 and 5.5.4.1).	SMALL to MODERATE
Public services	Potential short-term strain on community services in Burke County during early stages of 7-year construction period (see Section 4.5.4.4)	SMALL
Aesthetics and recreation	Because the plant already exists onsite, very little marginal impact on aesthetic and recreation from additional reactors (see Sections 4.5.1.4, 4.5.3.4, 5.5.1.4, and 5.5.3.4)	SMALL to MODERATE
Cultural resources	There would likely be an adverse effect to a cultural resource. Southern has committed to develop procedures to manage cultural resources in the event of an inadvertent discovery onsite (see Sections 4.6 and 5.6).	MODERATE

Table 11-3. (contd)

Benefit-Cost Category	Description (All costs in 2003 U.S. dollars)	Impact Assessment[(a)]
Health impacts (nonradiological and radiological)	Small estimated lake temperature increases would not significantly increase abundance of thermophilic microorganism. Radiological doses to the public and occupational workers would be monitored and controlled in accordance with regulatory limits (see Sections 4.8, 4.9, 5.8 and 5.9).	SMALL

(a) Impact assessments are listed for all impacts evaluated in detail as part of this EIS. The details on impact assessments are found in the indicated sections of this EIS.
(b) Based on Yucca mountain waste maintenance levy. Source: WNA 2007
(c) Decommissioning costs are also included in total operating costs.
(d) Internal costs are costs incurred by Southern to implement proposed construction and operation of the VEGP site. Note that no impact assessments are provided for these private financial impacts.

The staff concludes, on the basis of the assessments summarized in this EIS, that the construction and operation of the proposed VEGP Units 3 and 4, with mitigation measures identified by the staff, would have accrued benefits that most likely would outweigh the economic, environmental, and social costs associated with constructing and operating two new units at the VEGP site.

11.7 Staff Conclusions and Recommendations

The staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued. The staff's evaluation of the safety and emergency preparedness aspects of the proposed action have been addressed in the staff's safety evaluation report that is anticipated to be published in May 2008.

This preliminary recommendation is based on (1) the ER submitted by Southern (Southern 2007), (2) consultation with Federal, State, Tribal, and local agencies, (3) NRC's own independent review, (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process, and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and in the EIS. In addition, in making its preliminary recommendation, the staff determined that there are no environmentally preferable or obviously superior sites. Finally, the staff preliminarily concludes that site-preparation and preliminary construction activities allowed by 10 CFR 50.10(e)(1) would not result in any adverse significant impact that cannot be redressed.

A comparative summary showing the environmental impacts of locating two new nuclear units at the VEGP site and at any of the alternative sites is shown in Table 11-4. Impacts of the no-action alternative, or denial of the ESP application, are also shown. Table 11-4 shows that the significance of the environmental impacts of the proposed action is SMALL for all impact categories with the exception of (1) land-use, aesthetic, and ecological resources because of uncertainty surrounding possible transmission line right-of-way locations, (2) a MODERATE cultural and historic resource impact, and (3) certain socioeconomic categories because of the influx of construction workers. The alternative sites may have environmental effects in at least some categories that reach MODERATE significance. The staff concludes that none of the alternative sites assessed are obviously superior to the VEGP site.

Table 11-4. Summary of Environmental Significance of Locating Two New Nuclear Reactors at the VEGP Site and at Alternative Sites and for the No-Action Alternative

	Proposed Action	No-Action Alternative			
Impact Category	**ESP Site**	**Denial of ESP**	**Plant Farley**	**Plant Hatch**	**Barton Site**
Land use	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	MODERATE
Air quality	SMALL	SMALL	SMALL	SMALL	SMALL
Water use and quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecology	SMALL to MODERATE	SMALL	MODERATE	SMALL to MODERATE	MODERATE
Socioeconomics	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Historic and cultural resources	MODERATE	SMALL	SMALL	SMALL	SMALL
Environmental justice	SMALL	SMALL	SMALL	SMALL	SMALL
Human health	SMALL	SMALL	SMALL	SMALL	SMALL

11.8 References

10 CFR Part 50. Code of Federal Regulations, Title 10 *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10 *Energy*, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 1508. Code of Federal Regulations. Title 40, *Protection of Environment*, Part 1508, "Terminology and Index."

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10. SUPPLEMENTARY NOTES

Docket Nos. 52-011

11. ABSTRACT *(200 words or less)*

This draft environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Southern Nuclear Operating Company, Inc. (Southern) for an early site permit (ESP). The proposed action requested in Southern's application is for the NRC to (1) approve a site within the existing Vogtle Electric Generating Plant (VEGP) boundaries as suitable for the construction and operation of a new nuclear power generating facility and (2) issue an ESP for the proposed location at the VEGP site, adjacent to the existing VEGP units.

The NRC staff's preliminary recomendation to the Commission related the environmental aspects of the proposed action is that the ESP should be issued as proposed. The staff's evaluation of the site safety and emergency preparedness aspects of the proposed action would be addressed in the staff's Safety Evaluation Report that is anticipated to be published in May 2008. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by Southern; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in this draft EIS, including the potential mitigation measures identified in the ER and this draft EIS. In addition, in making its recommendation, the staff determined that there are no environmentally preferable or obviously superior sites. Finally, the staff has concluded that the site preperation and preconstruction activities allowed by 10 CFR 50.10(e)(1) requested by Southern in its application will not result in any significant adverse environmental impact that cannot be redressed.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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