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Environmental Impact Statement for Combined Licenses (COLs) for Levy Nuclear Plant Units 1 and 2

Final Report

Chapters 6 to 10

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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 Progress Energy Florida, Inc. (PEF) for combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the PEF application are (1) NRC issuance of COLs for two new power reactor units at the Levy Nuclear Plant (LNP) site in Levy County, Florida, and (2) U.S. Army Corps of Engineers (USACE) issuance of a permit to perform certain construction activities on the site. The USACE is participating in preparing this EIS as a cooperating agency and participates collaboratively on the review team (which comprises NRC staff, contractor staff, and USACE staff).

This EIS includes the review team's analysis that considers and weighs the environmental impacts of constructing and operating two new nuclear units at the LNP site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts.

The Federal Water Pollution Control Act (Clean Water Act) requires that the USACE apply the criteria set forth in the 404(b)(1) Guidelines in evaluating projects that propose to discharge dredged or fill material into waters of the United States. The USACE must also determine through its Public Interest Review (PIR) whether the proposed project is contrary to the public interest. The USACE permit decision, including its evaluation under the 404 Guidelines and the PIR, will be documented in the USACE Record of Decision, which will be issued following the issuance of this EIS.

After considering the environmental aspects of the proposed action, the NRC staff's recommendation to the Commission is that the COLs be issued as proposed. This recommendation is based on (1) the application, including the Environmental Report (ER), submitted by PEF; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public scoping and draft EIS comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS.

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Executive Summary

By letter dated July 28, 2008, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from Progress Energy Florida, Inc. (PEF) for combined construction permits and operating licenses (combined licenses or COLs) for Levy Nuclear Plant (LNP) Units 1 and 2 located in southern Levy County, Florida. The review team's evaluation is based on the October 2009 Environmental Report revision to the application, October 2011 Final Safety Analysis Review revision to the application, responses to requests for additional information, and supplemental letters.

The proposed actions related to the LNP Units 1 and 2 application are (1) NRC issuance of COLs for construction and operation of two new nuclear units at the LNP site, and (2) U.S. Army Corps of Engineers (USACE) issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act, (Clean Water Act) and Section 10 of the Rivers and Harbors Act to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency and participates collaboratively on the review team, which consists of NRC staff, contractor staff, and USACE staff. The reactor design specified in the application is Revision 19 of the Westinghouse Electric Company, LLC, AP1000 certified design.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) directs that an 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. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

The purpose of PEF's requested NRC action – issuance of the COLs – is to obtain licenses to construct and operate two new nuclear units. These licenses are necessary but not sufficient for construction and operation of the units. A COL applicant must also obtain and maintain permits from other Federal, State, Tribal, and local agencies and permitting authorities. Therefore, the purpose of the NRC's environmental review of the PEF application is to determine if two nuclear units of the proposed design can be constructed and operated at the LNP site without unacceptable adverse impacts on the human environment. The purpose of PEF's requested USACE action is to obtain a permit to perform regulated activities that would affect waters of the United States.

Upon acceptance of the PEF application, 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. On December 4, 2008, the NRC held two public meetings in Crystal River, Florida, to obtain public input on the scope of the environmental review. The staff reviewed the oral testimony and written comments received during the scoping process and contacted Federal, State, Tribal, regional, and local agencies to solicit comments.

To gather information and to become familiar with the sites and their environs, the NRC and its contractors visited the Dixie, Putnam, and Highlands alternative sites in October 2008. In December 2008, the review team visited the LNP site and Crystal River alternative site. During the December 2008 site visit, the review team also conducted a site audit and met with PEF staff, public officials, and members of the public. During the scoping process, and after the draft EIS was published, the NRC and USACE staff contacted Federal, State, Tribal, regional, and local agencies and the public to solicit comments. All comments received were reviewed and responses are included in Appendix E.

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; (2) potential mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's recommendation regarding the proposed action.

To guide its assessment of the environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance found in 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, MODERATE, and LARGE:

> 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.

In preparing this EIS, the review team reviewed the application, including the Environmental Report (ER) submitted by PEF; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NRC's NUREG-1555, *Environmental Standard Review Plan – Standard Review Plans for Environmental Reviews for Nuclear Power Plants* and a Staff Memorandum on *Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Enviromental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements*. In addition, the NRC staff considered the public comments related to the environmental review received during the scoping process. Comments within the scope of the environmental review are included in Appendix D of this EIS.

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs be issued as requested. This recommendation is based on (1) the application, including the ER submitted by PEF; (2) consultation with other Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of public comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE will issue its Record of Decision based, in part, on this EIS.

A 75-day comment period began on the date of publication of the U.S. Environmental Protection Agency Notice of Availability of the filing of the draft EIS to allow members of the public and agencies to comment on the results of the environmental review. During this period, the NRC and USACE staff conducted a public meeting near the LNP site to describe the results of the environmental review, respond to questions, and accept public comments. All comments received during the comment period are included in Appendix E.

The NRC staff's evaluation of the site safety and emergency preparedness aspects of the proposed action will be addressed in the NRC's Safety Evaluation Report anticipated to be published in 2012.

Abbreviations

7Q10	the lowest average flow over a period of 7 consecutive days that occurs once every 10 years, on average
μS	micro Siemens
AADT	annual average daily traffic
ac	acre(s)
ACHP	Advisory Counsel of Historic Preservation
ACS	American Community Survey
ADAMS	Agencywide Documents Access and Management System
ADM	average daily membership
ADT	average daily traffic
AEA	Atomic Energy Act of 1954
AFUDC	allowance for funds used during construction
ALARA	as low as reasonably achievable
a.m.	ante meridian
AO	archaeological occurrence
AP1000	Westinghouse Electric Company, LLC AP1000 pressurized water reactor
APE	Area of Potential Effect
APP	Avian Protection Plan
APT	Aquifer Performance Testing
AQCR	Air Quality Control Region
AQI	Air Quality Index
ASLB	Atomic Safety and Licensing Board
BA	biological assessment
BACT	Best Available Control Technologies
BDS	blowdown system
BEA	Bureau of Economic Analysis
BEBR	Bureau of Economic Business Research
BEIR	Biological Effects of Ionizing Radiation
bgs	below ground surface
BLS	U.S. Bureau of Labor Statistics
BMP	best management practice
BP	Before Present
Bq	becquerel(s)
BRA	Biological Research Associates
BRC	Bureau of Radiation Control (of the State of Florida Department of Health) or Blue Ribbon Commission on America’s Nuclear Future
Btu	British thermal unit(s)
°C	degree(s) Celsius

CAA	Clean Air Act
CDC	U.S. Centers for Disease Control and Prevention
CDF	core damage frequency
CEQ	Council on Environmental Quality
CESQG	conditionally exempt small quantity generator
CFBC	Cross Florida Barge Canal
cfm	cubic foot (feet) per minute
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGP	Construction General Permit
CH2M HILL	CH2M Hill Nuclear Business Group
CHARTS	(Florida's) Community Health Assessment Resource Tool Set
Ci	curie(s)
cm	centimeter(s)
cm^3	cubic centimeter(s)
cm/s	centimeter(s) per second
CO	carbon monoxide
CO_2	carbon dioxide
COD	chemical oxygen demand
COL	combined construction permit and operating license or combined license
CORMIX	Cornell Mixing Zone Expert System
Corps	U.S. Army Corps of Engineers
CP	construction permit
CPUE	catch per unit effort
CPI	Consumer Price Index
CR	County Road
CRDC	Crystal River Discharge Canal
CREC	Crystal River Energy Complex
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWIS	cooling-water intake structure
CWS	circulating-water system
d	day(s)
DA	Department of Army
dB	decibel(s)
dBA	decibel(s) (acoustic)
DBA	design basis accident
DCD	Design Control Document
DHS	(Florida) Department of Human Services
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOF	(Florida) Department of Forestry
DOT	U.S. Department of Transportation
D/Q	deposition values or factors
DSM	demand-side management

DTS	demineralized water-treatment system
DWRM2	District-Wide Regulation Model, Version 2
E	endangered
EE	energy efficiency
E&SCP	Erosion and Sediment Control Plan
EA	environmental assessment
EAB	exclusion area boundary
EDG	emergency diesel generator
EFH	essential fish habitat
EIA	Energy Information Administration or Economic Impact Area
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EMS	emergency management services
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
EPRI	Electric Power Research Institute
EPU	Extended Power Uprate
EPZ	emergency planning zone
ER	Environmental Report
ERP	Environmental Resource Permit
ESA	U.S. Endangered Species Act of 1973, as amended
ESO	Environmental Support Organization
ESP	early site permit
ESRP	Environmental Standard Review Plan
ESWEMS	Essential Service Water Emergency Makeup System
ESWS	Essential Service Water System
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FAC	Florida Administrative Code
FAS	Floridan Aquifer System
FDA	U.S. Food and Drug Administration
FDACS	Florida Department of Agriculture and Consumer Service
FDCA	Florida Department of Community Affairs
FDEP	Florida Department of Environmental Protection
FDOE	Florida Department of Education
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FES	Final Environmental Statement
FERC	Federal Energy Regulatory Commission
FFWCC	Florida Fish and Wildlife Conservation Commission
FGT	Florida Gas Transmission Company

FIRM	Flood Insurance Rate Maps
FLUCFCS	Florida Land Use, Cover and Forms Classification System
FMP	fishery managemen plan
FNAI	Florida Natural Areas Inventory
fps	foot (feet) per second
FPSC	Florida Public Service Commission
FR	Federal Register
FRCC	Florida Reliability Coordinating Council
FS	Florida Statutes
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
FTE	full-time equivalent (employee)
FVCOM	Finite Volume Community Ocean Model
FWDS	Fire Water Distribution System
FWPCA	Federal Water Pollution Control Act (aka Clean Water Act)
FWRI	Fish and Wildlife Research Institute
FWS	U.S. Fish and Wildlife Service
g	gram(s)
gal	gallon(s) (3)
GBq	gigabecquerel
GCC	global climate change
GCN	Greatest Conservation Need
GCRP	U.S. Global Change Research Program
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GI-LLI	gastrointestinal lower large intestine
GIS	geographic information system
gpd	gallon(s) per day
gph	gallon(s) per hour
gpm	gallon(s) per minute
gps	gallon(s) per second
GW(e)	gigawatt(s) electric
GWh	gigawatthour(s)
Gy	gray(s)
ha	hectare(s)
HAPC	Habitat Areas of Particular Concern
HAZMAT	hazardous material
HBS	historic basin storage
HDPE	high-density polyethylene
HLW	high-level waste

hr	hour(s)
hr/yr	hour(s) per year
HVAC	heating, ventilation, and air conditioning
Hz	hertz
I	Interstate
IAEA	International Atomic Energy Agency
IAQCR	Interstate Air Quality Control Region
IBA	Important Bird Area
ICRP	International Council on Radiological Protection
IEA	International Energy Agency
IGCC	integrated gasification combined cycle
in.	inch(es)
in./s	inch(es) per second
INEEL	Idaho National Engineering and Environmental Laboratory
IRP	integrated resource planning
IRWST	in-containment refueling water storage tank
ISFSI	independent spent fuel storage installation
IWHRS	Integrated Wildlife Habitat Ranking System
K-8	kindergarten through 8th grade
K–12	kindergarten through 12th grade
kcfs	thousand cubic feet per second
kg	kilogram(s)
kg/ha/mo	kilogram(s) per hectare per month
kg/ha/yr	kilogram(s) per hectare per year
KH	Kimley-Horn
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt(s)
kVA	kilovolt-ampere(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
kW(e)	kilowatt electric
L	liter(s)
L/hr	liter(s) per hour
L/m	liter(s) per minute
lb	pound(s)
LC50	the concentration that is lethal to 50 percent of the sample population
LCFS	the transmission-line corridor from the proposed LNP to Central Florida South substation
LCR	the transmission-line corridor from the proposed LNP to the CREC 500-kV switchyard

Ld	daytime average noise levels
Ldn	day-night average noise level
LEDPA	least environmentally damaging practicable aternative
LLW	low-level waste
Ln	nighttime average noise levels
LNP	Levy Nuclear Plant
LNG	liquefied natural gas
LOAEL	Lowest Observed Adverse Effect Level
LOCA	loss-of-coolant accident
LOS	level of service
LPC	the transmission-line corridor from the proposed LNP to the proposed Citrus substation
Lpm	liter(s) per minute
LPZ	low population zone
LWA	limited work authorization
LWR	light water reactor
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mA	milliampere(s)
MACCS(2)	Melcor Accident Consequence Code System
MBq	megabecquerel(s)
MBTA	Migratory Bird Treaty Act
µg	microgram(s)
mg	milligram(s)
MCL	maximum contaminant level
MEI	maximally exposed individual
MFL	minimum flows and levels
Mgd	million gallons per day
mG	milliGauss
mGy	milliGray(s)
MHW	mean high water
mi	mile(s)
mi^2	square mile(s)
MIT	Massachusetts Institute of Technology
ml	milliliter(s)
MLU	Multi-Layer Unsteady state (model)
MMBtu	a thousand thousand British thermal units
mo	month
MOU	Memorandum of Understanding
mph	mile(s) per hour
mR	milliroentgen
mrad	millirad
mrem	millirem

MSA	Metropolitan Statistical Area
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSGP	Multi-Sector Generic Permit
msl	mean sea level
mSv	millisievert(s)
MSW	municipal solid waste
MT	metric ton(nes)
MTU	metric ton(nes) uranium
MW	megawatt(s); also monitoring well
MW(e)	megawatt(s) electric
MWh	megawatt-hour(s)
MW(t)	megawatt(s) thermal
MWd	megawatt-day(s)
N_2	nitrogen
NA	not applicable or data not available
NAAQS	National Ambient Air Quality Standards
NaCl	sodium chloride
NAGPRA	National American Graves Protection and Repatriation Act
NAVD88	Northern American Vertical Datum of 1988
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection and Measurements
ND	no data
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSR	New Source Review
NUREG	U.S. Nuclear Regulatory Commission technical document
NWR	National Wildlife Refuge
OCA	Owner-Controlled Area
ODCM	Offsite Dose Calculation Manual
OECD	Organization for Economic Cooperation
OFW	Outstanding Florida Water(s)
OMHD	Office of Minority Health & Health Disparities

OSHA	Occupational Safety and Health Administration
OWR	Old Withlacoochee River
oz	ounce(s)
PAM	primary amoebic meningoencephalitis
PARS	Publicly Available Records System
PCB	polychlorinated biphenyl
pCi	picocurie(s)
PCR	polymer chain reaction
PEF	Progress Energy Florida, Inc.
PEST	Model-Independent Parameter Estimation (code)
PHP	the transmission-line corridor from the Kathleen substation in Polk County to the Griffin substation in Hillsborough County and terminating at the Lake Tarpon substation in Pinellas County
PIR	Public Interest Review
PK	preschool
PK-12	preschool through 12th grade
p.m.	post meridian
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PMF	probable maximum flood
ppm	parts per million
PMP	probable maximum precipitation
PNNL	Pacific Northwest National Laboratory
ppm	part(s) per million
PPSA	Power Plant Siting Act
ppt	part(s) per thousand
PRA	probabilistic risk assessment
PSD	Prevention of Significant Deterioration
pss	practical salinity scale
psu	practical salinity unit
PWS	potable water system
R	roentgen(s)
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCS	reactor coolant system
rem	roentgen equivalent man (a special unit of radiation dose)
REMP	radiological environmental monitoring program
RFAI	Reservoir Fish Assemblage Index
RIMS	Regional Input-Output Modeling System
RLE	Required Local Effort
RM	river mile
ROD	Record of Decision

ROI	region of influence or region of interest
ROW	Right(s)-of-way
RSICC	Radiation Safety Information Computational Center
RV	recreational vehicle
Ryr	reactor-year
RWS	raw water system
µS	microsievert(s)
s or sec	second(s)
SACTI	Seasonal/Annual Cooling Tower Impact (prediction code)
SAMA	severe accident mitigation alternatives
SAMDA	severe accident mitigation design alternatives
SAR	Safety Analysis Report
SAS	surficial aquifer system
SCA	Site Certification Application
SCL	straight carpace length
SCR	selective catalytic reduction
SDS	sanitary drainage system
SER	Safety Evaluation Report
SERC	Southeastern Electric Reliability Council
SFWMD	South Florida Water Management District
SG	steam generator
SHGW	seasonal high groundwater
SHPO	State Historic Preservation Office or Officer
SHWL	seasonal high-water level
SJRWMD	St. Johns River Waste Management District
SMZ	Streamside Management Zone
SO_2	sulfur dioxide
SOx	sulfur oxides
SPCC	spill prevention, control, and countermeasures
SQG	small quantity generator
SR	State Route
SRWMD	Suwannee River Water Management District
SSC	structures, systems, or components or species of special concern
SU	Standard Unit
Sv	sievert(s)
SWA	Small Wild Area
SWAPP	Source Water Assessment and Protection Program
SWFWMD	Southwest Florida Water Management District
SWMM	Storm Water Management Model
SWPPP	stormwater pollution prevention plan
SWS	service-water system
T	ton(s) or threatened
Tarmac	Tarmac America, LLC

TBD	to be determined
TBq	terabecquerel(s)
T&E	threatened and endangered
TCP	traditional cultural property
TDS	total dissolved solids
TEDE	total effective dose equivalent
TIGER	Topologically Integrated Geographic Encoding and Referencing
TLSA	Transmission Line Siting Act
TMDL	Total Maximum Daily Load
TN	total nitrogen
TP	total phosphorus
TRAGIS	Transportation Routing Analysis Geographical Information System
TRU	transuranic (elements)
TSS	total suspended solids
μm	micrometer(s) or micron(s)
U-235	uranium-235
U-238	uranium-238
U_3O_8	triuranium octoxide (“yellowcake”)
UF_6	uranium hexafluoride
UFA	Upper Floridan Aquifer
UHS	ultimate heat sink
UMAM	Uniform Mitigation Assessment Methodology
UMTRI	University of Michigan Transportation Research Institute
UO_2	uranium dioxide
US	U.S. Highway
U.S.	United States
USACE	U.S. Army Corps of Engineers (or Corps)
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator
VOC	volatile organic compound
Westinghouse	Westinghouse Electric Company, LLC
WHO	World Health Organization
WIC	(Citrus County) Women-Infant-Children (Program)
WMA	Wildlife Management Area
WRB	wastewater-retention basin
WTE	waste-to-energy (plant)
WWS	wastewaster system

χ/Q	atmospheric dispersion factor(s); annual average normalized air concentration value(s)
XOQDOQ	computer program for the meteorological evaluation of routine effluent releases at nuclear power plants
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)

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 proposed Levy Nuclear Plant (LNP) Units 1 and 2 in Levy County, Florida.

In its evaluation of uranium fuel-cycle impacts from proposed Units 1 and 2 at the LNP site, Progress Energy Florida, Inc. (PEF) used the AP1000 advanced passive pressurized water reactor design. The capacity factor reported by PEF for the AP1000 reactor design is 93 percent (PEF 2009a). The results reported here apply to the impacts from two Westinghouse Electric Company, LLC (Westinghouse) AP1000 pressurized water reactor units.

6.1 Fuel-Cycle Impacts and Solid-Waste Management

This section discusses the environmental impacts from the uranium and solid-waste management for the AP1000 reactor design. The environmental impacts of this design are evaluated against specific criteria for light water reactor (LWR) designs at Title 10 of the Code of Federal Regulations (CFR) 51.51.

The regulations in 10 CFR 51.51(a) state that

> Under § 51.10, every environmental report prepared for the construction permit stage or early site permit stage or combined license 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 AP1000 reactors proposed for the LNP site are LWRs that would use uranium dioxide fuel; therefore, Table S–3 (10 CFR 51.51) can be used to assess environmental impacts of the uranium fuel cycle. Table S–3 values are normalized for a reference 1000-megawatts electric (MW(e)) LWR at an 80-percent capacity factor. The Table S–3 values are reproduced in Table 6-1. The power rating for the proposed Units 1 and 2 at the LNP site is 2074 MW(e), assuming that two AP1000 reactors would be located on the LNP site (PEF 2009a), with a capacity factor of 93 percent.

Specific categories of environmental considerations 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 U.S. Nuclear Regulatory Commission (NRC) 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, use, 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 (ac):		
Temporarily committed[(b)]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110-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 waterbodies	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.
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	4400	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
NO_x[(d)]	1190	Equivalent to emissions from a 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	10.0	
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	
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	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000-MW(e) LWR
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 model 1000-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 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, 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 1977a); 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 1 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 Non-Proliferation Act of 1978, as amended (Public Law 95-2422) was enacted. This law significantly affected the disposition of spent nuclear fuel by indefinitely deferring 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, as amended (42 USC 15801 et seq.) 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 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 (UO_2) by converting it to uranium hexafluoride (UF_6), 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 destined to be placed in a reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reaction has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor as spent fuel. After being stored onsite 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 NRC 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 NRC 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

(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.

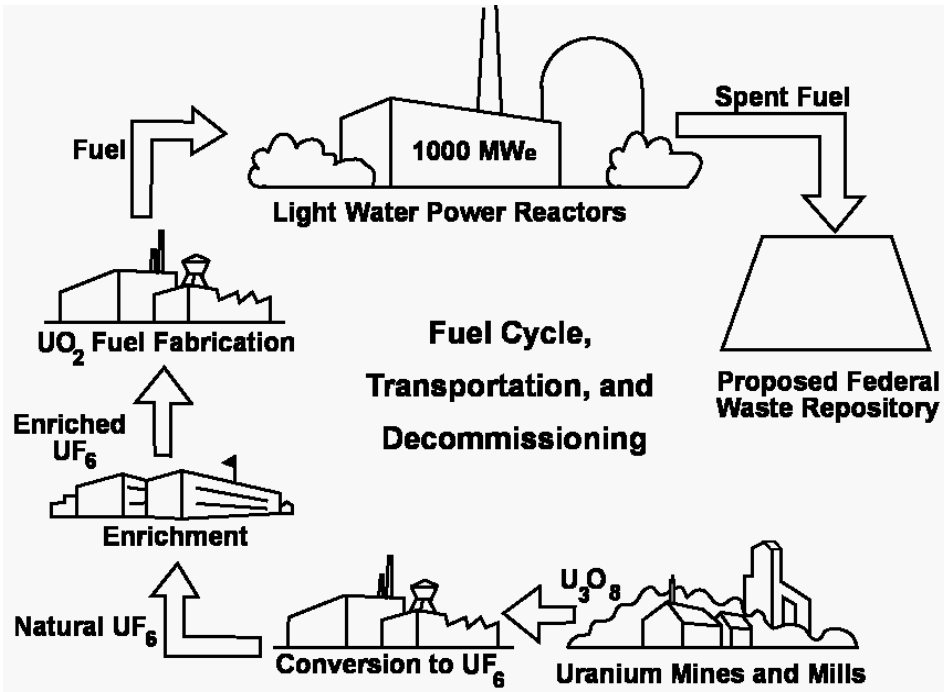

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (derived from NRC 1996)

considered here uses the same type of fuel; the staff's analyses in Section 6.2.3 of NUREG-1437 are summarized and provided here. 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 NRC staff considered the capacity factor of 93 percent with a total net electric output of 1037 MW(e) for each of the proposed Units 1 and 2 at the LNP site for a total of 2074 MW(e) (PEF 2009a). This is about 2.6 times (i.e., 2074 MW[e] divided by 800 MW[e] yields 2.6) 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, 2074 MW(e) for the site.

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. This is especially true in light of the following recent fuel cycle trends in the United States:

- Increasing use of in situ leach uranium mining, which does not produce mine tailings.
- Transitioning of U.S. uranium enrichment technology from gaseous diffusion to gas centrifuge. The centrifuge process uses only a small fraction of the electrical energy per separation unit compared to gaseous diffusion.

- Current LWRs use nuclear fuel more efficiently due to higher fuel burnup. Therefore, less uranium fuel per year of reactor operation is required than in the past to generate the same amount of electricity.
- Fewer spent-fuel assemblies per reactor-year are discharged; hence, the waste storage/repository impact is less.

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 NRC staff used an approach 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 NRC 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 NRC staff defined the model reactor as a 1000-MW(e) LWR operating at 80-percent capacity with a 12-month fuel-reloading cycle and an average fuel burnup of 33,000 megawatt-days/metric tons uranium (MWd/MTU). This is a "reactor reference year" or "reference reactor-year" depending on the source (either Table S–3 or 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 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 use of foreign uranium at the expense of the domestic uranium industry. These market conditions resulted in the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from these activities. However, there is renewed interest in uranium mining and milling in the United States and the NRC recently received multiple license applications for uranium mining and milling. The majority of these applications are 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 (NRC 1996) 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 would be about 294 ac. Of this land requirement, approximately 34 ac would be permanently committed land, and 260 ac would be 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). After 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 260 ac of temporarily committed land, 205 ac are undisturbed and 55 ac are disturbed. In comparison, a coal-fired power plant using the same megawatt-electric output as the LWR-scaled model and using strip-mined coal requires the disturbance of about 520 ac/yr for fuel alone. The NRC 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 would be 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 29,600 million gallons, about 28,800 million gallons are required for the removal of waste heat. Also scaling from Table S–3, other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 416 million gallons per year and discharge to the ground (e.g., mine drainage) of about 330 million gallons per year.

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are less than 5 percent of the 1000-MW(e) LWR-scaled model using once-through cooling. The maximum consumptive water use of 29,600 million gallons per year (assuming that all plants supplying electrical energy to the nuclear fuel cycle use cooling towers) would be less than 4 percent of the 1000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. The NRC 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 less than 4 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 largest source of carbon dioxide (CO_2) emissions associated with nuclear power is from the fuel cycle, not the operation of the plant, as indicated above and in Table S–3. The CO_2 emissions from the fuel cycle are less than 4 percent of the CO_2 emissions from an equivalent fossil-fuel-fired plant.

The largest use of electricity in the fuel cycle comes from the enrichment process. It appears that gas-centrifuge technology is likely to eventually replace gaseous-diffusion technology for uranium enrichment in the United States. The same amount of enrichment from a gas-centrifuge facility uses less electricity and therefore results in lower amounts of air emissions such as carbon dioxide than a gaseous-diffusion facility. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S–3 continue to be appropriately bounding values.

In Appendix I, the NRC staff estimates that the carbon footprint of the fuel cycle to support a reference 1000-MW(e) LWR for a 40-year plant life is on the order of 17,000,000 MT of CO_2 including a small contribution from other greenhouse gases. Scaling this footprint to the power level and capacity factor of LNP Units 1 and 2, the NRC staff estimates the carbon footprint for 40 years of fuel cycle emissions to be about 44,000,000 MT of CO_2. This rate of CO_2 production equals 1,100,000 MT per year, less than 0.02 percent of the total U.S. CO_2 emissions of 5,900,000,000 MT in 2008 (EPA 2010).

On this basis, the NRC staff concludes that the fossil fuel impacts, including greenhouse gas emissions, from the direct and indirect consumption of electric energy for fuel-cycle operations would be SMALL.

6.1.4 Chemical Effluents

The quantities of gaseous and particulate chemical effluents produced in fuel-cycle processes are given in Table S–3 (Table 6-1) for the reference 1000-MW(e) LWR and, according to WASH-1248 (AEC 1974), result from the generation of electricity for fuel-cycle operations. The principal effluents are sulfur oxides, nitrogen oxides, and particulates. Table S–3 states that the fuel cycle for the reference 1000-MW(e) LWR requires 323,000 MWh of electricity. The fuel cycle for the 1000-MW(e) LWR-scaled model would therefore require 840,000 MWh of electricity, or 0.02 percent of the 4.1 billion MWh of electricity generated in the United States in 2008 (DOE 2009). Therefore, the gaseous and particulate chemical effluents would add about 0.02 percent to the national gaseous and particulate chemical effluents from electricity generation.

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. In addition, all liquid discharges into the navigable waters of the United States from plants associated with 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, but as Table S–3 indicates, effluents are not released in quantities sufficient to have a significant impact on the environment.

Based on the above analysis, the NRC staff concludes that the impacts of these gaseous, particulate, and liquid 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 NRC 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 400 person-rem and 200 person-rem, respectively. Scaling these dose commitments by a factor of about 2.6 for the 1000-MW(e) LWR-scaled model would result in whole body dose commitment estimates of 1040 person-rem for gaseous releases and 520 person-rem for liquid releases. For both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 1600 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. PEF provided an assessment of radon-222 and technetium-99 in its Environmental Report (ER) (PEF 2009a). PEF's evaluation relied on the information discussed in NUREG-1437 (NRC 1996).

In Section 6.2 of NUREG-1437 (NRC 1996), the NRC staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operation of the reference 1000-MW(e) LWR. The estimated release 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, is approximately 13,500 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 NRC staff assumed that the LWR-scaled model would result in an emission of 2.6 Ci per site year (i.e., about 2.6 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 Subpart C 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 radon from mining, milling, and tailings before stabilization for each site year (assuming the 1000-MW(e) LWR-scaled model) would be approximately 2400 person-rem to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 47 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 NRC staff considered the potential doses 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 0.018 Ci from chemical processing of recycled uranium hexafluoride before it enters the isotope-enrichment cascade and 0.013 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 Subpart C 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 260 person-rem for the 1000-MW(e) LWR-scaled model.

Radiation protection experts 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 assumption 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 Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold model as a basis for estimating the risks from low doses. This approach is accepted by NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This nominal probability coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem, equal to 0.00057 effects per person-rem. The coefficient is taken from International Commission on Radiological Protection (ICRP) Publication 103 (ICRP 2007).

The nominal probability 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 4300 person-rem/yr) to calculate that the U.S. population would incur a total of approximately 2.5 fatal cancers, nonfatal cancers, and severe hereditary effects annually.

Radon-222 releases from tailings are indistinguishable from background radiation levels at a few miles from the tailings pile (at less than 1 km in some cases) (NRC 1996). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR 190.10, is 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 1 mrem/yr (61 FR 65120).

In addition, at the request of the U.S. Congress, the National Cancer Institute 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. The report 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) (NCRP 2009) is listed in Table 6-2. The nuclear fuel-cycle contribution to an individual's annual average radiation dose is extremely small (less than 1 mrem/yr) compared to the annual average background radiation dose (about 311 mrem/yr).

Based on the analyses presented above, the NRC staff concludes that the environmental impacts of radioactive effluents from the fuel cycle are SMALL.

6.1.6 Radiological Wastes

The quantities of buried radioactive waste material (low-level wastes (LLW), high-level wastes (HLW), and transuranic wastes) are specified in Table S–3 (Table 6-1). For LLW disposal at land burial facilities, the Commission notes in Table S–3 that there would be no significant radioactive releases to the environment.

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources

	Source	Dose (mrem/yr)[(a)]	Percent of Total
Ubiquitous background	Radon and thoron	228	37
	Space	33	5
	Terrestrial	21	3
	Internal (body)	29	5
	Total background sources	311	50
Medical	Computed tomography	147	24
	Medical x-ray	76	12
	Nuclear medicine	77	12
	Total medical sources	300	48
Consumer	Construction materials, smoking, air travel, mining, agriculture, fossil fuel combustion	13	2
Other	Occupational	0.5[(b)]	0.1
	Nuclear fuel cycle	0.05[(c)]	0.01
Total		624	

Source: NCRP 2009; Report 160, *Ionizing Radiation Exposure of the Population of the United States*
(a) NCRP Report 160 table expressed doses in mSv/yr (1 mSv/yr equals 100 mrem/yr).
(b) Occupational dose is regulated separately from public dose and is provided here for informational purposes.
(c) Calculated using 153 person-Sv/yr from Table 6.1 of NCRP 160 and a 2006 U.S. population of 300 million.

The Barnwell LLW disposal facility in Barnwell, South Carolina, no longer accepts Class B and C wastes from sources in states outside of the Atlantic Compact, so LNP would not be able to dispose of these wastes at Barnwell. The EnergySolutions, LLC, site near Clive, Utah, can accept LLW Class A from any U.S. LLW-generator site. The Waste Control Specialists, LLC, site in Andrews County, Texas, is licensed to accept Class A, B, and C LLW from the Texas Compact (Texas and Vermont). As of May 2011, Waste Control Specialists, LLC, may accept Class A, B, and C LLW from outside the Texas Compact for disposal, subject to established criteria, conditions, and approval processes (Blaney 2011).

By the time LNP Units 1 and 2 would begin operation, PEF expects to have entered into an agreement with an NRC-licensed facility that would accept LLW from LNP. If PEF has not entered into an agreement with an NRC-licensed facility that would accept LLW from LNP, PEF would implement measures to reduce or eliminate the generation of Class B and C wastes, extending the capacity of the onsite waste storage to more than 2 years (PEF 2011). If needed, PEF would also construct additional storage facilities onsite and has indicated (PEF 2011) that such facilities would be designed and operated to meet the guidance in Appendix 11.4-A of the Standard Review Plan, NUREG-0800 (NRC 2007). Finally, PEF could enter into an agreement with a third party contractor to process, store, own, and ultimately dispose of LLW from LNP.

Because PEF will have to choose one or a combination of these three options, the staff considered the environmental impacts of each of these three options.

Table S–3 addresses the environmental impacts if PEF enters into an agreement with an NRC-licensed facility for disposal of LLW, and Table S–4 addresses the environmental impacts from transportation of LLW as discussed in Section 6.2. The use of third-party contractors was not explicitly addressed in Tables S–3 and S–4; however, such third-party contractors are already licensed by the NRC and currently operate in the United States. Experience from the operation of these facilities shows that the additional environmental impacts are not significant compared to the impacts described in Tables S–3 and S–4.

The measures to reduce the generation of Class B and C wastes described by PEF, such as reducing the service run length of resin beds, could increase the volume of LLW, but would not increase the total curies of radioactive material in the waste. The volume of waste would still be bounded by or similar to the estimates in Table S–3, and the environmental impacts would not be significantly different.

In most circumstances, the NRC's regulations (10 CFR 50.59) allow licensees operating nuclear power plants to construct and operate additional onsite LLW storage facilities without seeking approval from the NRC. Licensees are required to evaluate the safety and environmental impacts before constructing the facility and make those evaluations available to NRC inspectors. A number of nuclear power plant licensees have constructed and operate such facilities in the United States. Typically, these additional facilities are constructed near the powerblock inside the security fence on land that has already been disturbed during initial plant construction. Therefore, the impacts on environmental resources (e.g., land use and aquatic and terrestrial biota) would be very small. All of the NRC (10 CFR Part 20) and EPA (40 CFR Part 190) dose limitations would apply both for public and occupational radiation exposure. The radiological environmental monitoring programs around nuclear power plants that operate additional onsite LLW facilities show that the increase in radiation dose at the site boundary is not significant; the radiation doses continue to be below 25 mrem/yr, the dose limit of 40 CFR Part 190. The NRC staff concludes that doses to members of the public within the NRC and EPA regulations are a small impact. In addition, NUREG-1437 assessed the impacts of LLW storage onsite at currently operating nuclear power plants and concluded that the radiation doses to offsite individuals from interim LLW storage are insignificant (NRC 1996). The types and amounts of LLW generated by the proposed reactors at LNP would be similar to those generated by currently operating nuclear power plants and the construction and operation of any interim LLW storage facilities would be similar to the construction and operation of the currently operating facilities. Therefore, the impacts of constructing and operating additional onsite LLW storage facilities would be minimal.

The Nuclear Waste Policy Act as amended (42 USC 10101 et seq.), mandates the siting, construction, and operation of repositories for deep geologic disposal of HLW and spent nuclear fuel. The Commission notes 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 disposal. In NUREG-0116 (NRC 1976), which provides background and context for the HLW and transuranic waste Table S–3 values established by the Commission, the NRC staff indicates that these HLWs and transuranic wastes would be buried and would not be released to the environment.

As part of the Table S–3 rulemaking, the staff evaluated, along with more conservative assumptions, the zero-release assumption associated with waste burial in a repository, and the NRC reached an overall generic determination that fuel-cycle impacts would not be significant. In 1983, the Supreme Court affirmed the NRC's position that the zero-release assumption was reasonable in the context of the Table S–3 rulemaking to address generically the impacts of the uranium fuel cycle in individual reactor licensing proceedings (Baltimore Gas & Electric v. NRDC 1983).

Furthermore, in the Commission's Waste Confidence Decision, 10 CFR 51.23, "[t]he Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation […] of that reactor in a combination of storage in its spent fuel storage basin and at either onsite or offsite independent spent fuel storage installations." That regulation also states that "the Commission believes there is reasonable assurance that sufficient mined geologic repository capacity will be available to dispose of the commercial HLW and spent fuel generated in any reactor when necessary." In addition, 10 CFR 51.23(b) applies the generic determination in Section 51.23(a) to provide that "no discussion of any environmental impact of spent fuel storage in reactor facility storage pools or independent spent fuel storage installations (ISFSI) for the period following the term of the […] reactor combined license or amendment […] is required in any […] environmental impact statement […] prepared in connection with […] the issuance or amendment of a combined license for nuclear power reactors under parts 52 or 54 of this chapter.".

In early 2010, the Secretary of Energy announced the formation of the Blue Ribbon Commission on America's Nuclear Future (BRC). The BRC's charter was to provide recommendations for developing a safe, long-term solution to managing the Nation's used nuclear fuel and nuclear waste. The BRC issued the final subcommittee reports in January 2012 and the final report to the Secretary of Energy on January 26, 2012 (BRC 2012). The final reports acknowledge that the methods of currently storing spent fuel at nuclear power plants are safe, but to ensure safety over the long term, the BRC recommendations cover topics such as the approach to siting future nuclear waste management facilities, the transport and storage of spent fuel and HLW, options for waste disposal, institutional arrangements for managing spent nuclear fuel and HLWs, reactor and fuel cycle technologies, and international considerations. The NRC is aware of the BRC's work, has reviewed the BRC final reports issued to date, and has concluded that these reports do not conflict with the conclusions in this EIS regarding the environmental impact of HLW disposal based on the assessment in Table S-3.

In the context of operating license renewal, Sections 6.2 and 6.4 of NUREG-1437 (NRC 1996) provide additional description of the generation, storage, and ultimate disposal of LLW, mixed waste, and HLW including spent fuel from power reactors. These sections conclude that environmental impacts from these activities are small. For the reasons stated above, the NRC staff concludes that the environmental impacts of radioactive waste storage and disposal associated with LNP Units 1 and 2 would be SMALL.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e) LWR-scaled model is about 1560 person-rem. This is based on a 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 would be maintained within the limits of 10 CFR Part 20 Subpart C, which is 5 rem/yr.

6.1.8 Transportation

The transportation dose to workers and the public totals about 2.5 person-rem annually for the reference 1000-MW(e) LWR, according to Table S–3 (Table 6-1). This corresponds to a dose of 3.2 person-rem for the 1000-MW(e) LWR-scaled model (PEF 2009a) and 6.5 person-rem for two proposed AP1000 reactors located at the LNP site. For purposes of comparison, the estimated collective dose from natural background radiation to the current population within 50 mi of the LNP site in 2005 is about 400,000 person-rem/yr (PEF 2009a). Based on this comparison, the NRC staff concludes that environmental impacts of transportation would be SMALL.

6.1.9 Conclusions for Fuel Cycle and Solid-Waste Management

The NRC 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. The NRC staff also evaluated the environmental impacts of greenhouse gas emissions from the uranium fuel cycle and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. Based on these evaluations, the NRC staff concludes that the impacts of the uranium fuel cycle would be SMALL.

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 LNP site and alternative sites, (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. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain, Nevada, site as a surrogate destination for a permanent repository. The impacts evaluated in this section for two new nuclear generating units at the LNP site are appropriate to characterize the alternative sites discussed in Section 9.3 of this EIS. Alternative sites evaluated in this EIS include the LNP site (proposed), and alternative sites at Crystal River, Dixie, Highlands, and Putnam. There is no meaningful differentiation among the proposed and the alternative sites regarding the radiological and nonradiological environmental impacts from normal operating and accident conditions and these conditions are not discussed further in Chapter 9.

NRC performed a generic analysis of the environmental effects of the transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants*, WASH-1238 (AEC 1972) and in a supplement to WASH-1238, 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 4 person-rem per reference reactor-year. The combined dose to the public along the route and dose to onlookers were estimated to result in a collective dose of 3 person-rem per reference reactor-year.

Environmental risks of radiological effects during accident conditions, as stated in Table S–4, are small. Nonradiological impacts from postulated accidents were estimated as one fatal injury in 100 reference reactor-years and one nonfatal injury in 10 reference reactor-years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977b) and NUREG/CR-6672 (Sprung et al. 2000) concluded that impacts were bounded by Table S–4 in 10 CFR 51.52.

(a) The transportation impacts associated with the LNP site were normalized for a reference 1100-MW(e) LWR at an 80-percent capacity factor for comparisons to Table S–4. Note that the basis for Table S–4 is an 1100 MW(e) LWR at an 80-percent capacity factor (AEC 1972; NRC 1975). The basis for Table S–3 in 10 CFR 51.51(b) that was discussed in Section 6.1 of this EIS is a 1000 MW(e) LWR with an 80-percent capacity factor (NRC 1976). However, because fuel cycle and transportation impacts are evaluated separately, this difference does not affect the results and conclusions in this EIS.

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 to be bounded by Table S–4) if the reactor meets the following criteria:

- The reactor has a core thermal power level that does not exceed 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 zircalloy-clad fuel rods.
- The 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, railcar, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or railcar.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities are resolved generically in 10 CFR 51.52, provided that the specific conditions in the rule (see above) are met. 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 weight percent uranium-235), or thermal power levels (above 3800 MW[t]). Departures from the conditions itemized in 10 CFR 51.52(a) are to 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 of new reactors.

In its application, PEF requested combined construction permits and operating licenses (COLs) for two proposed reactors at its LNP site in Florida. 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 1115 MW(e). The Westinghouse AP1000 reactors are expected to operate with a 93-percent capacity factor, yielding a net electrical output (annualized) of about 1037 MW(e). Fuel for the units would be enriched up to about 4.51 weight percent uranium-235, which exceeds the 4-percent condition given in 10 CFR 51.52(a). In addition, the expected peak irradiation level of about 62,000 MWd/MTU exceeds the 33,000 MWd/MTU condition given in 10 CFR 51.52(a). Therefore, a full description and detailed analysis of transportation impacts is required.

In its ER (PEF 2009a), PEF provided a full description and detailed analyses of transportation impacts. In these analyses, the radiological impacts of transporting fuel and waste to and from the proposed LNP site and alternative sites were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2006). RADTRAN 5.6 was used in this EIS and is the most commonly used transportation impact analysis software in the nuclear industry.

Comments on four previous early site permit EISs also were considered when developing the scope of this EIS. The most significant change is that this EIS includes an explicit analysis of the nonradiological impacts of transporting unirradiated fuel, spent fuel, and radioactive waste to and from the LNP site and alternative sites. Nonradiological impacts of transporting construction workers and materials (see Section 4.8.3) and operations workers (Section 5.8.6) are addressed elsewhere in this EIS. Publicly available information about traffic accident, injury, and fatality rates was used to estimate nonradiological impacts. In addition, the radiological impacts on maximally exposed individuals (MEIs) are evaluated.

6.2.1 Transportation of Unirradiated Fuel

The NRC staff performed an independent evaluation of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the LNP site and alternative sites. Radiological impacts of normal conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts on populations and MEIs are presented. Because the specific fuel fabrication plant for LNP unirradiated fuel is not known at this time, the NRC staff's analysis assumes a "representative" route between the fuel fabrication facility and LNP site and alternative sites. This means that there are no substantive differences between the impacts calculated, for the purposes of Chapter 9, for the LNP site and the four alternative sites. The site-specific differences are minor because the radiation doses from unirradiated fuel transport are minute and the differences in shipping distances between potential fuel fabrication plants and the LNP site and alternative sites are small.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities during 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 at some level would occur to the following individuals: (1) persons residing along the transportation corridors between the fuel fabrication facility and the LNP or alternative sites; (2) persons in vehicles traveling on the same route as an 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 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 NRC staff found that the number of truck shipments of unirradiated fuel to the LNP site or alternative sites would be fewer than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238. The results are consistent with the estimates provided in PEF's ER (PEF 2009a).

Table 6-3. Number of Truck Shipments of Unirradiated Fuel for the Reference LWR and a Single AP1000 Reactor at the LNP Site

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
LNP Westinghouse AP1000	23	5.4	233	1115	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 from the ER (PEF 2009a) for the Westinghouse AP1000 reactor.
(d) Normalized to net electric output for WASH-1238 reference LWR (i.e., 1100-MW[e] plant at an 80-percent or net electrical output of 880 MW[e]).

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. PEF specifies that unirradiated fuel would be shipped to the proposed reactor site by truck. 10 CFR 51.52, Table S–4, includes a condition that the truck shipments not exceed 73,000 lb as governed by Federal or State gross vehicle weight restrictions. PEF states in its ER that the unirradiated fuel shipments to the LNP site and alternative sites would comply with applicable weight restrictions (PEF 2009a).

Radiological Doses to Transport Workers and the Public

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 the number of shipments to which the individuals are exposed. For this EIS, the radiological dose impacts of the transportation of unirradiated fuel were calculated by the NRC staff for the worker and the public using the RADTRAN 5.6 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 3.3 ft from the transport vehicle is about

0.1 mrem/hr. This assumption also was used in the NRC staff's 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 those 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 reactor operation. Other key input parameters used in the radiation dose analysis for unirradiated fuel are shown in Table 6-4.

Table 6-4. RADTRAN 5.6 Input Parameters for Reference LWR Fresh Fuel Shipments

Parameter	RADTRAN 5.6 Input Value	Source
Shipping distance, km	3200	AEC 1972[(a)]
Travel fraction – Rural	0.90	Rural, suburban, and urban travel fractions are taken from NRC (1977b).
Travel fraction – Suburban	0.05	
Travel fraction – Urban	0.05	
Population density – Rural, persons/km^2	10	Rural, suburban, and urban population densities are taken from 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	Rural, suburban, and urban traffic counts are taken from 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 (DOE 1997).
Number of truck crew	2	AEC 1972, NRC 1977b, and DOE 2002a
Stop time, hr/trip	4	Based on one 30-minute stop per 4-hour driving time.
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 unirradiated fuel shipments. A 3200-km (2000-mi) "representative" shipping distance was assumed here.

The RADTRAN 5.6 results for this “generic” unirradiated fuel shipment are as follows:

- worker dose: 1.71×10^{-3} person-rem/shipment
- general public dose (onlookers/persons at stops and sharing the highway): 2.91×10^{-3} person-rem/shipment
- general public dose (along route/persons living near a highway or truck stop): 4.12×10^{-5} 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 on workers, public onlookers (persons at stops and sharing the road), and members of the public along the route (i.e., residents within 0.5 mi of the highway) for transporting unirradiated fuel to the LNP site and alternative sites for a single AP1000 reactor.

Table 6-5. Radiological Impacts Under Normal Conditions of Transporting Unirradiated Fuel to the LNP Site or Alternative Sites for a Single AP1000 Reactor

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose; person-rem/yr per 1100 MW(e)[(a)] (880 MW(e) net)		
		Workers	Public – Onlookers	Public – Along Route
Reference LWR (WASH-1238)	6.3	1.1×10^{-2}	1.8×10^{-2}	2.6×10^{-4}
Reference Westinghouse AP1000	5.0	8.5×10^{-3}	1.4×10^{-2}	2.0×10^{-4}
LNP	5.0	3.1×10^{-3}	7.6×10^{-3}	2.9×10^{-4}
Crystal River	5.0	3.1×10^{-3}	7.6×10^{-3}	2.9×10^{-4}
Dixie	5.0	3.0×10^{-3}	7.5×10^{-3}	2.5×10^{-4}
Highlands	5.0	3.6×10^{-3}	1.1×10^{-2}	3.5×10^{-4}
Putnam	5.0	2.7×10^{-3}	7.4×10^{-3}	2.6×10^{-4}
10 CFR 51.52, Table S–4 Condition	<1 per day	4.0×10^{0}	3.0×10^{0}	3.0×10^{0}

(a) Divide person-rem/yr by 100 to obtain doses in person-Sv/yr.

The cumulative annual dose estimates in Table 6-5 were normalized to 1100 MW(e) (880 MW[e] net electrical output). The NRC staff performed an independent review and determined that all dose estimates are bounded by the Table S–4 conditions of 4 person-rem/yr to transportation workers, 3 person-rem/yr to onlookers, and 3 person-rem/yr to members of the public along the route.

In its ER (PEF 2009a), PEF assumed that unirradiated fuel would be shipped from a fuel fabrication facility located near Lynchburg, Virginia, rather than the “generic” location assumed in WASH-1238. The NRC staff evaluated PEF’s analysis by attempting to duplicate a sample of the impact calculations. RADTRAN 5.6 calculations were performed using the route information and other input parameters specified in the ER. No significant differences were identified. Based on this confirmatory analysis, the NRC staff concluded that PEF's analysis of unirradiated fuel transportation impacts is sufficient to meet the requirements of 10 CFR 51.52(b).

Radiation protection experts 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, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effects per person-rem. The coefficient is taken from ICRP Publication 103 (ICRP 2007).

Both the NCRP and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995; ICRP 2007). The largest annual collective dose estimate for transporting unirradiated fuel to the LNP site and alternative sites was less than 2×10^{-2} person-rem, which is less than the 1754 person-rem value that ICRP and NCRP suggest would most likely result in zero excess health effects.

To place these impacts in perspective, the average U.S. resident receives about 311 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 2009). Using this average effective dose, the collective population dose from natural background radiation to the population along the generic representative route would be about 2.2×10^{5} person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the LNP site and alternative sites are minimal compared to the collective population dose to the same population from exposure to natural sources of radiation.

Maximally Exposed Individuals Under Normal Transport Conditions

A scenario-based analysis was conducted by the NRC staff to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the LNP site and alternative sites. The following discussion applies to unirradiated fuel shipments to, and spent fuel and radioactive waste shipments from, the LNP and any of the alternative sites. The analysis is based on data from DOE (2002b) and incorporates data 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 normalized fuel and waste shipments addressed in this EIS. In all cases, the NRC staff assumed that the dose rate emitted from the shipping containers is 10 mrem/hr at 2 m (6.6 ft) from the side of the transport vehicle. This assumption is conservative, in that the assumed dose rate is the maximum dose rate allowed by U.S. Department of Transportation (DOT) regulations (49 CFR 173.441). 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 LNP site and alternative sites. The analysis of MEIs is described below.

Truck Crew Member

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. The analysis assumed that crew member doses are limited to 2 rem/yr, which is the DOE administrative control level presented in DOE-STD-1098-99, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2005). The NRC staff anticipates this limit would apply to spent nuclear fuel shipments to a disposal facility, because DOE would take title to the spent fuel at the reactor site. There would be more shipments of spent nuclear fuel from the LNP site (or alternative sites) than there would be shipments of unirradiated fuel to and radioactive waste other than spent fuel from, these sites. This is because the capacities of spent fuel shipping casks are limited due to their substantial radiation shielding and accident resistance requirements. Spent fuel shipments also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002a). As a result, crew doses from unirradiated fuel and radioactive waste shipments would be lower than the doses from spent nuclear fuel shipments. The DOE administrative limit of 2 rem/yr (DOE 2005) is less than the NRC limit for occupational exposures of 5 rem/yr (10 CFR Part 20).

The U.S. DOT does not regulate annual occupational exposures. It does recognize that air crews are exposed to elevated cosmic radiation levels and recommends dose limits to air crew members from cosmic radiation (DOT 2003). Air passengers are less of a concern because they do not fly as frequently as air crew members. The recommended limits are a 5-year effective dose of 2 rem/yr with no more than 5 rem in a single year (DOT 2003). As a result of this recommendation, a 2-rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the LNP site and alternative sites.

Inspectors

Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. The Yucca Mountain Final EIS (DOE 2002a) assumed that inspectors would be exposed for 1 hour at a distance of 1 m (3.3 ft) from the shipping containers. Assuming conservatively that the external dose rate at 2 m (6.6 ft) is at the maximum allowed by regulations (10 mrem/hr), the dose rate at 1 m (3.3 ft) is about 14 mrem/hr (Weiner et al. 2006). Therefore, the dose per shipment is about 14 mrem. This is independent of the location of the reactor site. Based on this conservative external dose rate and the assumption that the same person inspects all shipments of fuel and waste to and from the LNP site and alternative sites, the annual doses to vehicle inspectors were calculated to be about 0.9 rem/yr, based on a combined total of 66 shipments of unirradiated fuel, spent fuel, and radioactive waste per year. This value is about one-half of the 2-rem/yr DOE administrative control level on individual doses (DOE 2005) and one-fifth of the 5-rem/yr NRC occupational dose limit (see 10 CFR Part 20).

Doses to State inspectors would be doubled for a site with two Westinghouse AP1000 reactors, like the LNP site and the alternative sites, which would bring their annual dose to approximately the DOE administrative limit.

Residents

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 obtained from the NRC staff's RADTRAN 5.6 output files. These dose estimates are based on an individual located 100 ft from the shipments that are traveling 15 mph. The potential radiation dose to the maximally exposed resident is about 0.043 mrem/yr for shipments of fuel and waste to and from the LNP site and alternative sites with a single AP1000 reactor. This dose would be doubled for a site with two Westinghouse AP1000 reactors, like the LNP site and the alternative sites.

Individuals Stuck in Traffic

This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for 1 hour at a distance of 4 ft. The NRC staff's analysis assumed this exposure scenario would occur only one time to any individual, and the dose rate was at the regulatory limit of 10 mrem/hr at 2 m (6.6 ft) from the shipment, so the dose rate would be higher at the assumed exposure distance of 4 ft. The dose to the MEI was calculated to be 16 mrem in DOE's Yucca Mountain Final EIS (DOE 2002b). 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.

Persons at a Truck Service Station

This scenario estimates doses to an employee at a service station where all truck shipments to and from the LNP site and alternative sites are assumed to stop. The NRC staff's analysis assumed this person is exposed for 49 minutes at a distance of 52 ft from the loaded shipping container (DOE 2002b). The exposure time and distance were based on the observations discussed by Griego et al. (1996). This results in a dose of about 0.34 mrem/shipment and an annual dose of about 22 mrem/yr for the LNP site and alternative sites, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the LNP site and alternative sites with a single AP1000 reactor. This dose would be doubled for a site with two Westinghouse AP1000 reactors, like the LNP site and the alternative sites.

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 LNP site and alternative sites 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 the consequences of transportation 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, consistent with the conclusions of WASH-1238 (AEC 1972), the impacts of accidents during transport of unirradiated fuel to a Westinghouse AP1000 reactor at the LNP site and alternative sites are expected to be negligible.

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 LNP site and alternative sites; that is, the analysis does not consider the 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 as follows:

Impacts = (unit rate) × (round-trip shipping distance) × (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). Nationwide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic accident, injury, and fatality rates for truck shipments similar to those to be used to transport unirradiated fuel to the LNP site and alternative sites. In addition, the DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) rates, which were taken from the Motor Carrier Management Information System, and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates in Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 percent and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting.

The nonradiological accident impacts for transporting unirradiated fuel to (and empty shipping containers from) the LNP site and alternative sites 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 an AP1000 reactor at the LNP site and alternative sites and the reference LWR in WASH-1238 due entirely to the estimated annual number of shipments. Overall, the impacts are minimal and there are no substantive differences among the LNP site and alternative sites. The impacts would be doubled for a site with two AP1000 reactors like the LNP site and the alternative sites.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the LNP Site and Alternative Sites with a Single AP1000 Reactor, Normalized to Reference LWR

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance (km)	Annual Round-trip Distance (km)	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (AEC 1972)	6.3	3200	4.0×10^{4}	1.9×10^{-2}	9.3×10^{-3}	5.8×10^{-4}
Reference Westinghouse AP1000	5.0	3200	3.2×10^{4}	1.5×10^{-2}	7.3×10^{-3}	4.6×10^{-4}
LNP	5.0	1166	1.2×10^{4}	6.9×10^{-3}	3.8×10^{-3}	3.1×10^{-4}
Crystal River	5.0	1152	1.1×10^{4}	6.9×10^{-3}	3.8×10^{-3}	3.1×10^{-4}
Dixie	5.0	1131	1.1×10^{4}	6.9×10^{-3}	3.8×10^{-3}	3.1×10^{-4}
Highlands	5.0	1349	1.3×10^{4}	7.1×10^{-3}	3.9×10^{-3}	3.3×10^{-4}
Putnam	5.0	1020	1.0×10^{4}	6.7×10^{-3}	3.7×10^{-3}	2.9×10^{-4}

6.2.2 Transportation of Spent Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting spent fuel from the LNP site and alternative sites to a spent fuel disposal repository. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain site in Nevada as a surrogate destination. Currently, NRC has not made a decision on the proposed geologic repository at Yucca Mountain. However, the NRC 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 on 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 NRC staff's 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). Due to the large size and weight of spent fuel shipping casks, each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with those made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1999). Because the alternative transportation methods involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999), thereby reducing impacts, these assumptions are conservative. Also, the use of current shipping cask designs for this analysis 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 by the NRC staff using the RADTRAN 5.6 computer code (Weiner et al. 2006). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the Transportation Routing Analysis Geographical Information System (TRAGIS) routing code (Johnson and Michelhaugh 2003). 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 (Johnson and Michelhaugh 2003). Traffic accident rates input to RADTRAN 5.6 and nonradiological impact calculations were adjusted to account for under-reporting, as discussed in Sections 4.8.3 and 6.2.1.3.

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 en route. 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 the following populations: (1) persons residing along the transportation corridors between the LNP site and alternative sites 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 (drivers). For purposes of this analysis, 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 LNP site and alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the Westinghouse AP1000. Information in the *Early Site Permit Environmental Report Sections and Supporting Documentation* (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 NRC staff assumed that the 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). In its ER (PEF 2009a), PEF assumed a shipping cask capacity of 0.5 MTU/shipment.

Input to RADTRAN 5.6 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 2003) for highway routes from the LNP site and alternative sites to the proposed Yucca Mountain facility. The resulting route characteristics information is shown in Table 6-7. Note that for truck shipments, all of the spent fuel is assumed to be shipped to the proposed Yucca Mountain facility over designated highway-route controlled quantity routes. In addition, TRAGIS data were used in RADTRAN 5.6 on a state-by-state basis. This increases precision and could allow the results to be presented for each state along the route between the LNP site and alternative sites and Yucca Mountain.

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 list of the values for these and other parameters and the sources of the information is provided in Table 6-8.

Table 6-7. Transportation Route Information for Shipments from the LNP Site and Alternative Sites to the Yucca Mountain Spent Fuel Disposal Facility[(a)]

Reactor Site	One-Way Shipping Distance, km				Population Density, persons/km^2			Stop Time per Trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
Levy County	4520.3	3479.8	935.2	105.4	9.9	318.5	2271.4	5.5
Crystal River	4506.5	3466.0	935.2	105.4	9.9	318.5	2271.4	5.5
Dixie	4407.8	3439.6	866.5	101.9	9.8	320.3	2268.2	5.5
Highlands	4867.9	3745.7	1005.0	117.4	9.9	327.6	2243.6	6.0
Putnam	4529.9	3504.3	915.2	110.6	9.8	327.0	2259.1	5.5

Source: Johnson and Michelhaugh 2003
(a) This table presents aggregated route characteristics given in the TRAGIS (Johnson and Michelhaugh 2003), including estimated distances from the LNP and alternative sites to the nearest TRAGIS highway node. Input to the RADTRAN 5.6 computer code was disaggregated to a state-by-state level.

Table 6-8. RADTRAN 5.6 Normal (Incident-Free) Exposure Parameters

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle speed, km/hr	88.49	Based on the 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	State-specific	State-specific rural, suburban, and urban traffic counts are taken from Weiner et al. (2006)
Traffic count – Suburban, vehicles/hr	State-specific	
Traffic count – Urban, vehicles/hr	State-specific	
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 the 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 – 5.82 Diameter – 1.0	DOE (2002b)
Packaging dimensions, m	Length – 5.82 Diameter – 1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977a), and DOE (2002a, b)
Stop time, hr/trip	Route-Specific	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)

Table 6-8. (contd)

Parameter	RADTRAN 5.6 Input Value	Source
Shielding factor applied to annular area surrounding vehicle at stops, dimensionless	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, dimensionless	0.2	Sprung et al. (2000)

For the purposes of this analysis, the transportation crew for spent fuel shipments delivered by truck is assumed to consist of two drivers. Escort vehicles and drivers 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 and would be negligible (DOE 2002b). Stop times for refueling and rest were assumed to occur at the rate of 30 minutes per 4 hours of 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 5.6 analyses. For this analysis, doses to the public at refueling and rest stops ("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 it extends from 10 to 800 m from the vehicle. This scheme is similar to that used by 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).

The results of these normal (incident-free) exposure calculations are shown in Table 6-9 for the LNP site and alternative sites. 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 persons along the route (persons living near the highway).

Shipping schedules for spent fuel generated by the proposed new units have not been determined. The NRC staff determined that it is reasonable to calculate annual doses assuming the annual number of spent fuel shipments is equivalent to the annual refueling requirements. 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 AP1000 reactors like the LNP site and the alternative sites.

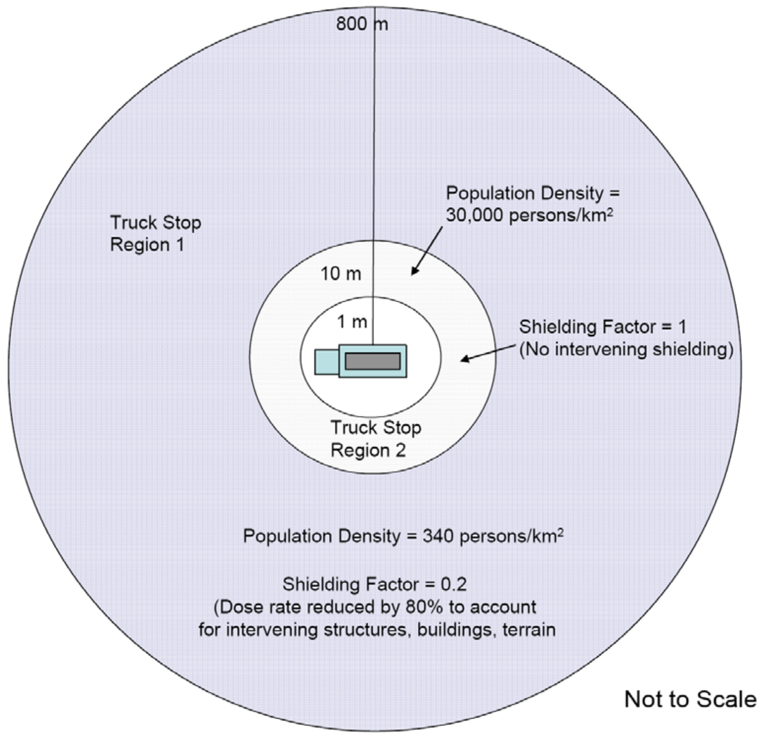

Figure 6-2. Illustration of Truck Stop Model

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the LNP Site and Alternative Sites to the Proposed High-Level Waste Repository at Yucca Mountain

	Normalized Impacts, Person-rem/yr[a]		
Site and Reactor Type	**Worker (Crew)**	**Onlookers**	**Along Route**
Reference LWR (WASH-1238)[b]	1.2×10^{1}	3.0×10^{1}	6.4×10^{-1}
Levy County AP1000[c]	8.2×10^{0}	2.0×10^{1}	4.2×10^{-1}
Crystal River AP1000[c]	8.2×10^{0}	2.0×10^{1}	4.2×10^{-1}
Dixie AP1000[c]	8.0×10^{0}	2.0×10^{1}	4.0×10^{-1}
Highlands AP1000[c]	8.9×10^{0}	2.2×10^{1}	4.7×10^{-1}
Putnam AP1000[c]	8.2×10^{0}	2.0×10^{1}	4.3×10^{-1}
Table S–4 Condition	4×10^{0}	3×10^{0}	3×10^{0}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Based on 60 shipments per year.
(c) Based on 40 shipments per year after normalizing to the reference LWR.

The small differences in transportation impacts among the LNP site and four alternative sites evaluated are not substantive and the differences among sites are relatively minor and are less than the uncertainty in the analytical results.

The bounding cumulative doses to the exposed population given in Table S–4 are as follows:

- 4 person-rem/reactor-year to transport workers
- 3 person-rem/reactor-year to general public (onlookers) and members of the public along the route.

The calculated population doses to the crew and onlookers for the reference LWR and the LNP and alternative 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 COL analysis (i.e., to a proposed repository in Nevada) than the distances used in WASH-1238 (AEC 1972). WASH-1238 assumed that each spent fuel shipment would travel a distance of 1000 mi, whereas the shipping distances used in this EIS were about 2700 mi to 3000 mi. If the shorter distance were used to calculate the impacts for the LNP and alternative sites spent fuel shipments, the doses would be reduced by about 60 percent. Other important differences are the stop model described above and the additional precision that results from incorporating state-specific route characteristics and vehicle densities on highways (vehicles per hour).

Where necessary, the NRC staff made conservative assumptions to calculate impacts associated with the transportation of spent fuel. Some of the key conservative assumptions are as follows:

- <u>Use of the regulatory maximum dose rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 calculations</u>. 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) would transport spent fuel that has cooled for a minimum of 5 years (see 10 CFR Part 961, Subpart B). 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 LNP site and alternative sites also are 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 are used.
- <u>Use of the shipping cask capacity used in WASH-1238</u>. The WASH-1238 analyses that form the basis for Table S–4 assumed that spent fuel would be shipped at least 90 days after discharge from a current LWR. The spent fuel shipping casks described in WASH-1238 were designed to transport 90-day-cooled fuel, so their shielding and containment designs must accommodate this highly radioactive cargo. Shipping-cask capacities assumed in WASH-1238 were approximately 0.5 MTU per truck cask. In the Yucca Mountain Supplemental EIS (DOE 2008), DOE assumed a 10-year cooling period for spent fuel to be shipped to the repository. This allowed DOE to increase the assumed

shipping-cask capacity to about 1.8 MTU per truck shipment of un-canistered spent fuel. The NRC staff believes this is a reasonable projection for future spent fuel truck shipping cask capacities. If this assumption were to be used in this EIS, the number of shipments of spent fuel would be reduced by about one-third with a similar reduction in radiological incident-free impacts.

- 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 by 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. More realistic stop times would further reduce the population doses in Table 6-9.

A sensitivity study was performed by the NRC staff to demonstrate the effects of using more realistic dose rates and stop times on the incident-free population dose calculations. 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 5.6 input values were unchanged. The result is that the annual crew doses were reduced to 4.9 person-rem/yr, or about 60 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 5.3 person-rem/yr (about 27 percent) and the annual doses to persons along the route were reduced to 1.5×10^{-1} person-rem/yr (about 36 percent).

In its ER (PEF 2009a), PEF describes the results of a RADTRAN 5.6 analysis of the impacts of incident-free transport of spent fuel to Yucca Mountain. The PEF analysis and this EIS used similar methods and input parameters. The NRC staff concluded that the results produced by PEF are similar to those calculated by the NRC staff and reported in this EIS.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual public dose impacts for transporting spent fuel from the LNP or alternative sites to Yucca Mountain are about 22 person-rem, which is less than the 1754 person-rem value that ICRP (2007) and NCRP (1995) suggest would most likely result in no excess health effects. This dose is very small compared to the estimated 2.5×10^5 person-rem that the same population along the route from the LNP site to Yucca Mountain would incur annually from exposure to natural sources of radiation. Note that the estimated population dose along the LNP-to-Yucca-Mountain route from natural background radiation is different than the natural background dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 of this EIS because the route characteristics are different. A generic route and actual highway routes were used in Section 6.2.1.1 for unirradiated fuel shipments and actual highway routes were used in this section for spent fuel shipments.

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 NRC staff used the RADTRAN 5.6 computer code to estimate the impacts of transportation accidents involving spent fuel shipments. RADTRAN 5.6 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 PEF’s ER (PEF 2009a). The Idaho National Engineering and Environmental Laboratory (INEEL) report (INEEL 2003) includes 140 radionuclides for Westinghouse AP1000 reactor spent fuel. The NRC staff conducted a screening analysis to select the dominant contributors to accident risks to simplify the RADTRAN 5.6 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 NRC staff analysis are listed in Table 6-10.

The list 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 Westinghouse AP1000 reactor spent fuel transportation accident impacts were calculated by the NRC staff assuming that the cobalt-60 inventory in the form of crud is 4.4 TBq/MTU (120 Ci/MTU), based on information provided by Sprung et al. (2000). PEF also included the impacts of crud in its spent fuel transportation impact analysis (PEF 2009a).

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 also are designed with fissile material controls to ensure that 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 NRC staff assumed that shipping casks approved for transportation of Westinghouse AP1000 reactor spent fuel would provide equivalent mechanical and thermal protection of the spent fuel cargo.

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for the Westinghouse AP1000 Reactor[(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[(b)]	1.20×10^{2}	4.40×10^{12}

Source: INEEL 2003 except where otherwise indicated.
(a) Divide becquerel/metric ton uranium (Bq/MTU) by 3.7×10^{10} to obtain curies/MTU.
(b) Cobalt-60 is the key radionuclide constituent of fuel assembly crud. The inventory was derived using data given by Sprung et al. (2000).

Accident frequencies are calculated in RADTRAN 5.6 using user-specified accident rates and conditional shipping cask failure probabilities. State-specific accident rates were taken from Saricks and Tompkins (1999) and used in the RADTRAN 5.6 calculations. The state-specific accident rates were then adjusted to account for under-reporting, as described in Section 6.2.1.3. Conditional shipping cask failure probabilities (that is, the probability of cask failure as a function of the mechanical and thermal conditions applied in an accident) were taken from Sprung et al. (2000).

The RADTRAN 5.6 accident risk calculations were performed using the radionuclide inventories (Ci/MTU) in Table 6-10 multiplied by the shipping cask capacity (0.5 MTU). The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (shipments/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from the LNP site and alternative sites to the proposed repository at Yucca Mountain in Nevada. As was done for routine exposures, the NRC 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 5.6 to calculate the population dose from the released radioactive material from four of five possible exposure pathways.[a] These pathways areas follows:

- external dose from exposure to the passing cloud of radioactive material (cloudshine).
- external dose from the radionuclides deposited on the ground by the passing plume (groundshine). The NRC 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.
- internal dose from inhalation of airborne radioactive contaminants (inhalation).
- internal dose from resuspension of radioactive materials that were deposited on the ground (resuspension). The NRC 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 NRC 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 LNP site and alternative sites 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) to provide a common basis for comparison to the impacts listed in Table S–4. Although there are slight differences in impacts among alternative sites, none of the alternative sites would be clearly favored over the LNP site. The impacts would be doubled for two AP1000 reactors at the LNP site or alternative sites. The transportation accident impact analysis conducted by PEF (PEF 2009a) used methods and data that are similar to those used in this EIS. Differences are insignificant in terms of the overall results.

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for an AP1000 Reactor at the LNP Site and Alternative Sites, Normalized to Reference 1100-MW(e) LWR Net Electrical Generation

Site, Reactor Type	Normalized Population Impacts, Person-rem/yr[(a)]
Reference LWR (WASH-1238)[(b)]	1.4×10^{-4}
Levy County AP1000[(c)]	9.2×10^{-5}
Crystal River AP1000[(c)]	9.2×10^{-5}
Dixie AP1000[(c)]	9.1×10^{-5}
Highlands AP1000[(c)]	9.4×10^{-5}
Putnam AP1000[(c)]	9.2×10^{-5}

(a) Divide person-rem/yr by 100 to obtain person-Sv/yr.
(b) Based on 60 shipments per year.
(c) Based on 40 shipments per year after normalizing to the reference LWR.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual collective public dose estimate for transporting spent fuel from the LNP and alternative sites to Yucca Mountain is less than 1×10^{-4} person-rem, which is less than the 1754 person-rem value that ICRP (2007) and NCRP (1995) suggest would most likely result in zero excess health effects. The collective population dose from natural background radiation to the population along the representative routes from the LNP and alternative sites to Yucca Mountain would be about 2.5×10^{5} person-rem. Therefore, the radiation doses from transporting spent fuel to Yucca Mountain are minimal compared to the collective population dose to the same population from exposure to natural sources of radiation.

6.2.2.3 Nonradiological Impact of Spent Fuel Shipments

The general approach used to calculate the nonradiological impacts of spent fuel shipments is the same as that used for unirradiated fuel shipments. 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. In addition, the accident, injury, and fatality rates from Saricks and Tompkins (1999) were adjusted to account for under-reporting (see Section 6.2.1.3). The results are shown in Table 6-12 for a single AP1000 reactor. The impacts would be doubled for a site with two AP1000 reactors like the LNP site and the alternative sites. Overall, the impacts are minimal and there are no substantive differences among the alternative sites.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the LNP Site and Alternative Sites to Yucca Mountain for a Single AP1000 Reactor, Normalized to Reference LWR

		Nonradiological Impacts, per year		
Site	**One-Way Shipping Distance, km**	**Accidents**	**Injuries**	**Fatalities**
Levy County	4520.3	1.5×10^{-1}	8.7×10^{-2}	6.2×10^{-3}
Crystal River	4506.5	1.5×10^{-1}	8.7×10^{-2}	6.2×10^{-3}
Dixie	4407.8	1.4×10^{-1}	8.7×10^{-2}	6.1×10^{-3}
Highland	4867.9	1.5×10^{-1}	8.9×10^{-2}	6.6×10^{-3}
Putnam	4529.9	1.5×10^{-1}	8.7×10^{-2}	6.2×10^{-3}

Note: The number of shipments of spent fuel assumed in the calculations is 40/yr after normalizing to the reference LWR.

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting radioactive waste other than spent fuel from the LNP site and alternative sites. 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 railcar.
- The weight limitation of 33,100 kg (73,000 lb) per truck and 90.7 MT (100 T) per cask per railcar would be met.
- Traffic density would be less than the condition of one truck shipment per day or three railcars per month.

Radioactive waste other than spent fuel 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 LNP 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. The maximum projected waste-generation rates for the Westinghouse AP1000 reactor (5717 ft^3 per year is the maximum estimated rate given by Westinghouse [2008]) could exceed the reference LWR waste-generation rate. However, projections of the rate of waste generation are uncertain and are a function of PEF's radioactive waste-management practices. Therefore, waste-generation rates for the proposed LNP reactors are anticipated to be much closer to the expected rate, shown in Table 6-13, than the maximum rate.

Table 6-13. Summary of Radioactive Waste Shipments from the LNP Site and Alternative Sites for a Single AP1000 Reactor

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
Levy County Westinghouse AP1000, expected	1964 ft^3/yr per unit[(c)]	56	1115[(c)]	47	21

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 L (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 proposed LNP Westinghouse AP1000 (PEF 2009a). 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 (82.6 ft^3 per shipment [108 m^3/yr divided by 46 shipments/yr]).

(c) This value was taken from the PEF ER (PEF 2009a).

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 LNP site and alternative sites. 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 LNP site or alternative sites is also less than the one-shipment-per-day condition.

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.

The nonradiological impacts of radioactive waste shipments were calculated using the same general approach used for unirradiated and spent fuel shipments. For this EIS, the shipping distance was assumed to be 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). These rates were adjusted to account for under-reporting, as described in Section 6.2.1.3. The results are presented in Table 6-14. As shown, the calculated nonradiological impacts for transportation of radioactive waste other than spent fuel from the LNP site and alternative sites to waste disposal facilities are less than the impacts calculated for the reference LWR in WASH-1238.

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the LNP Site and Alternative Sites with a Single AP1000 Reactor

	Shipments per Year	**One-Way Distance, km**	**Accidents per Year**	**Injuries per Year**	**Fatalities per Year**
Reference LWR (WASH-1238)	46	800	3.4×10^{-2}	1.7×10^{-2}	1.1×10^{-3}
LNP and Alternative Sites, Westinghouse AP1000	21	800	1.6×10^{-2}	7.8×10^{-3}	4.9×10^{-4}

Note: The shipments and impacts have been normalized to the reference LWR.

6.2.4 Conclusions for Transportation

The NRC staff performed an independent confirmatory analysis of the impacts under normal operating and accident conditions of transporting fuel and wastes to and from a Westinghouse AP1000 reactor to be located at the LNP site. Four alternative sites also were evaluated, including Crystal River, Dixie, Highlands, and Putnam (PEF 2009a). To make comparisons to Table S–4, the environmental impacts were adjusted (i.e., normalized) to the environmental impacts associated with the reference LWR in WASH-1238 (AEC 1972) by multiplying the AP1000 reactor impact estimates by the ratio of the total electric output for the reference reactor to the electric output of the proposed reactor.

Because of the conservative approaches and data used to calculate impacts, the NRC staff does not expect the actual environmental effects to exceed those calculated in this EIS. Thus, the NRC staff concludes that the environmental impacts of the transportation of fuel and radioactive wastes to and from the LNP site and alternative sites would be SMALL, and would be consistent with the environmental impacts associated with the transportation of fuel and radioactive wastes to and from current-generation reactors presented in Table S–4 of 10 CFR 51.52.

The NRC staff notes that on March 3, 2010, DOE (2010) submitted a motion to the Atomic Safety and Licensing Board to withdraw with prejudice its application for a permanent geologic repository at Yucca Mountain, Nevada. Regardless of the outcome of this motion, the NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case Florida to Nevada. The distance from the LNP site or any of the alternative sites to any new planned repository in the contiguous United States would be no more than double the distance from the LNP site or alternative sites to Yucca Mountain. Doubling the environmental impact estimates from the transportation of spent reactor fuel, as presented in this section, would provide a reasonable bounding estimate of the impacts to meet the needs of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq). The NRC staff concludes that the environmental impacts of these doubled estimates would still be SMALL.

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 safe removal of a facility 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.

An applicant for a COL is required to certify that sufficient funds will be available to ensure radiological decommissioning at the end of power operations. As part of its COL application for the proposed Units 1 and 2 on the LNP site, PEF included a Decommissioning Funding Assurance Report (PEF 2009b). PEF would establish an external sinking funds account to accumulate funds for decommissioning.

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement I, Regarding the Decommissioning of Nuclear Power Reactors* (GEIS-DECOM), NUREG-0586 Supplement 1 (NRC 2002). Environmental impacts of the DECON, SAFSTOR, and ENTOMB decommissioning methods are evaluated in the GEIS-DECOM. A COL applicant is not required to identify a decommissioning method at the time of the COL application. The NRC staff's evaluation of the environmental impacts of decommissioning presented in the GEIS-DECOM identifies a range of impacts for each environmental issue for a range of different reactor designs. The NRC staff concludes that the construction methods that would be used for the advanced boiling water reactor are not sufficiently different from the construction methods used for the current plants to significantly affect the impacts evaluated in the GEIS-DECOM. Therefore, the NRC staff concludes that the impacts discussed in the GEIS-DECOM remain bounding for reactors deployed after 2002, including the AP1000 reactor.

The GEIS-DECOM does not specifically address the carbon footprint of decommissioning activities. However, it does list the decommissioning activities and states that the decommissioning workforce would be expected to be smaller than the operational workforce and that the decontamination and demolition activities could take up to 10 years to complete. Finally, it discusses SAFSTOR, in which decontamination and dismantlement are delayed for a number of years. Given this information, the NRC staff estimated the CO_2 footprint of decommissioning to be of the order of 6.3×10^4 MT without SAFSTOR. This footprint is about equally split between decommissioning workforce transportation and equipment usage. The details of the NRC staff's estimate are presented in Appendix I. A 40-year SAFSTOR period would increase the footprint of decommissioning by about 40 percent. These CO_2 footprints are roughly three orders of magnitude lower than the CO_2 footprint presented in Section 6.1.3 for the uranium fuel cycle.

The NRC staff relies upon the bases established in the GEIS-DECOM and concludes the following:

1. Doses to the public would be well below applicable regulatory standards regardless of which decommissioning method considered in GEIS-DECOM is used.
2. Occupational doses would be well below applicable regulatory standards during the license term.
3. The quantities of Class C or greater than Class C wastes generated would be comparable or less than the amounts of solid waste generated by reactors licensed before 2002.
4. Air quality impacts of decommissioning are expected to be negligible at the end of the operating term.
5. Measures are readily available to avoid potential significant water-quality impacts from erosion or spills. The liquid radioactive waste system design includes features to limit release of radioactive material to the environment, such as pipe chases and tank collection basins. These features will minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.
6. Ecological impacts of decommissioning are expected to be negligible.
7. Socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

On the basis of the GEIS-DECOM and the evaluation of air quality impacts from greenhouse gas emissions above, the NRC staff concludes that, as long as the regulatory requirements on decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

6.4 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 71. Code of Federal Regulations, Title 10, *Energy*, Part 71, “Packaging and Transportation of Radioactive Material.”

10 CFR Part 961. Code of Federal Regulations, Title 10, *Energy*. Part 961, “Standard Contract for Disposal of Spent Nuclear Fuel and/or High Level Waste.”

40 CFR Part 190. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.”

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7.0 Cumulative Impacts

The review team, comprising staff of the U.S. Nuclear Regulatory Commission (NRC) and U.S. Army Corps of Engineers (USACE), evaluated the potential impacts of construction and operation of two new nuclear units at the Levy Nuclear Plant (LNP) site proposed by Progress Energy Florida, Inc. (PEF) in its application for combined construction permits and operating licenses (COLs) (PEF 2009a). In doing so, the review team considered potential cumulative impacts on resources that could be affected by the combination of construction, preconstruction, and operation of two Westinghouse Electric Company LLC AP1000 pressurized water reactors at the LNP site, and other past, present and reasonably forseeable future actions.

The National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.), requires Federal agencies to consider the cumulative impacts of proposed actions under their review. Cumulative impacts may result when the environmental effects associated with the proposed action are compounded with temporary or permanent effects associated with past, present, and reasonably foreseeable future projects. For purposes of this analysis, past actions are those prior to the receipt of the COL application. Present actions are those related to resources from the time of the COL application until the start of NRC-authorized construction of the proposed new units. Future actions are those that are reasonably foreseeable through the building and operation of proposed LNP Units 1 and 2, including decommissioning. The review team considered cumulative effects of the proposed LNP Units 1 and 2 with past, present, and reasonably foreseeable future actions. The geographic area over which these actions could contribute to cumulative impacts is dependent on the type of resource considered and is described below for each resource area. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time on the same resources.

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 by the review team to each impact category, as presented in Chapter 1. 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 general area surrounding the LNP site that would affect the same resources affected by the proposed new units, 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 potentially 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 cumulative 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.

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impacts analysis, including the effects of past actions. The incremental impacts related to the construction activities requiring NRC authorization (10 CFR 50.10(a)) are described and characterized in Chapter 4 and those related to operations are described and characterized in Chapter 5. These impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area.

This chapter includes an overall cumulative impact assessment for each resource area. The specific resources that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. This assessment includes the impacts of construction and operations for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts of past, present and reasonably foreseeable future Federal, non-Federal, and private actions that could affect the same resources as the proposed action.

The review team visited the LNP site in December 2008. The team then used the information provided in the environmental report (ER), responses to requests for additional information, information from other Federal and State agencies, and information gathered during the LNP site visit to evaluate the cumulative impacts of building and operating a nuclear facility at the proposed site. To inform the cumulative analysis, the review team researched databases of the U.S. Environmental Protection Agency (EPA) for recent environmental impact statements (EISs) within Florida, used an EPA database for permits for water discharges in the area to identify water-use projects, and used the www.recovery.gov website to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). Other actions and projects that were identified during this review and considered in the review team's independent analysis of the cumulative effects are described in Table 7-1. Distances listed in Table 7-1 are from the planned powerblock location except as otherwise noted.

7.1 Land-Use Impacts

The description of the affected environment in Section 2.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.1, the NRC staff concludes that the impacts of NRC-authorized construction on land use would be SMALL and no further mitigation would be warranted. As described in Section 5.1, the review team concludes that the impacts of operations on land use would also be SMALL and no further mitigation would be warranted.

Table 7-1. Past, Present, and Reasonably Foreseeable Future Projects and Other Actions Considered in the Levy Cumulative Analysis[(a)]

Project Name	Summary of Project	Location	Status
Energy Projects			
Operation and decommissioning of Crystal River Energy Complex (CREC) Units 1-5	The CREC consists of five power-generating plants operated by PEF, four fossil-fuel plants and one nuclear plant. The fossil-fuel plants began operations in 1966, 1969, 1982, and 1984. The nuclear plant began operations in 1977.	About 9 mi southwest of the LNP site	Operational. The nuclear plant (Unit 3) is shut down due to damage to the containment. Repair expected to be completed by 2014. The State of Florida Conditions of Certification for LNP would require PEF to discontinue the operations of two fossil-fuel units by December 31, 2020, assuming licensing, construction, and commencement of operation of LNP occur in a timely manner (PEF 2011a; DOE/EIA 2010; FDEP 2011a).[(b)]
Construction of an independent spent fuel storage installation (ISFSI) at CREC	ISFSI will provide additional capacity for storing spent nuclear fuel in dry casks.	About 9 mi southwest of the LNP site	Under construction (NRC 2010)
Renewal of the CREC nuclear Unit 3	Extension of operations of CREC Unit 3 for an additional 20-year period beyond the end of the current license term, which is valid through midnight December 3, 2016.	About 9 mi southwest of the LNP site	Proposed. If granted, the license renewal would provide PEF the authority to continue operations through 2036. The draft supplemental EIS for the license renewal was issued May 26, 2011 (PEF 2008a; NRC 2011a).
Uprate at CREC Unit 3	CREC Unit 3 has requested an extended power uprate, or increase in the maximum power level at which the nuclear power plant may operate. The project would also include construction of a new helper cooling tower.	About 9 mi southwest of the LNP site	Proposed. The application submitted to the State of Florida was approved in August 2008. USACE issued a public notice on May 25, 2010. A Federal application was submitted to NRC on June 15, 2011. (PEF 2011b).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Inglis Lock bypass channel spillway hydropower project	2-MW hydroelectric project at the existing Inglis Lock bypass spillway. The project would include construction of an intake structure, intake and discharge channels, turbines, and a transmission line.	Approximately 3 mi south-southwest of the LNP site	Proposed. An application has been submitted to the Federal Energy Regulatory Commission (Inglis 2009).
Florida Gas Transmission Company, LLC (FGT) Phase VIII Expansion Project	Construction and expansion of natural-gas pipelines, new compressor, meter, regulator stations, and other appurtenant facilities	Various counties in Alabama and Florida, including Levy, Citrus, and Hernando. Collocated with U.S. Highway 19 (US-19) in the vicinity of the LNP site	Project is complete and the facilities have been placed in service (FERC 2009; Panhandle Energy 2011).
Mining Projects			
Tarmac King Road Limestone Mine	A 9400-ac aggregate mining site. The mining site would be 4800 ac (including 900 ac set aside for wetlands); with remaining 4600 ac donated to Florida for preservation.	The eastern border of the site is about 2 mi west of the LNP site (see Figure 2-4)	Proposed. A permit application was submitted to USACE in September 2007. A draft EIS is expected to be completed in 2012 (USACE 2008; PEF 2009b).
Holcim Mine	Limestone quarry	About 7 mi southwest of the LNP site	Operational (FDEP 1997)
Inglis Quarry	Limestone quarry	About 6 mi southwest of the LNP site	Operational (EPA 2010a)
Crystal River Quarries – Red Level	Limestone quarry	About 7 mi south of the LNP site	Operational (EPA 2010b)
Crystal River Quarries – Lecanto	Limestone quarry	About 19 mi south-southeast of the LNP site	Operational (EPA 2010c)
Gulf Hammock Quarry	Limestone quarry	About 12 mi north of the LNP site	Operational (EPA 2010d)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Transportation Projects			
Cross Florida Barge Canal (CFBC)/ Marjorie Harris Carr Cross-Florida Greenway	The CFBC was a proposal to connect the Gulf of Mexico to the Atlantic Ocean. Two sections were partially constructed between 1964 and 1971. A constructed section extends westward from Lake Rousseau to the Gulf of Mexico. Portions of the CFBC are currently used as part of the Marjorie Harris Carr Cross Florida Greenway (FDEP 2010).	About 3 mi south of the LNP site	Operational downstream of Lake Rousseau. Marjorie Harris Carr Cross Florida Greenway is currently managed as a protected greenbelt corridor. Construction was suspended January 1971 (FDEP 2010).
Widening of the US-19 bridge and highway at the CFBC	The project widens the bridge from 2 lanes to 4 lanes on 2 spans	About 3 mi north of the Crystal River site	The project was completed in July 2011 (FDOT 2010, 2011a)
Parks and Aquaculture Facilities			
Goethe State Forest	A 53,398-ac forest managed by Florida Department of Agriculture and Consumer Services (FDACS) for timber management, wildlife management, outdoor recreation, and ecological restoration (FDACS 2010).	Adjacent to the northeastern boundary of the LNP site	Development likely limited in this area (PEF 2009a)
Other parks, forests, and reserves	Numerous State and national parks, forests, reserves, and other recreational areas, including: Inglis Island Trail, Inglis Lock Recreation Area, Cedar Keys National Wildlife Refuge, Cummer Sanctuary, Crystal River National Wildlife Refuge, Lower Suwannee National Wildlife Refuge; Withlacoochee State Forest; Ocala National Forest; Crystal River Preserve State Park;	Throughout the 50-mi region	Development likely limited in these areas (PEF 2009a)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
	Silver River State Park; and the Homosassa Springs Wildlife State Park.		
Crystal River Mariculture Center	Multi-species marine hatchery	About 7 mi southwest of the LNP site adjacent to CREC.	Operational (FFWCC 2011)
Other Aquaculture Facilities	Multi-species marine hatcheries	Throughout region	Operational
Other Actions/Projects			
Commercial forest management	Managed forests for timber production	Throughout region	Operational
Commercial dairies	Several dairies are located within the 50-mi region including the Levy County Dairy, Alliance, and Piedmont Dairies, Hill Top Dairy, and Oak Grove Dairy, Inc.	Throughout region	Operational
Minor water dischargers and wastewater-treatment plants	National Pollutant Discharge Elimination System (NPDES)-permitted dischargers in Fanning Springs, Trenton, Blitchville, Bell, Chiefland, Cedar Key, Suwannee, and other locations.	Throughout region	Operational
Concrete companies	Two ready-mixed concrete suppliers	Northern Levy County	Operational (EPA 2010e, f)
Various hospitals and industrial facilities that use radioactive materials	Medical and other industrial isotopes	Within 50 mi	Operational in nearby cities and towns.
Future urbanization	Construction of housing units and associated commercial buildings, such as the proposed Port District near Inglis; roads, bridges, and rail, such as the Suncoast toll road expansion; construction of water- and/or	About 6 mi southwest of the LNP site and throughout region.	Construction would occur in the future, as described in local land-use planning documents (FTE 2010; 2011b; Citrus County 2009).

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
	wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents. There is a low potential for increased urbanization within Levy and Citrus counties because population growth is expected to be less than 2 percent per year (see Table 2-16)		

(a) The review team is aware of recent events in the Gulf of Mexico associated with the Deepwater Horizon oil spill. To date, information associated with impacts on aquatic and terrestrial resources is preliminary and inconclusive. Although not included in this EIS, the review team will consider information associated with the oil spill for the LNP project as it becomes available.
(b) Although the timeline for licensing, construction, and operation of the LNP has shifted since the Conditions of Certification were published, the NRC expects that the subject condition is still applicable and that CREC Units 1 and 2 will discontinue operations when the LNP comes online.

The combined impacts from construction and preconstruction are described in Section 4.1 and they were determined to be MODERATE and would be mitigated as described in Section 4.1. In addition to land-use impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts. For this cumulative impacts analysis, the geographic area of interest is the area within a 15-mi radius of the LNP site and the transmission-line corridors. The review team determined that a 15-mi radius would represent the area that would be directly affected because it includes the primary communities (such as Inglis, Crystal River, Yankeetown, and Dunnellon) that would be affected by the proposed project.

Historically, Levy County was known for mining and timber operations. Much of the LNP site was used for intensive pine tree production and harvesting operations. The natural vegetation and land surface were significantly altered by these operations, which resulted in a series of hillocks and furrows. Lake Rousseau was formed when the Withlacoochee River was dammed in the early 1900s. The Cross Florida Barge Canal (CFBC) was partially constructed from the Gulf of Mexico to Lake Rousseau, and other lands acquired to construct the CFBC are now managed as the Marjorie Harris Carr Cross-Florida Greenway to conserve natural resources and provide recreational opportunities. The Crystal River Energy Complex (CREC, an energy facility also owned by PEF), constructed over a period from the 1960s to the 1980s, currently consists of a single 850-MW nuclear unit and four coal-fired generating units. From 1960 until 1985, the population of Levy County increased from about 10,000 to about 22,000, and the population of Citrus County increased from about 10,000 to about 70,000 (CensusScope 2010). Thus, residential land use in the region increased dramatically during that period. Currently, the region around the LNP site is largely rural and undeveloped land. Approximately 17.4 percent of the land is cropland and pasture, 14.8 percent is nonforested wetlands, 12.3 percent is residential, 12.1 percent is bays and estuaries, 9.0 percent is forested wetlands, 8.8 percent is deciduous forest land, 8.0 percent is other agricultural land, 7.7 percent is mixed forest land, and the remaining 9.9 percent is made up of a variety of land uses as shown in Table 2-2 (PEF 2009a).

Within the region, the reasonably foreseeable project with the greatest potential to affect cumulative land-use impacts would be the Tarmac King Road Limestone Mine. The 4800-ac mine site is located 1 mi west of the intersection of U.S. Highway 19 (US-19) and King Road in Levy County, within about 2 mi of the LNP site. About 2700 ac would be mined over about a 100-year period, with an additional 1300 ac disturbed to site a quarry processing plant, roads, and other infrastructure. The company plans to donate another 4600 ac of land to the State of Florida for preservation. Tarmac America LCC (Tarmac) has applied for permits to begin construction of the mine in 2011, with operations beginning in 2013. Tarmac estimates that at the height of mining activity, about 500 trucks would leave the mine site daily and enter US-19 (Tarmac America 2010). The potential impacts from this increased traffic, coupled with traffic from the LNP site, are considered in Section 7.4. Widening of the US-19 bridge and highway was completed in 2011 to alleviate traffic issues in the area (FDOT 2011a). Because the mine would include less than 2 percent of the geographic area of interest, not including the Gulf water area, the review team expects that the proposed Tarmac mine would have a minimal impact on land use. However, because the LNP site is only 2 mi from the proposed mine, together the projects would have a noticeable, but not destabilizing, impact on land use.

In the State of Florida's Conditions of Certification for the LNP site (FDEP 2011a), CREC Units 1 and 2, two coal-fired plants, would stop operating by December 31, 2020, as long as PEF completes the licensing process, construction activities, and commences commercial operation of LNP Units 1 and 2 within a timely manner. Land use at the CREC site likely would remain industrial. Depending on economic conditions, PEF sells 60 to 95 percent of the coal plant ash to cement and building materials manufacturers, with the remainder going to Citrus Central Landfill in Lecanto, Florida. With the closure of CREC Units 1 and 2, this source of ash no longer would be available locally, although ash would still be available from coal-fired Units 4 and 5. PEF has also proposed to install a new helper cooling tower on the south bank of the CREC discharge canal to replace the group of helper cooling towers that are currently located on the north bank (USACE 2010). The review team expects that land-use impacts associated with these projects would be minimal.

As described in Table 2-1, approximately 180 mi of entirely new transmission-line corridors would be built to support proposed LNP Units 1 and 2, although new corridors would be located adjacent to existing utility corridors to the extent practicable. New transmission lines would convert 547 ac of “Hardwood – Conifer Mix,” 247 ac of “Coniferous Plantation,” and 192 ac of “Cypress” land uses, among others, to utility land use, and would pass through undisturbed areas. Increased urbanization, especially long linear projects such as new or expanded roads or pipelines, would also contribute to the loss of open or forested areas and increase fragmentation of habitats along or near the transmission lines. Due to the extent of new transmission lines that would be built, the review team expects the corridors would have a noticeable impact on the local area.

Future urbanization in the review area could contribute to additional decreases in open areas, forests, and wetlands and generally result in some increase in residential and industrialized areas. Currently, only about 12 percent of the region around the LNP site is in residential land use. Local land-use planning documents describe future construction of residential and commercial buildings, although such development would likely be limited because the predicted growth rate in the area is approximately 2 percent (see Table 2-16). The Florida Department of Transportation completed the US-19 bridge expansion in July of 2011 and plans to expand the Suncoast toll road. Florida Gas Transmission Company (FGT) recently placed into service its liquefied natural-gas pipeline collocated with the existing pipeline in the vicinity of the Crystal River site (Panhandle Energy 2011). These projects would have limited impacts on land use because a small incremental amount of land would be converted to a new land use, and it would be adjacent to the current roads or pipelines. Development would likely be limited in the nearby Goethe State Forest and other parks and recreational areas. Therefore, the incremental impacts associated with increased urbanization would be minimal.

Global climate change could increase temperature and reduce precipitation, which could result in reduced crop yields and livestock productivity (GCRP 2009), and may change portions of agricultural and ranching land uses in the geographic area of interest. In addition, global climate change could increase sea level and storm surges in the geographic area of interest (GCRP 2009), thereby changing land use through inundation and loss of coastal wetlands and other low-lying areas. However, existing State and national forests, parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by sea-level rise. Because other projects listed in Table 7-1 that are within the geographic area of interest would be consistent with applicable land-use plans and control policies and would occur in dispersed locations, the review team considers their contribution to the cumulative land-use impacts to be relatively minor and manageable.

Based on its evaluation, the review team concludes that the cumulative land-use impacts associated with construction, preconstruction, and operations of the proposed LNP and other past, present, and reasonably foreseeable projects in the geographic area of interest would be MODERATE. The land-use impacts would be sufficient to alter noticeably, but not destabilize, important attributes of the land resource. The incremental land-use impacts associated with the transmission-line corridors for the project and the Tarmac King Road Limestone Mine in combination with the LNP site are the principal contributors to the MODERATE characterization of cumulative land-use impacts. Transmission-line corridors would pass through undisturbed lands, including wetlands, and PEF and the State of Florida have identified mitigation measures to be taken. Because the NRC does not authorize the building of transmission lines, the NRC staff concludes that the incremental impacts of NRC-authorized activities would be SMALL.

7.2 Water Use and Quality

This section analyzes the cumulative impacts of the proposed LNP Units 1 and 2, and other past, present, and reasonably foreseeable projects on water use and water quality.

7.2.1 Water-Use Impacts

This section describes cumulative water-use impacts from construction, preconstruction, and operations of proposed LNP Units 1 and 2, and other past, present, and reasonably foreseeable projects.

7.2.1.1 Surface-Water-Use Impacts

The description of the affected environment in Section 2.3 serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on surface-water use would be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification. As described in Section 5.2, the review team concludes that the impacts of operations on surface-water use would also be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification.

The combined surface-water-use impacts from construction and preconstruction are described in Section 4.2.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect surface-water use, including the potential impacts of global climate change, as discussed above. For this analysis, the geographic area of interest is strongly influenced by the site’s proximity to the Gulf of Mexico, which could theoretically provide a virtually unlimited water source. To examine cumulative surface-water-use impacts, this analysis includes the area within 20 mi of the LNP site, which would be expected to encompass the area affected by the proposed units and other area water users in this region of the Florida Gulf Coast. The 20-mi region is partially located within Levy, Citrus, and Marion counties. Within this region, past, present, and foreseeable future actions that contribute to cumulative impacts include the existing CREC units, a planned uprate of CREC Unit 3, potential decommissioning of CREC Units 1 and 2, existing and proposed mines, and proposed transportation projects (see Table 7-1).

The LNP site is located in Levy County. A portion of Levy County is under the jurisdiction of the Southwest Florida Water Management District (SWFWMD) while the rest is under the Suwannee River Water Management District (SRWMD). The SRWMD water-supply plan was published in 2010 (SRWMD 2010) and covers the period from 2010 to 2030. Currently, almost all water used in SRWMD is supplied by groundwater from the Upper Floridan aquifer. Because of declining aquifer levels, waters from rivers in the area are recommended as an alternative source. The SRWMD is developing a water resources management and conservation plan to protect the resources while meeting future demand.

According to the 2010 draft Regional Water Supply Plan prepared by SWFWMD (2010), the Withlacoochee River is the only major river in the northern planning region of the district where the LNP site is located. Although minimum flow for the Withlacoochee River has not yet been established, the SWFWMD (2010) stated that in the future, established minimum flows will provide some bound on the water supply from the river during low-flow conditions. In a preliminary study conducted by the Withlacoochee Regional Water Supply Authority in cooperation with the SWFWMD, the agencies concluded that an additional 93 Mgd of surface-water supply may potentially be available from the river. Currently, minor withdrawals totaling 0.5 Mgd are permitted from the Withlacochee and the Rainbow rivers (SWFWMD 2010). The proposed LNP units would not withdraw surface waters from the Withlacoochee River, the Suwannee River, or their tributaries. Because the Gulf of Mexico is a virtually unlimited source, historical water use impact on it from recreation and industry (e.g., CREC power plant units) is undetectable. Mining activities in Levy, Citrus, and Marion counties used 1.8 Mgd in 2005 and are expected to use 4 Mgd by 2030 (SWFWMD 2010). These mining uses include surface and groundwater.

The LNP units would withdraw water from the CFBC, which is connected to the Gulf of Mexico. The CFBC receives freshwater inflows from the Old Withlacoochee River (OWR, a remnant arm of the Withlacoochee River) and groundwater springs in addition to tidal exchanges of saltwater from the Gulf of Mexico. The review team determined that the consumptive use of surface water for operation of the proposed units (no surface-water use is planned for construction and preconstruction activities) would remain undetectable relative to the volume of water in the Gulf of Mexico and minor within the 20-mi area surrounding the LNP site. The predominant surface-water user within this area is CREC, and its withdrawals have an insignificant effect on surface-water availability from the Gulf of Mexico. PEF has proposed to install a new helper cooling tower on the south bank of the CREC discharge canal to replace the group of helper cooling towers that are currently located on the north bank (USACE 2010). During critical summer months, similar to the existing group of helper cooling towers, the new helper cooling tower would withdraw discharged cooling water from CREC units and the discharged blowdown water from the LNP units and cool it before discharging the water back into the CREC discharge canal. The helper cooling tower would cool the waters in the CREC discharge canal sufficiently to meet the National Pollutant Discharge Elimination System (NPDES) maximum temperature limit. Because the helper cooling tower would only be required to cool the discharged water a few degrees, and because it would operate only a few months during the year, the consumptive use of the new helper tower is expected to be minimal.

Another proposed project in the area, is the development of the Inglis Lock bypass channel spillway hydropower project. There would be minor water use during building and installation of the hydropower project. The review team determined that water use during building and installation would be temporary and would therefore not result in a cumulative impact on water availability in the area. The project would not result in consumptive use of surface water during its operation and therefore would not have a cumulative impact on water availability in the geographic area of interest. The impacts of other projects listed in Table 7-1 are considered in the analysis included in Sections 4.2 and 5.2 or would have little or no impact on surface-water use.

For this water-use analysis, the review team considered forecasted changes to temperature and precipitation for southwest Florida. For the State of Florida, the projected range of change in temperature from “present day” (1993–2008) to the period encompassing the licensing action (i.e., 2040 to 2059) is reported in the U.S. Global Change Research Program (GCRP) report to be between 1 to 4°F (GCRP 2009). While the GCRP has not incrementally forecasted the change in precipitation by decade to align with the licensing action, the projected change in precipitation from the “recent past” (1961–1979) to the period 2080 to 2099 is a decrease of between 20 to 25 percent in spring and an increase of between 15 to 20 percent in the fall (GCRP 2009). Declines in aquifer water levels may continue throughout Florida, as the aquifers are relied on in response to changes in precipitation and the growth in demand for freshwater (GCRP 2009). Such changes in climate could result in adaptations to both surface-water and groundwater management practices and policies that are unknown at this time.

Global climate change could result in changes in seasonal precipitation and increased temperatures. These forecasted changes have the potential to reduce surface runoff and increase evapotranspiration. Changes in climate during the life of proposed Units 1 and 2, described above, could result in either an increase or decrease in the amount of runoff; however, the divergence in model projections for the southeastern United States precludes a definitive estimate (GCRP 2009). While the changes that are attributed to climate change in these studies are not insignificant, the review team did not identify climate change related effects at the local and watershed scale under the currently unknown adaptations to water-management policies that would alter its assessment that the impacts on the surface-water resource would be minor. Also based on this compilation, it is reasonably foreseeable that sea level rise may exceed 3 ft by the end of the century due to global climate change (GCRP 2009). The increase in sea level relative to the CFBC and the Withlacoochee River, potentially coupled with reduced streamflow (also due to global climate change), could result in the saltwater front in the CFBC and the Withlacoochee River moving upstream.

The review team determined that the consumptive use of water from the operation of LNP Units 1 and 2 and all other consumptive uses (existing or likely future uses) would not alter the volume of water in the Gulf of Mexico and would not noticeably alter the surface-water resource within 20 mi of the LNP site. Based on its evaluation, the review team concludes that the cumulative impacts on surface-water use from construction, preconstruction, and operations of two new nuclear units and other past, present, and reasonably foreseeable future activities would be SMALL, and no mitigation would be warranted. As stated above, the review team also considered global climate change-related effects on the surface-water resource and water use. While these changes from global climate change may not be insignificant, the review team has not identified climate change-related effects at the local and watershed scale under the currently unknown adaptations to water-management policies that would alter the conclusions presented above.

7.2.1.2 Groundwater-Use Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on groundwater use would be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification. As described in Section 5.2, the review team concludes that the impacts of operations on groundwater use would also be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification.

The combined impacts from construction and preconstruction are described in Section 4.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect groundwater use, including potential effects of global climate change. For this analysis, a geographic area of interest has been identified which extends 20 mi from the LNP site. This 20-mi region is sufficiently large to characterize potential cumulative groundwater use impacts. As discussed in Section 2.3.1.2, groundwater in the Upper Floridan aquifer at the Levy site moves west-southwest from areas of higher hydraulic head east of the site to discharge to local springs and offshore springs in the Gulf of Mexico. The surficial and the Upper Floridan aquifers could be affected by water withdrawal for construction, preconstruction, and operation of proposed LNP Units 1 and 2.

The geographic area of interest described above is located within two Florida water management districts – the SWFWMD and the SRWMD. Within the SWFWMD, the geographical area of interest falls in the northern planning region of the district. The SWFWMD has monitored the groundwater resources in the northern planning region since the passage of the 1972 Florida Water Resources Act including the initiation of the water resources assessment project in the late 1980s which continues today (SWFWMD 2010). The assessment led to modifications to the district's permitting rules. The northern planning region has recently experienced population growth and development leading to larger groundwater withdrawals. The average (non-drought) water demand in the northern planning region in 2005 was 82 Mgd and is projected to increase to 106 Mgd in 2010 and 154 Mgd in 2030 (SWFWMD 2010). The SWFWMD has estimated that during 2010-2030, potential water availability in the northern planning region could be 240 Mgd (SWFWMD 2010). However, this estimated water availability includes contributions from unused permitted and available unpermitted surface waters from the Withlacoochee River, reclaimed water, desalination of seawater, and conservation measures (SWFWMD 2010). The projected 2030 water demand cannot be met solely by groundwater from the Upper Floridan aquifer. The review team concludes that groundwater has historically been extensively used in the region and therefore has noticeably altered the resources. The alteration on groundwater resources from historical use is also evident from the careful planning and permitting process the SWFWMD uses to ensure that impacts to the resource is minimized.

Near-term alterations of the groundwater supply due to projected use of 1.58 Mgd of groundwater for LNP operations are expected to be minor, based on the results of predictive simulations, and on conditions imposed for certification by the State of Florida that limit the allowable drawdown caused by pumping from the LNP wellfield (see Section 5.2.2.2). Projected future groundwater usage by all permitted users within the boundary of the local-scale groundwater flow model, based on population projections from the 2000 U.S. Census, is discussed in Section 2.3.2.2. The increase in usage is projected to be relatively small (from 3.51 Mgd in 2001 to 10.3 Mgd in 2078; see Section 2.3.2.2) compared to the estimated water balance for the local-scale groundwater flow model domain (208 Mgd; see Section 5.2.2.2). Therefore, the review team determined that cumulative impacts of both the proposed LNP project and other current and future permitted groundwater users are also expected to be minor. The SWFWMD has determined that the groundwater use at the proposed LNP site would be limited and would not significantly affect future planning in the region (FDEP 2011a).

Agriculture and other activities (e.g., existing mining activities at the Inglis Rock Quarry) have historically used groundwater in the region of interest. The Florida Department of Environmental Protection (FDEP) and SWFWMD have developed a proactive groundwater management program to preserve and manage groundwater resources. Other potential cumulative impacts include changes in the groundwater system associated with climate change (see discussion in Section 7.2.1.2 above) and the proposed Tarmac King Road Limestone Mine.

The Tarmac King Road Limestone Mine is proposed to be located about 2 mi west of the LNP site. Tarmac has applied for permits to begin operations in 2013. The Tarmac mine site would be 9400 ac in area of which 2700 ac, consisting of wetlands and uplands, would be mined. A 900-ac area would be set aside for wetlands and 4500 ac would be donated to the State of Florida for preservation. This limestone mine is expected to use less than 1 Mgd of water (PEF 2009a), which is comparable to LNP operational usage. Currently, the USACE is preparing a draft EIS for the Tarmac mine that would evaluate the impacts of water use associated with the Tarmac Mine project. Although no specific evaluation of the impacts of water use at the Tarmac mine on groundwater levels and wetlands was performed for the LNP Units 1 and 2 draft EIS, the review team determined that the effects of water use at the Tarmac mine site on the groundwater resource would be of the same order of magnitude as those predicted for the LNP wellfield located on the LNP site because both projects would withdrawal a comparable amount of groundwater. As discussed in Section 5.2.2.2, a modeling evaluation indicated that average LNP operational groundwater use (1.58 Mgd) represents only a small percentage (0.8 percent) of the total water flux (208 Mgd) moving through the groundwater model domain. Assuming similar geohydrologic conditions at the Tarmac site, the review team determined that the proposed water use would also be a relatively small amount of the flux moving through the groundwater system.

The projected groundwater usage associated with normal LNP operation and temporary increases in withdrawal rate associated with maximum daily operation are small relative to the groundwater resource. Because no other past, present, or reasonably foreseeable actions with significant impacts were identified, the review team concludes that cumulative impacts on the groundwater resource from preconstruction, construction, and operation of the proposed LNP units, and other past, present, and reasonably foreseeable projects, including the potential of decreased precipitation and increased temperatures due to global climate change, would be SMALL, and mitigation beyond the conditions imposed for certification by the State of Florida discussed in Chapters 4 and 5 would not be warranted. As stated earlier, global climate change could result in alteration of the groundwater resource in the geographic area of interest by varying the recharge to the aquifers, changing the use of agricultural chemicals, and affecting land use patterns. While the changes in groundwater resource that are indirectly attributable to climate change may not be insignificant, the review team did not identify climate change related effects at the local and regional scale under the currently unknown adaptations to water-management policies that would alter its conclusion regarding groundwater use.

7.2.2 Water-Quality Impacts

This section describes cumulative water-quality impacts from construction, preconstruction, and operations of proposed LNP Units 1 and 2, and other past, present, and reasonably foreseeable projects.

7.2.2.1 Surface-Water-Quality Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on surface-water quality would be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification. As described in Section 5.2, the review team concludes that the impacts of operations on surface-water quality would also be SMALL, and no further mitigation would be warranted beyond the conditions imposed by the State of Florida Conditions of Certification.

The combined surface-water-quality impacts from construction and preconstruction are described in Section 4.2.3.1 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect surface-water quality. For the cumulative analysis of impacts on surface water, the review team analyzed impacts to the CFBC between Lake Rousseau and the Gulf of Mexico and the area within 20 mi of the LNP site because this is the area that would exhibit effects from cumulative impacts. The 20-mi region is partially located within Levy, Citrus, and Marion counties. Within this region, past, present, and foreseeable future actions that contribute to cumulative impact include the existing CREC units, a planned uprate of CREC Unit 3, potential decommissioning of CREC Units 1 and 2, existing and proposed mines, and proposed transportation projects (see Table 7-1). The discharges from the CREC and existing projects are permitted by existing NPDES permits. The potential discharges from other proposed projects would also be permitted under NPDES permits and best management practices would be used to minimize runoff that may adversely affect water quality of receiving waters in the region.

As stated in Section 2.3.3.1 of the EIS, there are some waterbodies near the LNP site that are listed on the State's 303(d) list of impaired waterbodies (FDEP 2011b). Historical point and non-point source discharges have affected the water quality of streams and rivers near the LNP site. Lake Rousseau and the lower Withlacoochee River appear on the final verified 2010 303(d) list as impaired waterbodies because of the presence of mercury in fish tissue (FDEP 2011b). The State of Florida has a total maximum daily loads (TMDL) program to help protect and restore the quality of waters. In addition, the State of Florida also designates waterbodies as outstanding Florida waters (OFWs) and special waters to which pollutant discharges are generally prohibited. The lower Withlacoochee River near the LNP site is an OFW. Lake Rousseau and the CFBC are not designated as OFWs. There would be no LNP Units 1 and 2 station related discharges to the lower Withlacoochee River or the CFBC. As stated in Section 4.2.1, LNP Units 1 and 2 and their ancillary facilities would be built within the 100-year floodplain and result in encroachment up to the 100-year floodplain elevation above the overflow elevation and encroachment in natural depressions below the overflow elevation; the retention storage in natural depressions below the overflow elevation is also called historic basin storage (HBS). The SWFWMD's bases of review regarding water quality for Environmental Resource Permit applications do not allow any net encroachment into the floodplain up to the 100-year flood level (SWFWMD 2011). As stated in Section 4.2.1, the review team's assessment of the two analyses for floodplain encroachment effects determined that without any compensation for the encroachment, the maximum increase in flood level in the down-gradient areas would be less than 1 in. Because the maximum increase in flood level is minor and because appropriate State of Florida regulations are in place to compensate for adverse effects, the review team determined that the effects on flood levels and water quality in the down-gradient areas would not be noticeable. As stated in Section 4.2.1, the review team also determined that the loss in HBS because of building of LNP facilities can be compensated within the proposed wet detention ponds. Therefore, the review team determined that the impacts of building LNP facilities on HBS would be minor.

The other existing and reasonably foreseeable projects mentioned above would either not discharge to these waterbodies or their discharges would be controlled by FDEP under State and Federal regulations. As stated above, the State of Florida, under the TMDL program, helps protect and restore the quality of impaired waters. Therefore, the review team determined that the cumulative impacts from existing, proposed, and reasonably foreseeable future action on these waterbodies would be noticeable but not destabilizing.

As described in EIS Section 5.2.3.1, the review team independently used the Finite Volume Coastal Ocean Model (MEDM 2010, Chen et al. 2003, 2004) to estimate the water-quality parameters of the discharge plume in the Gulf of Mexico. Table 5-1 lists the four configurations that resulted in eight simulated scenarios, one each for summer and winter conditions for each configuration. The cumulative impact on the Gulf of Mexico in the vicinity of the CREC discharge canal is a result of all past, present, and reasonably foreseeable future projects. These projects include the cooling-water discharge from CREC Units 1 through 5, uprate to Unit 3, and the blowdown discharge from the closed-loop cooling system of LNP Units 1 and 2. The review team also evaluated the impacts of the uprate to CREC Unit 3 and the potential future shutdown of CREC Units 1 and 2 on the water quality parameters, temperature and salinity, of the Gulf near the discharge point.

Based on the water-quality simulations described above, the review team determined that the combined discharge of CREC Units 1 through 5 including the uprate of Unit 3 and the blowdown discharge from LNP Units 1 and 2, would result in a thermal plume with a noticeably large area with increase in ambient Gulf water temperature of about 6°C in summer and about 10°C in winter. Therefore, the review team concluded that the cumulative impacts of the combined discharges from past, present, and reasonably foreseeable future projects on water temperatures in the Gulf would be noticeable. Based on the simulations described above, the review team also determined that both during summer and winter, the combined discharge would result in salinity increase of less than about 1 psu over ambient salinity of Gulf waters. Therefore, the review team concluded that the cumulative impacts of the combined discharges from past, present, and reasonably foreseeable future projects on the salinity in the Gulf would be noticeable. The incremental impact from LNP Units 1 and 2 on water quality would be minor. Other chemical releases are permitted by the NPDES process that also requires the respective projects to monitor these releases to ensure compliance.

PEF has proposed to install a new helper cooling tower on the south bank of the CREC discharge canal to replace the group of helper cooling towers that are currently located on the north bank (USACE 2010). During critical summer months, similar to the existing group of helper cooling towers, the new helper cooling tower would withdraw discharged cooling water from CREC units and the discharged blowdown water from the LNP units and cool it before discharging the water back into the CREC discharge canal. The helper cooling tower would cool the waters in the CREC discharge canal sufficiently to meet the NPDES maximum temperature limit. Because the helper cooling tower would only be required to cool the discharged water a few degrees and because it would operate only a few months during the year, the new helper tower is expected to only minimally change the water quality in the Gulf of Mexico.

The review team also simulated water quality parameters if CREC Units 1 and 2 were to shut down and only CREC Units 3 through 5 (including the uprated Unit 3) and LNP Units 1 and 2 were to remain in operation, as described as a condition by the State of Florida's Conditions of Certification (FDEP 2011a). Based on simulations described above, the review team determined that the plume in the Gulf would be significantly smaller and somewhat cooler (about 0.6°C) than ambient waters in summer because the cooling water discharge of the once-through cooling systems of CREC Units 1 and 2 would cease. In winter, after stoppage of discharge from CREC Units 1 and 2, the discharge plume would be slightly smaller in size than when CREC Units 1 and 2 would be in operation. However, a noticeably large area would have temperatures about 10°C warmer than ambient winter temperature in the Gulf. The salinity in the plume, however, would increase slightly because the operating units have closed-cycle cooling systems that use 1.5 cycles of concentration. The maximum increase in salinity would be about 2.5 psu over ambient salinity in the Gulf in summer and about 1 psu in winter. Therefore, the review team concluded that the cumulative impacts of the combined discharges, if CREC Units 1 and 2 were to shut down, on water temperature and salinity in the Gulf would be noticeable. As stated above, the review team concluded that the contribution of LNP Units 1 and 2 to the noticeable cumulative impact would be minimal.

As stated in Section 2.3.1, it is reasonably foreseeable that sea-level rise may exceed 3 ft by the end of the century due to global climate change (GCRP 2009). The increase in sea level could result in the saltwater front moving farther inland in the CFBC. As stated above, global climate change could result in changed precipitation and increased temperatures in the vicinity of the proposed plant. These forecasted changes have the potential to reduce surface runoff, increase evapotranspiration, change cropping patterns, and alter nutrient loadings to runoff. The changes may result in alteration of the surface-water quality in the region.

Other present and reasonably foreseeable future actions in the geographic area of interest that could contribute to cumulative impacts on surface-water quality include the operation of CREC, Units 1-5, the renewal of the license for Unit 3, a proposed power uprate for Unit 3, and the possible closure of two CREC coal-fired units. The areal extent of the influence of these facilities on water quality would be noticeable in the Gulf's nearshore marine environment, but not destabilizing to the resource. Based on its evaluation, the review team concludes that the cumulative surface-water-quality impacts would be MODERATE. The contribution of LNP Units 1 and 2 to these impacts is minor. Therefore, the incremental impacts from NRC-authorized activities would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted. While the effects on water quality from global climate change related to changes in sea level, precipitation, and temperature described above in the region may not be insignificant, the review team has not identified climate-change related effects at the local and watershed scale under the currently unknown adaptations to water-management policies that would alter the conclusions presented above.

7.2.2.2 Groundwater-Quality Impacts

The description of the affected environment in Section 2.3 serves as a baseline for the cumulative impacts assessments in this resource area. As described in Section 4.2, the impacts from NRC-authorized construction on groundwater quality would be SMALL, and no further mitigation would be warranted. As described in Section 5.2, the review team concludes that the impacts of operations on groundwater quality would also be SMALL, and no further mitigation would be warranted.

The combined groundwater-quality impacts from construction and preconstruction of the proposed LNP units are described in Section 4.2.3.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable projects that could affect groundwater quality, including the potential impacts of global climate change. For this analysis, a geographic area of interest has been identified which extends 20 mi from the LNP site. Because the extent of the zone of influence of the possible groundwater wells is less than 2 mi, this 20-mi region is sufficiently large to characterize potential cumulative groundwater-quality impacts.

The FDEP Conditions of Certification would require a cleanup of any spills that may occur at the LNP site. Therefore, any impacts on the quality of the aquifer that exists beneath the site from activities associated with construction, preconstruction and operation of the proposed units would not affect this resource regionally.

Land-use changes, agriculture, and other activities (e.g., existing mining activities at the Inglis Rock Quarry) have historically used groundwater in the region of interest. FDEP and SWFWMD have developed a proactive groundwater-management program to preserve and manage groundwater resources including groundwater quality (Fla. Admin. Code 62-520). Based on the importance of the underlying aquifer, projects are required by the FDEP to control and prevent effluent discharges to the groundwater (Fla. Admin. Code 62-520). Best management practices would be used at current and proposed mining projects to ensure that the adverse effects to groundwater quality are minimized.

Global climate change can result in a rise in sea level (GCRP 2009) that may induce saltwater intrusion in the surficial and Floridan aquifers. Projected changes in the climate for the region during the life of the proposed LNP units include an increase in average temperature and a decrease in precipitation. These changes are likely to result in changes to agriculture including crops, pests, and the associated changes in application of nutrients, pesticides, and herbicides that may reach groundwater. As a result, groundwater quality may be altered by the infiltration of chemicals. Under the geohydrologic and operational conditions present at the LNP site, operational groundwater-quality impacts would be minor.

Based on the fact that no other past, present, or reasonably foreseeable actions with significant impacts on groundwater quality were identified, the review team concludes that cumulative impacts on the quality of the groundwater resource would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted. While the changes in groundwater quality that are indirectly attributable to climate change may not be insignificant, the review team did not identify climate change related effects at the local and regional scale under the currently unknown adaptations to water-management policies that would alter its conclusion regarding groundwater quality above.

7.3 Ecology

This section addresses the cumulative impacts on terrestrial and aquatic ecological resources as a result of activities associated with the proposed LNP project and other past, present, and reasonably foreseeable future activities within the geographic area of interest for each resource.

7.3.1 Terrestrial Ecosystem Impacts

The description of the affected environment in Section 2.4.1 provides the baseline for the cumulative impacts assessments for terrestrial ecological resources, including wetlands and important species. As described in Section 4.3.1, the NRC staff concludes that impacts from NRC-authorized construction on terrestrial resources would be SMALL, and additional mitigation beyond that already proposed would not be warranted. As described in Section 5.3.1, the impacts of operations on terrestrial resources would be SMALL to MODERATE, and additional mitigation beyond that already proposed is not expected to be warranted. The conclusion in Section 5.3.1 is primarily based upon the uncertainty that exists regarding the potential effects of groundwater withdrawal on wetlands and associated biota.

The combined impacts from construction and preconstruction were described in Section 4.3.1 and determined to be MODERATE. The conclusion in Section 4.3.1 is primarily based upon the extent of impacts on wetlands, wildlife, and Federally and State-listed species. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and future actions that could affect terrestrial resources. For the cumulative analysis of terrestrial ecology, the geographic area of interest is considered to encompass the 20-mi radius around the LNP site, plus the certified corridors for the proposed transmission lines and other offsite linear features (as defined in Chapter 2). Corridors range in width from approximately 300 ft to 1 mi wide. The geographic area of interest is expected to encompass the locations of possible development projects potentially capable of substantially influencing terrestrial ecological resources on and close to the LNP project. This area generally coincides with those defined for hydrology and aquatic ecology, both of which are closely interrelated with the terrestrial ecology of this coastal setting. This area includes watersheds providing direct runoff from the LNP site to the Gulf of Mexico, as well as the lower watersheds of the Withlacoochee and Waccasassa river basins.

7.3.1.1 Wildlife and Habitats

The geographic area of interest is located primarily in the Gulf Coastal Flatwoods ecoregion, although portions of the corridors associated with the proposed transmission lines cross into the Southwest Florida Flatwoods and the Central Florida Ridges and Uplands ecoregions (EPA 2010g). Prior to European settlement, much of the geographic area of interest consisted of mature pine flatwoods interspersed with bottomland hardwood forests, cypress swamps, freshwater marshes and drier uplands. Today, most of the landscape has been altered by past actions such as forestry, farming, livestock grazing, and sparsely distributed urbanization. It remains largely rural in character, consisting of scattered small towns and large tracts of privately-owned forest and agricultural land, as well as local, State, and Federal forestland, parks, and wetlands.

Past terrestrial and wetland habitat losses in the geographic area of interest have occurred primarily from urbanization (e.g., residences, commercial development, roads, and utility development), agricultural practices (including commercial forest management), mining, construction of the CFBC, and development of the CREC. Extensive areas of habitat have already been altered for forest management, agriculture, mining, and low density residential development. Development and operation of power plants at the CREC, which began in the 1960s, have contributed cumulatively to many of the same types of impacts on terrestrial ecological resources as those associated with the proposed LNP project. The cumulative impacts resulting from CREC operation would continue for the geographic area of interest.

Cumulative Impacts

Habitat degradation in the geographic area of interest has already resulted from the conversion of natural landscapes to intensively managed forests, pastureland and other agricultural uses, rural residential development, and other developments causing fragmentation of the landscape. This cumulative loss, degradation, and fragmentation of habitat have already contributed to declines in wildlife populations and biodiversity within the area. In addition, decreased precipitation, sea-level rise, more frequent storm surges, increased intensity of coastal storms, and increased temperatures resulting from global climate change may already be contributing to wetland losses and exacerbating the ongoing trend (GCRP 2009).

The geographical area of interest, includes portions of State forests, parks, reserves, wildlife-management areas and other conservation areas. Most of the Goethe State Forest is managed for timber, wildlife, outdoor recreation and ecological restoration. Lake Rousseau contains shoreline habitats of high value to shorebirds, waterfowl, and other waterbirds. Lands acquired to construct the CFBC are now managed as the Marjorie Harris Carr Cross Florida Greenway to conserve natural resources and provide recreation. Other sensitive terrestrial ecological resources include the Waccasassa Bay Preserve State Park, Crystal River Preserve State Park, wetlands associated with the lower Withlacoochee and Waccasassa rivers, various springs (e.g., Big King Spring, Little King Spring) and other sensitive streams and habitats (see Figure 2-18). Wetlands are abundant in low-lying areas, and the proposed transmission line and other offsite corridors traverse streams, lakes, and riparian zones. This interspersion of wetlands, lakes, and protected uplands support a wide variety of wildlife and plants.

The impacts on terrestrial ecological resources from site preparation, development and operation of the proposed LNP Units 1 and 2 and associated transmission lines are described in Sections 4.3.1 and 5.3.1. As noted in Section 4.3.1.1, including Table 4-4, preconstruction and construction impacts on the LNP site would result in the permanent and temporary loss of about 777 ac of habitat.Table 4-5 indicates that preconstruction and construction activities on the LNP site would affect approximately 450 ac of wetlands. As noted in Section 4.3.1.2, including Table 4-6, about 1233 ac of additional habitat would be disturbed (temporary, permanent, clearing impacts) to build the associated transmission lines and other offsite facilities, Table 4-5 indicates that building the associated offsite facilities would affect approximately 138 ac of wetlands. PEF has committed to mitigating for the loss or impairment of functions in all wetlands affected by the LNP project (see Section 4.3.1.7).

Development of other projects, such as the proposed Tarmac King Road Limestone Mine, the proposed new helper cooling tower at CREC Unit 3, the Inglis Lock bypass channel spillway hydropower project, the completed expansion of the FGT pipeline, the completed US-19 bridge upgrade, the proposed Sun Coast Toll Road extension, as well as anticipated continued urbanization and increased outdoor recreation would cumulatively contribute to losses of wetlands and other terrestrial habitats. For example, at the proposed Tarmac King Road Limestone Mine, about 2700 ac of wetlands and uplands would be mined, with an additional 1300 ac disturbed to site a quarry processing plant, roads and other infrastructure. Total wetland impacts are estimated at 1140 ac (BRA 2010). Tarmac plans to mitigate for wetland impacts by conducting a variety of conservation measures on a 4600-ac site adjacent to the proposed mine that would be protected through a conservation easement. The construction of the new helper cooling tower at CREC Unit 3 would result in the discharge of fill within approximately 1.3 ac of wetlands. Wildlife that occupies areas near where site clearing and wetland filling activities occur could be adversely affected as a consequence of habitat loss, and competition for remaining resources. Some wildlife would perish or be displaced during land clearing. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds and larger mammals, many of which would be displaced to adjacent communities. Undisturbed lands adjacent to areas of activity, such as parks and managed areas described in Table 7-1, could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels.

Global climate change may also result in loss of additional terrestrial habitat. Sea-level rise resulting from climate change along the Gulf Coast of Florida could accelerate the loss of wetlands and estuaries, thus eliminating breeding and foraging habitat for wildlife (Ning et al. 2003; GCRP 2009). Global climate change could also cause shifts in species ranges and migratory corridors as well as changes in ecological processes (GCRP 2009).

Long linear projects that cross forested habitats; such as the proposed LNP transmission-line s, expansion of the FGT pipeline, and extension of the Sun Coast Toll Road, would also cumulatively contribute to habitat fragmentation. Habitat fragmentation is of particular concern for forested habitats, whose fragmentation decreases the amount of interior forested habitat required for certain species such as many warblers, vireos, and woodpeckers. The incremental increase in fragmentation resulting from the LNP project would be minimized by the collocation of multiple linear features exiting the southern boundary of the site using a single “common corridor." Fragmentation of terrestrial habitats would be further reduced by collocation of most of the new transmission lines with existing PEF transmission lines, and by routing of much of the blowdown pipeline across habitat already disturbed by construction of the CFBC. The clearing of new utility rights-of-way could be beneficial for some species, including those that inhabit early successional habitat or use forest edge environments, such as white-tailed deer (*Odocoileus virginianus*), bobwhite quail (*Colinus virginianus*), eastern meadowlark (*Sturnella magna*), and gopher tortoise (*Gopherus polyphemus*). Birds of prey, such as red-tailed hawks (*Buteo jamaicensis*), may exploit new hunting grounds provided by the new forest openings. Forested wetlands within the rights-of-way would be converted to, and maintained in, an herbaceous or scrub-shrub condition that could provide improved foraging habitat for waterfowl and wading birds.

Salt deposition from cooling-tower drift would occur at the LNP and would continue under normal operation of the CREC. Damage to vegetation and habitats from salt drift under current operation was documented to be minimal (see Section 5.3.1), and the requirement for salt drift monitoring was terminated by the FDEP in 1996 (PEF 2009c). Thermal mitigation for the proposed power uprate at CREC Unit 3 would involve building a new supplemental mechanical draft cooling tower at the CREC. This would increase the potential for cumulative salt-drift impact at the CREC. Based upon prior monitoring conducted at the CREC site, damage to vegetation and habitats from the anticipated increase in salt drift would be expected to be minor.

The impacts of cooling-tower drift for existing power plants were evaluated by the NRC (1996, 1999) [a] in NUREG-1437 and found to be of minor significance for nuclear power plants in general, including those with various numbers and types of cooling towers. Because the LNP project cooling towers would be about 9 mi northeast of the CREC cooling towers, no overlap is expected between their respective cooling-tower plumes. Of 18 operating nuclear power plants where the effects of cooling-tower drift on vegetation were investigated by NRC to support anticipated operating license renewals, vegetation damage attributable to the drift was observed in a maximum area of about 20 ac (NRC 1996). Areas of vegetation damage attributable to overlapping plumes of salt drift from power plants 9 mi away are therefore unlikely. The license renewal GEIS (NRC 1996) indicates that the effects of increased humidity, ground-level fogging, and icing are similarly localized and that areas of overlapping effect from sources 9 mi distant would be unlikely. No other cooling towers associated with current or proposed energy projects lie within the geographic area of interest (Table 7-1). Consequently, potential cumulative impacts from cooling-tower plumes (salt deposition, fogging, and icing) would be minimal, limited to the CREC and LNP sites, and not expected to noticeably affect terrestrial resources.

The geographic area of interest lies within a branch of the Eastern Atlantic Flyway that crosses northern and central Florida, a migration route used by neotropical migrants and other birds (FWS 2010; Birdnature.com 2009). Cooling towers, other tall structures, and nighttime lights associated with the continued and proposed operations at the CREC and the proposed LNP project may present increased risks for collision and mortality for migrating birds. However, the Avian Protection Plan that PEF is obligated to prepare as a condition of certification (FDEP 2011a) for the LNP project (see Section 4.3.1.7) would minimize incremental risk to birds. The CREC currently maintains two natural draft cooling towers, a four-bank low-profile mechanical draft cooling tower, and four tall stacks that support four coal-fired units. An additional low-profile mechanical draft “helper” cooling tower is planned at the CREC under the proposed CREC Unit 3 power uprate. The low height of the mechanical draft cooling tower at the CREC and the towers planned for the LNP site (about 56 ft above grade); however, are similar to other buildings at or proposed for the sites, and would not be expected to present a significant collision hazard for birds. Existing and future communication towers and other tall structures within the geographic area of interest could also present potential collision hazards to migrating birds. Although bird mortality resulting from disorientation and collisions with nighttime lighted

(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.

structures has been documented, it would not be expected to represent a significant source of mortality and would have a minimal effect on populations.

Wildlife would be subjected to impacts from increased noise and traffic from the new LNP plant, Tarmac mine, expansion of the Sun Coast Toll Road, completed expansion of US-19, completed expansion of the FGT pipeline, as well as ongoing regional development. As discussed in Chapter 5, noise modeling predicts no perceptible to very slight increases in noise from LNP operations at the site boundary. Except in areas immediately adjacent to major noise sources, expected noise levels would be below the 80- to 85-dBA threshold at which birds and red foxes (a surrogate for small and medium-sized mammals) are startled or frightened (Golden et al. 1980). Therefore, disturbance to wildlife from noise would be localized and should have minimal impact on overall population health. Noise from the operation of the Tarmac King Road Limestone Mine would include blasting once every week or two to loosen rock, noise associated with excavation and processing, and truck traffic in and out of the mine (Tarmac America 2010). Noise and vibrations from blasting and other operations would be required to be at or below limits imposed by the State of Florida. Noise levels would increase at the CREC with the addition of a new helper cooling tower to support the proposed CREC Unit 3 power uprate (see Table 7-1). Nevertheless, operational noise at the CREC site at levels that could substantially affect wildlife would not be expected beyond the site boundary (PEF 2007). Additional traffic on highways and roads would contribute to an incremental increase in traffic-related wildlife mortalities. It is estimated that about 500 trucks a day would leave the proposed site at the height of mining activity (Tarmac America 2010). These impacts from increased traffic would not be expected to noticeably reduce regional wildlife populations.

Operation of new transmission lines and corridors present increased risks for avian collision and electrocution beyond the risk posed by existing transmission lines. Siting new lines in or alongside existing corridors can reduce the potential for avian mortality by limiting the number of rights-of-way birds need to cross, and hence opportunities for collision. The proposed collocation of more than 90 percent of the new LNP transmission lines with existing PEF transmission-line corridors (PEF 2009c) would reduce the potential for additional avian collision and electrocution, as would the avian protection plan that PEF is obligated to prepare as a Condition of Certification by the FDEP (2011a) (see Section 4.3.1.7). No new transmission lines are proposed under the proposed operating license extension or power uprate for CREC Unit 3. Vegetation control within transmission-line corridors can have both adverse and beneficial effects on wildlife. While periodic vegetation control can result in incidental wildlife mortality, species that inhabit early successional habitat (including emergent and scrub-shrub wetlands) or use edge environments would benefit from the maintenance of these habitat conditions. These planned transmission-line operation and maintenance practices would be expected to have only minimal cumulative effects on wildlife, whether adverse or beneficial.

In the State of Florida's Conditions for the LNP Site Certification, CREC Units 1 and 2 (fossil-fuel plants) would be decommissioned assuming LNP Units 1 and 2 are licensed, constructed, and begin operation in a timely manner (FDEP 2011a). This decommissioning would be expected to provide only minimal beneficial impacts on terrestrial resources because the area on and surrounding the CREC would likely remain industrial.

7.3.1.2 Important Species

Important terrestrial species meeting the NRC criteria are identified and discussed in Sections 2.4.1.3 and 2.4.1.4. Future urban, industrial and utility development, new transmission-line corridors, and the effects of future changes in climate may potentially affect important species that occur near the LNP project primarily by decreasing or degrading the available habitat for these species. As described above, habitat loss may occur through loss of upland and wetland habitats from urban or agricultural development, quarries, sea-level rise, increasing salinity of estuarine areas, and inundation or filling of wetland habitats. Sea-level rise resulting from climate change along the Gulf Coast of Florida could accelerate the loss of wetlands and estuaries, thus eliminating breeding and foraging habitat for commercial, game, and threatened and endangered wildlife (Ning et al. 2003; GCRP 2009). Loss or alteration of habitats could affect many of the Federal and State-listed plant species that may occur near the LNP project (see Table 2-8).

Populations of a number of Federal and State-listed birds use tidal marshes and estuaries along the Florida Gulf Coast in the area near the LNP project. Examples, among others noted in Table 2-8, include Scott's seaside sparrow (*Ammodramus maritimus*), piping plover (*Charadrius melodus*), and American oystercatcher (*Haematopus palliatus*), as well as several wading bird species. Threats posed to these species include the loss or degradation of foraging habitat and the loss of breeding habitat as a result of sea level rise and increased salinity caused by climate change. Nesting habitat for the brown pelican (*Pelecanus occidentalis*) along the Florida Gulf Coast might also be altered or inundated by sea level rise due to changing climate.

Numerous other Federal and State-listed birds may occur within or adjacent to the predominantly inland areas near the LNP project (see Table 2-8). Wading birds such as the wood stork, little blue heron, and white ibis would be affected by development activities that alter or destroy wetland and marsh habitats where birds nest or forage. Examples of such development include activities associated with the LNP, the helper cooling tower at CREC Unit 3, the Tarmac King Road Limestone Mine, and increased urbanization. Activities that generate noise such as mining or operation of heavy machinery could affect or disturb rookeries where these birds breed. Removal of mature pine forest could degrade breeding and foraging habitat for red-cockaded woodpeckers, and clearing oak scrub habitats could affect Florida scrub jay.

Federal and State-listed reptiles and amphibians could be affected by projects involving land-clearing (such as development of LNP, the helper cooling tower at CREC Unit 3, the Tarmac King Road Limestone Mine, increased urbanization, etc.), habitat loss or fragmentation (such as new transmission-line corridors or expansion of US-19, Sun Coast Toll Road, or the FGT pipeline), wetland fill or degradation, and increased vehicle traffic on roads and right-of-ways. Species that may occur near the LNP site wherever suitable habitat is present include the gopher tortoise, Florida pine snake (*Pituophis melanoleucus mugitus*), sand skink (*Neoseps reynoldsi*), short-tailed snake (*Stilosoma extenuatum*), eastern indigo snake (*Drymarchon corais*) and gopher frog (*Rana capito*) (Table 2-8). The eastern indigo snake, Florida pine snake, and gopher frog are often commensal with the gopher tortoise, using the tortoise burrow systems for shelter. These species could be displaced and would likely suffer increased mortality. The American alligator (*Alligator mississippiensis*), listed as threatened under the Endangered Species Act (due to similarity of appearance to the American crocodile, *Crocodylus acutus*) is found in areas near the LNP site, but is considered to have fully recovered (52 FR 21059). Although trends and conditions, such as urbanization, industrialization, and global climate change, could affect the American alligator's habitat and local distribution, none of the identified present or future projects is expected to affect this recovered species.

Four State-listed mammals are identified from areas near the LNP site: the Florida mouse (*Podomys floridanus*), Homosassa shrew (*Sorex longirostris eionis*), Sherman's fox squirrel (*Sciurus niger shermani*), and Florida black bear (*Ursus americanus floridanus*). All could be affected by the loss or degradation of suitable habitat by development (such as development of LNP, the helper cooling tower at CREC Unit 3, the Tarmac King Road Limestone Mine, etc.). The Florida mouse is often commensal with the gopher tortoise, seeking shelter in tortoise burrow systems. The less mobile Florida mouse and Homosassa shrew would be at greater risk of incurring mortality during land clearing, while black bear and Sherman's fox squirrel would be displaced to adjacent communities. Habitat fragmentation could adversely impact Florida black bear, which require expansive tracts of forest and wetlands to persist. Persistence of such species in this area could eventually depend on proper management of the remaining large tracts of protected land.

The creation and maintenance of new utility corridors, including those for LNP transmission lines, the FGT pipeline, and expansion of US-19 and the Sun Coast Toll Road, would be beneficial for some important species that use early successional habitat or edge environments, such as white-tailed deer, bobwhite quail, gopher tortoise, and Florida burrowing owl. Local populations of game species may be temporarily affected by development activities. During land-clearing activities habitat may be lost, and game species could be displaced during clearing and grading. However, because many game species are habitat generalists, they are expected to adapt readily to changed landscape conditions. Vegetation control and other maintenance practices within transmission-line rights-of-way could be harmful to gopher tortoises if protective measures are not taken in areas occupied by this species.

New transmission-line and other utility corridors would contribute to habitat fragmentation, which could reduce habitat for species that require large unfragmented tracts of suitable habitat such as red-cockaded woodpeckers, Florida black bear and eastern indigo snakes. Building new transmission lines and corridors would also present an increased mortality risk from avian collision and electrocution for large important species such as bald eagles, Florida sandhill cranes, herons and egrets. Large structures, transmission lines and nighttime lights associated with future projects may also pose a mortality hazard for protected species that use the branch of the Eastern Atlantic Flyway that crosses northern and central Florida (FWS 2010; Birdnature.com 2009). Although these potential collision hazards generally have little effect on population levels for common bird species, impacts on less common bird species may be more substantial. Because none of the potentially affected bird species are endemic to the geographic area of interest, it is unlikely that the collision impacts would pose a risk to the overall survival of any avian species, including the less common species. The collocation of most of the new LNP transmission lines with existing PEF transmission lines, the routing of much of the LNP blowdown pipeline across habitat already disturbed by construction of the CFBC, and the collocation of multiple linear features exiting the LNP site as a single “common corridor" would minimize incremental impacts on important species from habitat fragmentation and reduce potential avian collision and electrocution hazards. The Avian Protection Plan that PEF is obligated to prepare as a Condition of Certification (FDEP 2011a) for the LNP project (see Section 4.3.1.7) would also minimize incremental risk to birds.

Several species of Federal and State-listed plants may occur near the LNP site wherever suitable habitat is present (Table 2-8). Proposed projects that involve clearing and grading could remove individuals of listed plants if suitable habitats are disturbed, especially species requiring forest habitats. However, creation of new utility corridors could provide new habitat for some listed plants favoring herbaceous and scrub instead of forest cover if vegetation-maintenance practices are adapted to benefit any populations that establish.

7.3.1.3 Summary of Cumulative Impacts on the Terrestrial Ecosystem

Cumulative impacts on terrestrial ecology resources are estimated based on the information provided by PEF and the review team’s independent evaluation. Past, present, and reasonably foreseeable future activities exist in the geographic area of interest that could affect terrestrial ecological resources in ways similar to the proposed LNP project. Development and expansion of transmission-line corridors and infrastructure to support proposed future projects would likely affect wildlife and may be detrimental to native upland and wetland habitats. Loss of wildlife habitat, increased habitat fragmentation, impacts on important species, and increased loss of wetlands and other habitats from continued development, such as new roads and pipelines, and as a consequence of climate change are unavoidable and would continue to occur. Alteration or loss of habitat, increased habitat fragmentation, and increased risk of avian collision and electrocution within a branch of the Eastern Atlantic Flyway would contribute to the cumulative impacts. Based on this analysis, the review team concludes that cumulative impacts from construction, preconstruction, and operations of the proposed LNP units and from other past, present, and reasonably foreseeable future actions on wildlife, important species and their habitats would noticeably alter, but not likely destabilize, terrestrial ecological resources in the surrounding landscape.

The review team therefore concludes that the cumulative impacts to terrestrial resources from past, present, and reasonably foreseeable future actions in the geographic area of interest would be MODERATE. This determination is based primarily upon the extent of expected wetland loss and fragmentation of wetland and upland forest habitats resulting from the LNP project and other other activities in the geographic area of interest, as well as from continued widespread manipulation of habitats for commercial forest management. The incremental impacts from NRC-authorized construction and operation activities would be SMALL to MODERATE, primarily due to the possible effects of groundwater withdrawal on nearby wetlands and associated biota. Although incremental impacts on terrestrial resources could be noticeable near the LNP project, these impacts would not be expected to broadly destabilize the overall ecology of the regional landscape.

7.3.2 Aquatic Ecosystem Impacts

The description of the affected environment in Section 2.4.2 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.3.2, the NRC staff concludes that the impacts of NRC-authorized construction activities on aquatic biota would be SMALL, and no further mitigation would be warranted. Similarly, as described in Section 5.3.2, the review team concludes that the impacts of operations on aquatic biota would be SMALL, and no further mitigation would be warranted.

The combined impacts on aquatic resources from construction and preconstruction were described in Section 4.3.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and future actions that could affect aquatic ecology. For this analysis, the geographic area of interest is the waterbodies connected to the proposed LNP site and offsite facilities, the entire CFBC, Lake Rousseau, the Inglis Lock bypass channel, the OWR, the CREC intake and discharge, and the Levy and Citrus counties offshore areas of the Gulf of Mexico. The proposed transmission-line corridors are also included in the geographic area of interest. Other nearby watersheds, such as the Waccasassa River basin, do not affect water quality or biota in the waterbodies associated with LNP activities and are therefore not considered in the cumulative impacts analysis.

Other actions in the vicinity that have present and reasonably foreseeable future potential impacts on the CFBC and Gulf of Mexico offshore of the CREC include continued operation of the existing CREC, the proposed power uprate of CREC Unit 3, current operation of the Inglis Quarry, widening of the US-19 bridge across the CFBC, a proposed hydropower project on the Inglis Lock bypass channel spillway, the proposed Tarmac King Road Limestone Mine, decommissioning of CREC Units 1 and 2, development of a Port District along the CFBC, and natural environmental stressors (e.g., short- or long-term changes in precipitation or temperature and the resulting response of the aquatic community).

Historically, the construction and operation of CREC Units 1–5 have had some impact on fisheries and aquatic resources in the Gulf of Mexico, which PEF mitigates by hatchery supplementation, and mechanical cooling of discharge (NRC 2011b). Studies to assess impingement and entrainment losses of aquatic biota at CREC were published in 1985 (Stone and Webster 1985) and a stock enhancement plan was implemented to mitigate impingement and entrainment losses. The Crystal River Mariculture Center began operation October 1991, with red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), and pink shrimp (*Farfantepenaeus duorarum*) among the primary species cultured. Other species such as pinfish (*Lagodon rhomboides*), pigfish (*Orthopristis chrysoptera*), stone crab (*Menippe mercenaria*), and blue crab (*Callinectes sapidus*) are also cultured and released in the Gulf of Mexico (PEF 2009d). Thermal impacts were also assessed in a study released in 1985, which concluded that the thermal discharges from CREC created substantial damage to seagrass beds in Crystal Bay (Stone and Webster 1985). Cooling towers and limitations on CREC operations were required as mitigation for thermal impacts associated with the CREC discharge. Subsequent monitoring of seagrass beds was conducted to assess recovery and is described in more detail in 2.4.2.1 (NRC 2011b).

Between 1999 and 2005, 8 Federally threatened loggerhead sea turtles (*Caretta caretta*), 38 Federally endangered green sea turtles (*Chelonia mydas*), 1 Federally endangered hawksbill sea turtle (*Eretmochelys imbricata*), and 92 Federally endangered Kemp's ridley sea turtles (*Lepidochelys kempii*) have been collected at CREC (Eaton et al. 2008). PEF currently has an incidental take permit from the National Marine Fisheries Service (NMFS) that allows an incidental live take of up to 75 sea turtles annually, 3 annual causal sea turtle mortalities, and a reporting requirement for non-causal related mortalities of 8 or more within a 12-month period (NMFS 2002). PEF has an ongoing program to monitor the intake canal for the presence of sea turtles, perform rescues for stranded individuals, provide rehabilitation, and release resources when possible. In 2000, NRC found no significant impact on marine turtles from the operation of CREC Unit 3 (NMFS 2002).

The current CFBC was constructed starting in 1964, but was never completed as a cross-Florida canal and was officially deauthorized in 1991 (Noll and Tegeder 2003). The western portion of the completed CFBC extends from the Gulf of Mexico to the Inglis Lock at Lake Rousseau, and is typical of a tidal canal with marine and estuarine characteristics. Currently, portions of the CFBC are managed as a protected greenbelt corridor as part of the Marjorie Harris Carr Cross Florida Greenway (Noll and Tegeder 2003).

Cumulative impacts on aquatic resources within the CFBC may also include activities or events that are distinct from the LNP site. Activities related to construction of the hydropower system on the Inglis Lock bypass channel could temporarily affect the downstream migration of fish from Lake Rousseau to the Withlacoochee River, but would not affect the CFBC or OWR. The completed US-19 bridge expansion did not include in-water construction, and impacts on the CFBC were mitigated through best management practices (BMPs) to control erosion and stormwater runoff during bridge construction. The Inglis Quarry is located on the north side of the CFBC. Drainage ditches, associated with the quarry are separated from the CFBC by a containment berm (SDI 2008). Barge traffic within the CFBC is likely to be limited to LNP module transportation, and should have minimal impact on aquatic resources as discussed in Section 4.3.2. The proposed Tarmac King Road Limestone Mine expansion may affect groundwater flux in a fashion similar to that for LNP as discussed in Section 7.2.1.2. As described in Section 4.2.1, the probable impact on overall reduction in groundwater flux due to the establishment of this mine through the region is expected to be small. The CREC Unit 3 power uprate is not expected to have any construction-related impacts except for those related to the construction of an additional mechanical draft cooling tower on the CREC site on land that has been previously disturbed. Any onsite potential construction-related impacts would be mitigated through the use of BMPs. The contribution of LNP construction-related impacts to impacts related to other nearby construction activities would be minor. Impacts from construction of LNP would be temporary and minor, largely mitigated, and mainly confined to the site. Therefore, the staff concludes that the overall contribution of LNP construction to cumulative losses of aquatic organisms in the region would be minor.

For operations, the review team considered the potential cumulative impacts on the Gulf of Mexico and CFBC related to impingement and entrainment of aquatic organisms and also thermal and chemical releases from both CREC and LNP. Water withdrawn for operation of proposed LNP Units 1 and 2 would require a net intake of 190 cfs (122 Mgd). The source of the 190 cfs, under low flow conditions, would be 50 cfs from leakage of Lake Rousseau water through the Inglis Lock and freshwater springs, emanating in the CFBC in the vicinity of the intake structure; 70 cfs from the discharge of Lake Rousseau water at the Inglis Dam that would enter the CFBC via the OWR; and an inflow of 70 cfs that would come from the Gulf of Mexico.

Currently, CREC Units 1–5 withdraw over 15 times more water from the Gulf of Mexico for operations than the required 190 cfs for LNP Units 1 and 2. The proposed CREC Unit 3 uprate would not increase station water intake flow for CREC Units 1, 2, and 3 (PEF 2007). The additional waste heat generated as a result of the CREC Unit 3 power uprate would be dissipated to the atmosphere by the additional mechanical draft cooling tower planned for construction at the CREC site.

The review team considered the potential incremental cumulative impacts of impingement and entrainment of aquatic organisms related to operation of LNP 1 and 2 along with continued operation of CREC Units 1–5. As discussed in Section 5.3.2, the proposed closed-cycle cooling system with mechanical draft cooling towers for proposed LNP Units 1 and 2 would not be expected to result in a discernable impact on populations of aquatic organisms inhabiting Crystal Bay and Withlacoochee Bay areas of the Gulf of Mexico as a result of impingement or entrainment.

The review team is aware that CREC Units 1 and 2 (fossil-fuel plants) which contribute significantly to the overall impingement and entrainment of aquatic organisms at CREC, is planned for decommissioning once LNP Units 1 and 2 begin operation (FDEP 2011a). This significant reduction in intake withdrawal volume (greater than 48 percent) at CREC would reduce the cumulative impact of impingement and entrainment related to operation of CREC on aquatic organisms in the Gulf of Mexico, and may result in a net positive impact on local fisheries. Loss of thermal effluent volume would not be expected to adversely affect populations of the West Indian manatee, because the majority of the manatee population prefers to overwinter in nearby Kings Bay (FWS 2011).

The operation of the proposed Inglis hydropower project would involve the use of bar racks to prevent debris and organisms larger than 2 in. from traveling through the turbine (Inglis 2008). Any potential impacts from the Inglis hydropower project are isolated from the impacts on the CFBC because the Inglis Lock bypass channel and Withlacoochee River are physically separated and are not directly connected to the CFBC. The construction and operation of the hydroelectric facility would have no effect on populations of aquatic organisms inhabiting the CFBC. Therefore, the Inglis hydroelectric project would have no detectable incremental cumulative impact on aquatic resources affected by the building and operation of LNP.

The review team also considered the potential cumulative impacts of thermal discharges from the combination of blowdown streams from both CREC and LNP. The operation of all five units at CREC with the uprate of CREC Unit 3, and without the LNP Units 1 and 2 discharge would result in no thermal increase with the operation of a new helper cooling tower to augment the current modular helper cooling towers during summer conditions (PEF 2007). The review team is aware that the possibility exists that CREC Units 1 and 2 (fossil-fuel plants) which contribute to the discharge flow, would be decommissioned once LNP Units 1 and 2 begin operation. The staff conducted a thermal analysis of two cases involving the discharge from CREC.

The first case evaluated the thermal discharge from all five units at CREC, the power uprate from CREC Unit 3 and the blowdown from LNP Units 1 and 2. A second analysis involved CREC Units 3 through 5, the Unit 3 power uprate, blowdown from LNP 1 and 2 and CREC Units 1 and 2 permanently shut down. The thermal analyses for these two cases are presented in Section 5.2.3.1.

The first scenario concludes that resulting changes in discharges at CREC would be minimal for thermal and chemical impacts with a slight increase in discharge plume size. The addition of the LNP Units 1 and 2 discharge would result in an increased discharge volume of 88 Mgd, and a slight increase in thermal plume temperature during winter conditions and a slight increase in salinity over current conditions during winter and summer conditions, as discussed in Section 5.3.2.1.

The second scenario, with CREC Units 1 and 2 not operating, CREC Units 3 through 5 operating, CREC Unit 3 with the power uprate, and LNP Units 1 and 2 operating, would result in a discharge plume much decreased in size when compared to the first scenario. CREC Units 1 and 2 currently contribute 919 Mgd total discharge to the Gulf of Mexico during summer operations. This accounts for greater than 45 percent of the total CREC discharge (PEF 2009e). The predicted thermal plume would decrease during both summer and winter conditions as a result from the decreased discharge plume. Salinity increases would occur under both summer and winter conditions due to increased cycles of concentration with CREC Units 1 and 2 non-operational, but are less than 1.5 psu.

Both scenarios represent a noticeable temperature and salinity change in the immediate Gulf of Mexico waters compared to the same region prior to CREC operations from a cumulative point of view (as discussed in Section 7.2.2.1). However, habitats and aquatic organisms in this area have adapted to the salinity and temperature changes so that the incremental impacts of LNP 1 and 2 discharge, CREC uprate of Unit 3, and decommissioning of CREC Units 1 and 2 would likely not be noticeable.

The review team considered the potential cumulative impacts from chemical releases, including increases in total dissolved solids in the combined CREC and LNP discharge. CREC Units 1–5 are in compliance with the Federal Water Pollution Control Act (also referred to as Clean Water Act) (33 USC 1251 et seq.) Section 316(a) (thermal discharges) impacts from cooling-water systems. Chemical releases from the existing unit(s) currently comply with the FDEP NPDES permitting requirements, and compliance with the Unit 3 uprate, and decommissioning of CREC Units 1 and 2 is expected to continue and would be monitored in the future. The FDEP will take cumulative chemical releases from the existing and proposed unit(s), as well as from other industrial sites discharging to the Gulf of Mexico into consideration before approving a NPDES permit for the proposed unit(s). Given the lack of other discharges into the immediate area of the CREC discharge, it is likely that the cumulative impacts from LNP discharge combined with the discharge from CREC Units 1 through 5 with and without operation of CREC Units 1 and 2 would be minimal.

Nutrients introduced to groundwater from natural or man-made events such as fires may affect nutrient loading in surface waters. Nutrients would be discharged to groundwater through infiltration of surface waters located as stormwater-detention ponds on the LNP site and are not expected to affect offsite waterbodies such as the Withlacoochee River or Lake Rousseau. Furthermore appropriate stewardship of the site by the applicant is expected to significantly reduce the potential for uncontrolled fires involving onsite vegetation.

Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility can present additional constraints on aquatic resources. Future activities may include shoreline development, such as the proposed Port District, for commercial, industrial, and residential waterfront development along the CFBC to the west of US-19 (Citrus County 2009), increased water needs, and increased discharge of effluents into the Gulf of Mexico or the CFBC. The review team is also aware of the potential for global climate change affecting aquatic resources. The impact of global climate change on aquatic organisms and habitat in the geographic area of interest is not precisely known. Global climate change could result in sea level rise and may cause regional increases in the frequency of severe weather, decreases in annual precipitation and increases in average temperature (GCRP 2009). Such changes in climate could alter aquatic community composition on or near the CREC site through changes in species diversity, abundance and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce aquatic habitat, but specific predictions on aquatic habitat changes in this region due to global climate change are inconclusive at this time. The level of impact resulting from these events would depend on the intensity of the perturbation and the resiliency of the aquatic communities. Aquatic ecosystem responses to these events are difficult to predict. Although trends and conditions, such as urbanization, industrialization, and global climate change, could affect aquatic species habitats, none of the identified present or future projects is expected to adversely affect aquatic species in the geographic area of interest.

Cumulative impacts on aquatic ecology resources are estimated based on the information provided by PEF and the review team's independent review. The commencement of operation of CREC induced thermal effects in Crystal Bay resulted in noticeable loss of seagrass beds, and losses to the fishery from entrainment and impingment. Impingement and entrainment mortality resulted in the requirement for mariculture activities in an effort to mitigate for the loss of aquatic organisms. The operation of CREC has had noticeable impacts on the aquatic environment within the Levy geographic region of interest. In addition, reasonably foreseeable future activities such as the decommissioning of CREC Units 1 and 2, will likely lessen the effects of CREC operations on the aquatic resources in Crystal Bay. The review team concludes that the cumulative impacts of past, present, and reasonable foreseeable future activities on the aquatic resources of Crystal Bay would be SMALL to MODERATE, primarily due to the continued operation of CREC. However, the review team concludes that the incremental contribution to this assessment of impact from the NRC-authorized activities related to construction and operation of LNP 1 and 2 would be SMALL.

7.4 Socioeconomics and Environmental Justice

The evaluation of cumulative impacts on socioeconomics and environmental justice is described in the following sections.

7.4.1 Socioeconomics

The description of the affected environment in Section 2.5 serves as a baseline for the cumulative impacts assessment in these resource areas. As described in Section 4.4, the NRC staff concluded that the socioeconomic impacts of NRC-authorized construction activities would be SMALL with exceptions discussed as follows. The NRC staff found that specific community public services were either at capacity or otherwise limited in some areas and concluded that the impacts of NRC-authorized construction activities would include MODERATE impacts on Inglis and Dunnellon police and emergency services and Levy County fire-protection services and MODERATE impacts on schools serving Inglis, Yankeetown, and Dunnellon during peak employment years. Aesthetic impacts near the LNP site would be SMALL, although localized MODERATE impacts would be felt along newly cleared transmission-line corridors. The review team anticipates SMALL impacts from NRC-authorized construction and preconstruction of the LNP on the existing road network, with the exception of the intersection of US-19 and the construction driveway where impacts would be MODERATE and intermittent.

As described in Section 5.4, the review team determined that the physical and demographic effects of plant operations would be SMALL. Economic and tax impacts would be SMALL and beneficial throughout the region, except for Levy County where property tax impacts would be LARGE and beneficial and economic impacts from salaries, sales, and expenditures would be MODERATE and beneficial. Impacts on infrastructure, transportation, and community services would be SMALL adverse except for short-term MODERATE adverse impacts on police and emergency services in Inglis and Dunnellon; fire-protection services in Levy County; and schools serving Inglis, Yankeetown, and Dunnellon. The review team determined that in the long term, once local funding has been adjusted, all of these MODERATE impacts would reduce to SMALL. Aesthetic impacts near the LNP site would be SMALL, although localized MODERATE impacts would be felt along transmission-line corridors.

The impact analyses in Chapters 4 and 5 are cumulative by nature. The combined impacts from construction and preconstruction were described in Section 4.4 and were determined to be the same as described above for NRC-authorized activities. In addition to socioeconomic impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative socioeconomic impacts. For this cumulative impacts analysis, the geographic area of interest is considered to be the region (i.e., the 50-mi radius around the LNP site). The review team determined the region includes the primary communities and three counties – Marion, Levy, and Citrus – that make up the economic impact area (EIA) that would be most affected by the proposed project.

For more than a century, the LNP site has been used for forest plantation. Most of the LNP site would be preserved in its present forested condition with forest surrounding the industrial area. The closest residential properties are located 1.6 mi northwest and 1.7 mi west-southwest of the site. There are no sensitive populations near the LNP site. The nearest recreational resources are Goethe State Forest, the Marjorie Harris Carr Cross-Florida Greenway, Inglis Island Trail, Inglis Lock Recreation Area, and the CFBC.

In 2010, approximately 2 percent of the resident population of the region lived within 10 mi of the proposed LNP site. The remaining 98 percent lived between 10 mi and 50 mi of the proposed site. The resident population within 10 mi of the proposed site is concentrated in and around the communities of Yankeetown, to the west-southwest of the proposed site; Inglis, to the southwest; and Dunnellon, to the east. Within the wider region, the resident population is concentrated around the cities of Gainesville, to the north-northeast; Crystal River, to the south; and Ocala, to the east-northeast. In the EIA, Levy County is the least populated and most rural, followed by Citrus County, which gained population and urban development following construction of the CREC. Marion County is the most populated and least rural.

Projects and plans that have contributed to existing conditions around the LNP site, in the EIA, and in the region include those listed in Table 7-2. They are a part of the baseline demography, economy, and community infrastructure discussed in Section 2.5 of this EIS. The table presents some likely effects based on the review team's understanding of similar projects and on information provided during interviews with local officials. The information in the table suggests that county comprehensive plans have had a noticeable impact on current conditions region-wide by controlling the nature of development and residential settlement. Construction of the CREC also had a noticeable impact, particularly in Citrus County where conditions now are reportedly much different from what they were before the facility was constructed (NRC 2009). As indicated, these effects are reflected in current capacities and conditions presented in Section 2.5.

Table 7-2. Contributions of Past Projects to Current Conditions

Project	Likely Contributions Present Socioeconomic Conditions
CREC	• In-migrating construction and operations workers affecting demography, employment, and associated revenues from direct and indirect jobs, as well as demand for housing and community infrastructure – noticeable and character-changing impact in Citrus County evidenced in new planned residential developments, increased school capacity over time, and interviewees' comments that Citrus County had been like Levy County before the CREC was built. • Property tax revenues enabling development of community infrastructure.
Construction of CFBC	• Typical short-term impacts of large construction project – minor effects on demography; minor beneficial effects on employment and associated revenues.
Improvements to Federal, State, and county roads	• Typical short-term impacts of medium- and large-construction projects – minor effects on demography; minor beneficial effects on employment and associated revenues. • Improved access to jobs and community infrastructure for residents and visitors – minor effect on demography; minor beneficial effects on employment and associated revenues.
Water- and/or wastewater-treatment and distribution facilities	• Enabling increased and more dense residential development – minor to noticeable effects on demography.
County comprehensive plans	• Preserving rural quality of life by design – noticeable effect on demography.

Within the region, the two reasonably foreseeable projects listed in Table 7-1 with the greatest potential to affect cumulative socioeconomic impacts would be the Tarmac King Road Limestone Mine during preconstruction and construction of LNP, and the closure of two of the four coal-fired units at CREC during operation of LNP. The other projects involve continuation of restricted development in existing parkland and open space, little or no change in current levels of employment at existing establishments, or new development consistent with controls in existing county comprehensive plans. The review team believes the effects of these projects have been included in population and demand projections in the county comprehensive plans and in other public agency planning processes.

Tarmac has applied for permits to begin construction of the King Road Limestone Mine in 2011 with operations beginning in 2013. Tarmac estimates that at the height of mining activity, about 500 trucks would leave the mine site daily and enter US-19 (Tarmac America 2010). The potential impacts from this increased traffic, coupled with traffic from the LNP site, were considered by Kimley-Horn in its traffic study for PEF and discussed by the review team in Sections 4.4 and 5.4 (Kimley-Horn 2009). The review team determined the traffic-related impacts from the King Road Limestone Mine were minor except during the highest traffic periods, such as shift changes, when road congestion would create noticeable, intermittent impacts.

Tarmac plans to mine approximately 2700 ac of wetlands and uplands over 100 years, with an additional 1300 ac disturbed to site a quarry processing plant, roads, and other infrastructure. Total wetland impacts are estimated at 1140 ac (BRA 2010). Tarmac plans to mitigate wetland impacts by conducting a variety of conservation measures on a 4500-ac site adjacent to the proposed mine that would be protected by a conservation easement. The potential aesthetic and recreational impacts from the mine would be small because of intervening vegetation and proposed wetland mitigation.

The planned construction of Tarmac mine will end around the beginning of LNP site planned preconstruction and construction activities. Tarmac will require 602 onsite construction workers and between 150 and 200 indirect jobs will also be created (McElveen 2010). The idle construction workers may be able to find work at the LNP site, thereby alleviating some negative impacts from the end of mine construction. Approximately 35 workers will be onsite annually to work during mine operations and between 200 and 300 indirect jobs will be created as a result of mine operations (McElveen 2010; Weisskoff 2010). The review team believes any direct and indirect economic effects from salaries, taxes, etc. would be negligible compared to the construction and operation impacts from the LNP. The staff believes the cumulative economic impact from the mine would not change the impact level of MODERATE and beneficial in Levy County during LNP preconstruction and construction and LARGE and beneficial during LNP operation.

The loss of operations-related jobs at CREC with the closure of two of its four coal-fired units could be mitigated by the employment of operations workers at the LNP site. Citrus County would see a loss in property tax revenue paid by PEF for the coal-fired units at CREC that would not be offset by property taxes paid by PEF for the LNP units, because these taxes would be paid to Levy County. Because Citrus County would still receive tax revenue from PEF for the remaining nuclear unit and two coal units at CREC, the review team determined that the lost revenue would be minor and not sufficient to alter Citrus County's ability to provide infrastructure and community services to its population. The review team did not identify any other physical, economic, or infrastructure impact category that would produce an impact level larger than SMALL.

The review team did not identify other projects that would significantly contribute to cumulative socioeconomic effects beyond those identified in Chapters 4 and 5. Thus, the team determined that cumulative socioeconomic effects of the LNP project and other past, present, and reasonably foreseeable projects would be SMALL throughout the region, with the following exceptions: there would be MODERATE short-term adverse effects on police, emergency service, fire-protection services, and schools in specific local communities during peak construction and preconstruction employment years. The short-term adverse effects would be expected to become SMALL once local funding has been adjusted after a few years of LNP operation. There would also be a MODERATE and intermittent impact on one transportation corridor. Levy County would see long-term LARGE beneficial property tax impacts after LNP begins operation. Citrus County would see SMALL adverse property tax impacts after two coal-fired units at CREC are closed. There would be long-term MODERATE aesthetic impacts along transmission-line corridors.

Based on the preceding conclusions and because NRC-authorized construction and operations activities represent only a portion of the analyzed activities, the NRC staff concludes that the cumulative impacts of NRC-authorized construction and operations activities would be SMALL for all impact areas and in all parts of the region, with the noted exceptions. The review team's finding of MODERATE adverse impacts during the building of LNP was based on the fact that specific community public services were either at capacity or otherwise limited. Consequently, any increase in demand for services would result in a noticeable impact. As discussed, the review team expects these impacts would reduce to SMALL during operation of LNP. The NRC staff found that the cumulative LARGE beneficial property tax impact on Levy County and the MODERATE beneficial impact on the Levy County economy would be due to NRC-authorized construction, while the cumulative SMALL adverse property tax impact on Citrus County would not be due to NRC-authorized activities.

7.4.2 Environmental Justice

The description of the affected environment in Sections 2.5 and 2.6 serves as a baseline for the cumulative impacts assessment of environmental justice impacts. The combined physical and socioeconomic impacts from construction and preconstruction and from operations are summarized in Sections 4.5.4 and 5.5.4. Adverse physical and socioeconomic impacts were determined to be SMALL for most elements throughout the region, and MODERATE in the short term for education and police, emergency, and fire-protection services in certain locations, and SMALL for all elements in the longer term, once local funding has been adjusted. As discussed in Sections 4.5 and 5.5, the review team concluded that no disproportionately high and adverse impacts on minority and low-income populations would result from NRC-authorized construction activities or from operation of LNP. Therefore, environmental justice impacts would be SMALL.

In addition to environmental justice impacts from preconstruction, construction, and operation of LNP, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative environmental justice impacts. For this cumulative analysis, the general geographic area of interest is considered to be the 50-mi region described in Section 2.5.1.

As shown in Figure 2-26, all census block groups with minority and low-income populations that meet the criteria discussed in Section 2.6 are located 10 mi or farther away from the LNP site. The closest minority populations (both aggregate and African-American) are in Citrus County between Citrus Springs and Dunnellon, approximately 10 mi from the site. The closest low-income populations, near Otter Creek in Levy County, are almost 20 mi from the site. There are concentrations of block groups with African-American populations around the communities of Otter Creek, Usher, Chiefland, and Williston in Levy County between 20 and 30 mi from the site; around Ocala in Marion County, about 30 mi from the site; around Gainesville in Alachua County, about 45 mi from the site; and in the northwest corner of Sumter County, between 20 and 30 mi from the site. (Note: These are linear distances from the LNP site center; driving distances to all communities are greater). There are concentrations of block groups with low-income populations that overlap with African-American populations around Otter Creek, Usher, and Chiefland in Levy County and around Ocala (Marion County) and Gainesville (Alachua County).

As discussed in Section 7.4.1 for socioeconomic cumulative impacts, the two reasonably foreseeable projects listed in Table 7-1 with the greatest potential to affect cumulative environmental justice impacts within the region would be the Tarmac King Road Limestone Mine during preconstruction and construction of LNP and the closure of coal-fired units at CREC during operation of LNP. The other projects involve continuation of restricted development in existing parkland and open space, little or no change in current levels of employment at existing establishments, or new development consistent with controls in existing county comprehensive plans. The review team believes the effects of these projects have been included in population and demand projections in the county comprehensive plans and in other public agency planning processes.

As explained in Section 7.4.1, the potential impacts from increased traffic associated with the new limestone mine, coupled with traffic from the LNP site, were considered in Sections 4.4 and

5.4 and, as mentioned, were considered minor except during shift changes with no disproportionately high and adverse impacts on low-income and minority populations.

After construction, the region would experience reduced direct construction employment and related indirect jobs. This reduction would be somewhat offset by the introduction of new operations workers at the new units. The planned closure of two of the four coal-fired units at CREC after the proposed two nuclear power units are operating would impose a loss in tax revenue paid by PEF to Citrus County. The review team found no evidence that these socioeconomic impacts would have a disproportionately high and adverse affect on low-income or minority populations in the region. The review team also found no evidence that impacts described in the other sections of this chapter (i.e., impacts to land use, water use and quality, ecology, historic and cultural resources, air quality, health; and impacts of waste, postulated accidents, fuel cycle transportation and decommissioning) would have a disproportionately high and adverse affect on minority or low-income populations in the region.

Based on the analysis above, the review team determined that cumulative environmental justice impacts of preconstruction, construction, and operation of LNP and other past, present, and reasonably foreseeable projects would be SMALL and that the environmental justice impacts impacts from NRC-authorized activities in combination with the other projects described in Table 7-1 would be SMALL.

7.5 Historic and Cultural Resources

The description of the affected environment in Section 2.7 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.6, impacts on cultural resources from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.6, the review team concludes that the impacts on cultural resources from operations are SMALL. Mitigation may be warranted only in the event of an unanticipated discovery during any ground-disturbing activities associated with construction or maintenance of the operating facility. These actions would be determined by PEF in consultation with the Florida State Historic Preservation Office (SHPO). PEF’s cultural resource management procedures would be followed if it encountered cultural resources during building and operation (PEF 2008b).

The combined impacts from preconstruction and construction are described in Section 4.6 and were determined to be SMALL. If preconstruction activities associated with the transmission lines result in significant alterations to the cultural resources in the transmission-line corridors, then the impact could be greater. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable projects that could affect historic and cultural resources. The geographic area of interest for this assessment of potential cumulative impacts includes the direct and indirect areas of potential effect (APEs) for cultural resources at the LNP site, which are defined in

Section 2.7, and the transmission-line corridors. The cumulative impacts assessment considers the eligibility of historical properties for listing in the National Register of Historic Places. Coordination with the SHPO and Tribal historic preservation officers provided information on cultural resources and potential impacts on cultural resources with respect to other past, present, and reasonably forseeable future actions in the geographic area of interest.

The cultural background for the LNP site is described in Section 2.7.1. Historically, several groups of American Indians lived in Florida, many of which became extinct or merged with other groups due to non-American Indian encroachment by explorers and settlers by the mid-1700s. The largest groups were the Miccosukee Tribe of Indians and the Seminole Tribe of Florida. Conflict between settlers and the Seminoles was defined by warfare and slave raids until the mid-19th century, by which time conflict and disease had contributed to the near-extinction of the Seminoles. By 1858, at the end of the third Seminole War, only 200 Seminoles remained. Nine forts were reportedly established in Levy County as part of the conflict with Native Americans in the region with the Second and Third Seminole Wars. During the Civil War, the Cedar Key port was occupied by both northern and southern troops. The town nearest to the LNP project area was first recorded as Black Dirt in 1860. Over the next 30 years, its name changed from Black Dirt to Blind Horse, then to Inglis.

Projects within the geographic area of interest that may have a potential cumulative impact on cultural resources include Tarmac King Road Limestone Mine, Goethe State Forest and future urbanization such as the expansion or creation of roads or pipelines near or intersecting the proposed transmission lines. Development in the Goethe State Forest is unlikely; however such projects could affect cultural resources if ground-disturbing activities occur or if new above-ground structures affect the visual APE. As described in Section 2.7, there are known cultural resources in the transmission-line corridors. Long linear projects such as new or expanded roads or the FGT pipeline project may intersect the proposed transmission-line corridors. Because cultural resources can likely be avoided by long linear projects, impacts on cultural resources would be minimal. If activities associated with building the transmission lines or road or pipeline expansion projects result in significant alterations (both physical alteration and visual intrusion) of cultural resources in the transmission-line corridors, then cumulative impacts on cultural resources would be greater.

Cultural resources are nonrenewable. Therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative cultural resources impact from preconstruction, construction, and operation of two units at the LNP site, and other past, present, and reasonably foreseeable projects would be SMALL.

7.6 Air Quality

The description of the affected environment in Section 2.9 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.7, the impacts of NRC-authorized construction activities on air quality impacts would be SMALL, and no further mitigation would be warranted. As described in Section 5.7, the review team concludes that the impacts of operations on air quality would be SMALL, and no further mitigation would be warranted.

7.6.1 Criteria Pollutants

The combined impacts from construction and preconstruction are described in Section 4.7 and were determined to be SMALL. In addition to the impacts from preconstruction, construction, and operations, the cumulative analysis also considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts on air quality. For this cumulative analysis of criteria pollutants, the geographic area of interest is considered to be Levy County within the West Central Florida Intrastate Air Quality Control Region (40 CFR 81.96). As set forth in 40 CFR 81.310, air quality attainment status for Levy County reflects the effects of past and present emissions from all pollutant sources in the region. Levy County is in attainment for all of the National Ambient Air Quality Standards.

The air quality impacts of site development for LNP Units 1 and 2 would be local and temporary. Generally, the distance from building activities to the site boundary would be sufficient to avoid significant air quality impacts. Permitted air emission sources at the proposed LNP site include the cooling towers. The emissions of particulate matter from the two cooling towers would exceed 100 T/yr, making these towers a major source of particulate matter. As a result, the applicant has received a prevention of significant deterioration permit from the State of Florida (PSD-FL-403) for the emissions from the cooling towers. Of the projects listed in Table 7-1, the operation of the Tarmac King Road Limestone Mine is the only project with the potential to have significant impacts on air quality. The primary pollutant from the quarry is fugitive dust emissions (Florida Air Quality Permit 0750089-001-AC), and the level of dust emission would be regulated by the State (FDEP 2008). Other industrial projects listed in Table 7-1 would have *de minimis* impacts. Given that these other projects all have institutional controls and the LNP site is influenced by coastal wind patterns, it is unlikely that there would be a degradation of air quality of Levy County.

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the GCRP, it is the "… production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use…" Approximately one-third of the greenhouse gas emissions are the result of generating electricity and heat (GCRP 2009). This assessment is focused on greenhouse gas emissions.

Greenhouse gas emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7.1, 5.10.3, 6.1.3, and Appendix I. The review team has concluded that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single nuclear plant are minimal. The review team also concluded that the impacts of the combined emissions for the full plant life cycle are minimal.

The cumulative impacts of a single source or combination of greenhouse gas emission sources must be placed in geographic context, as follows:

- The environmental impact is global rather than local or regional.
- The effect is not particularly sensitive to the location of the release point.
- The magnitude of individual greenhouse gas sources related to human activity, no matter how large compared to other sources, is small when compared to the total mass of greenhouse gases resident in the atmosphere.
- The total number and variety of greenhouse gas emission sources is extremely large and ubiquitous.

These points are illustrated in Table 7-3.

Table 7-3. Comparison of Annual Carbon Dioxide Emission Rates

Source	Metric Tons per Year
Global Emissions	28,000,000,000[(a)]
United States	6,000,000,000[(a)]
1000 MW Nuclear Power Plant (including fuel cycle, 90 percent capacity factor)	400,000[(b)]
1000 MW Nuclear Power Plant (operations only, 90 percent capacity factor)	5000[(b)]
Average U.S. Passenger Vehicle[(c)]	5

(a) EPA 2009
(b) Appendix I
(c) FHWA 2006

Assuming that LNP becomes operational in a timely manner, the coal-fired Units 1 and 2 at the CREC would be shut down by 2020 (FDEP 2011a). This action would lead to a reduction in the amount of greenhouse gas emissions associated with the operation of these two coal-fired units and emissions associated with the coal fuel cycle.

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The previously referenced GCRP (2009) report provides a synthesis of the results of numerous climate-modeling studies. The review team concludes that the cumulative impacts of greenhouse emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based on the impacts set forth in the GCRP report (GCRP 2009), the review team concludes that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable. The review team further concludes that the cumulative impacts would be noticeable with or without the greenhouse gas emissions (including the possible reduction of emissions associated with the shutdown of Units 1 and 2 at the CREC) of the proposed project.

Consequently, the review team recognizes that greenhouse gas emissions, including carbon dioxide, from individual stationary sources and cumulatively from multiple sources can contribute to climate change, and the carbon footprint is a relevant factor in evaluating energy alternatives. Section 9.2.5 contains a comparison of carbon footprints of the viable energy alternatives.

7.6.3 Summary of Air Quality Impacts

Cumulative impacts on air quality resources are estimated based on the information provided by PEF and the review team's independent evaluation. Other past, present, and reasonably foreseeable activities exist in the geographic areas of interest (local for criteria pollutants and global for greenhouse gas emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions of effluents from the LNP site and other projects would not be noticeable. With the exception of the particulate emissions from the cooling towers (which require a permit from the State of Florida), the LNP and other projects listed in Table 7-1 would have *de minimis* impacts. The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable. The review team concludes that the cumulative impacts would be noticeable with or without the greenhouse gas emissions from the LNP site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic areas of interest would be SMALL to MODERATE. The incremental contribution of impacts on air quality resources from building and operating proposed Units 1 and 2 would be SMALL. The incremental contribution of impacts on air quality resources from the NRC-authorized activities would also be SMALL.

7.7 Nonradiological Health

The description of the affected environment in Section 2.10 serves as a baseline for nonradiological health. As described in Section 4.8, the nonradiological health effects associated with building would include noise, criteria air pollutant and dust emissions from construction equipment, occupational injuries, and increased air emissions and traffic accidents associated with transporting workers and construction materials to and from the site. As discussed in Section 4.8.4, the NRC staff has concluded that the nonradiological health impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted other than that described in PEF's ER.

Nonradiological health impacts from LNP operation would include potential growth of thermophilic etiological agents in the cooling system, noise from the LNP and cooling-water intake pump, increased air emissions and traffic accidents, occupational injuries, and acute and chronic exposures to electromagnetic force (EMF) from the transmission lines. As described in Section 5.8, the nonradiological health impacts from operation of the proposed LNP Units 1 and 2 would also be SMALL and warrant no further mitigation.

The review team has concluded that the combined nonradiological health impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted other than that described in the ER (PEF 2009a). In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts on nonradiological health (Table 7-1). For most of the nonradiological health impacts of facility construction and operation (air emissions, noise, occupational injuries), cumulative effects may occur only in areas very close to the LNP site. Occupational injuries would occur only on the LNP construction site, and there would thus be no potential for cumulative impacts with other projects.

For cumulative impacts associated with transmission-line corridors, the geographic area of interest is the transmission system associated with proposed LNP Units 1 and 2 (as described in Section 2.2.2). None of the present or future projects appears likely to have cumulative impacts on acute or chronic EMF exposure in or near the transmission-line corridors.

The review team considered the cumulative impacts associated with harmful thermophilic microorganisms in nearby waterbodies. The thermal contribution of LNP blowdown to the CREC discharge from Units 1 through 5, and assuming the Unit 3 power uprate, would be minor and would not increase the incidence of illness due to thermophilic microorganisms. The review team is aware that the total heat discharge from the CREC would be reduced if the two older coal-fired plants at the CREC are decommissioned by December 31, 2020, as required by the FDEP Conditions of Certification, assuming LNP Units 1 and 2 are licensed, constructed, and begin operations in a timely manner (FDEP 2011a). The operation of the proposed Inglis Lock bypass channel spillway hydropower project would not affect water temperature. Thus, the combined impact on thermophilic etiologic agents from LNP, CREC, and the proposed Inglis Lock project would be minimal.

Impacts of criteria air pollutants and fugitive dust during building and construction and noise from construction and operation have been assessed as minimal for the nearest offsite receptors located 1.6 and 1.7 mi from the center of the project site (see Sections 4.8.1, 4.8.2, and 5.7.1). Cumulative noise and air emission impacts from all but one of the current and future projects identified in Table 7-1 were considered to be minor because of the distance separating them from the LNP site. That one project is the Tarmac King Road Limestone Mine, which is approximately 2 mi to the west of the site. The combined noise or dust emission impacts from the LNP and the mine could possibly affect residents adversely. Combined impacts would most likely occur during LNP building activities. After the LNP begins operation, noise and particulate impacts from the LNP are predicted to be minimal, and the combined noise and air emission impacts from the LNP and the Tarmac mine would be intermittent and minimal overall.

The review team is also aware of the potential climate changes that could affect human health. Information regarding the state of knowledge in this area (GCRP 2009) has been reviewed in the preparation of this EIS. Projected changes in the climate for the region during the life of proposed LNP Units 1 and 2 include an increase in average temperature and a decrease in precipitation in the area of interest accompanied by an increase in severe weather events. Potential impacts of climate change that have been identified include the following:

- reduced cooling system efficiency at the LNP (and other power-generation facilities), which would result in increased temperature of the cooling-tower discharge water and possible increased growth of thermophilic, etiological agents
- increased incidence of diseases transmitted by food, water, and insects following heavy downpours and severe storms
- increased severity of water pollution associated with sediments, fertilizers, herbicides, pesticides, and thermal pollution caused by projected heavier rainfall intensity and longer periods of drought.

Potential increases in temperature and incidence of disease are of particular concern owing to the rapid growth of elderly population in Florida that may be particularly susceptible to these effects. While the effects of future climate change identified in these studies are not insignificant, their relationship to LNP operations is not clear, and the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of waterborne diseases. While operation of the LNP might result in local increases in etiological agent growth, it is not clear that the operation of LNP would increase health risks owing to the strong controls on exposure to microbes (see Section 5.8.1).

Estimates of cumulative impacts on nonradiological health are based on information provided by PEF and the review team's independent evaluation of impacts resulting from the building and operation of the proposed LNP Units 1 and 2, along with a review of potential impacts from other past, present, and reasonably foreseeable projects located near the LNP site, CREC discharge, and the transmission-line corridor. The review team determined that the impacts from future projects that could affect nonradiological health impacts, including continued operations at CREC, the CREC Unit 3 uprate, and potential closure of two CREC coal-fired plants when the LNP Units 1 and 2 become operational, and global climate change, would be minimal. Therefore, the cumulative impacts of the LNP and other past, present and foreseeable future projects on public and worker nonradiological health would be SMALL, and mitigation beyond what is discussed in Sections 4.8 and 5.8 would not be warranted.

7.8 Radiological Impacts of Normal Operation

The description of the affected environment in Section 2.11 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.9, the NRC staff concludes that the radiological impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.9, the NRC staff concludes that the radiological impacts from operations would be SMALL, and no further mitigation would be warranted.

The combined impacts from construction and preconstruction are described in Section 4.9 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For the purposes of this analysis, the geographic area of interest is the area within the 50-mi radius of the LNP site. Historically, the NRC has used the 50-mi radius as a standard bounding the geographic area to evaluate population doses from routine releases from nuclear power plants. The geographic area of interest includes CREC Unit 3. Also within the 50-mi radius of the site, there are likely to be hospitals and industrial facilities that use radioactive materials.

As stated in Section 2.11, PEF has conducted a radiological environmental monitoring program (REMP) around CREC-3 since 1977. The program measures radiation and radioactive materials from all sources, including existing CREC Unit 3, hospitals, and industrial facilities. The staff review of the REMP reports found no indication of radiological consequence associated with the operation of CREC Unit 3.

As described in Section 4.9, the estimate of dose to construction workers during the building of proposed LNP Units 1 and 2 is well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. The estimate of doses to construction workers building proposed LNP Unit 2 includes Unit 1 as a source of exposure. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of two new units at the LNP site are well below regulatory limits and standards. In addition, the dose to the maximally exposed individual from the LNP site and CREC Unit 3 (including any increased doses from the planned 20 percent power uprate) would be well within the regulatory standard of 40 CFR Part 190. Also, based on results of the CREC Unit 3 REMP and estimates of doses to biota given in Section 5.9, the NRC staff concludes that the cumulative radiological impact on biota would not be significant. The results of the REMP indicate that effluents and direct radiation from area hospitals and industrial facilities that use radioactive materials do not contribute measurably to the cumulative dose.

Currently, there are no other new nuclear facilities planned within 50 mi of the LNP site. If this changes, the NRC, the U.S. Department of Energy, and the State of Florida would regulate or control proposed LNP Units 1 and 2 and any other reasonably foreseeable future actions in the region that could contribute to cumulative radiological impacts. Therefore, the NRC staff concludes that the cumulative radiological impacts of operating the proposed LNP Units 1 and 2, along with the existing CREC Unit 3 and the influence of other man-made sources of radiation nearby, would be SMALL, and mitigation would not be warranted.

7.9 Nonradiological Waste

Cumulative impacts on water and air from nonradiological waste are discussed in Sections 7.2 and 7.6, respectively. The cumulative impacts of nonradioactive waste destined for land-based treatment and disposal are primarily related to the available capacity of area treatment and disposal facilities and the amount of waste generated by the proposed project and other reasonably foreseeable projects.

During construction, offsite land-based waste treatment and disposal would be minimized by production and delivery of modular plant units, by segregation of recyclable materials, and by management of vegetative waste on site. Building activities would generate small quantities of construction debris, and the construction workforce would produce small quantities of municipal solid waste (MSW). Most of the projects listed in Table 7-1 would generally either not coincide with the construction of the proposed LNP project (e.g., CREC Unit 3 uprate and potential closure of two CREC fossil fuel units) or would produce waste streams of a different nature (e.g., mining and park projects).

During operation, PEF estimates that the LNP would generate an average of 1617 T of nonradioactive, nonhazardous, solid waste annually, equivalent to less than 0.3 percent of the 573,000 T of MSW managed in Levy, Citrus, and Marion counties in 2008 (FDEP 2009). As of 2006, Florida had 50 MSW landfills and 11 waste-to-energy plants, with additional landfill capacity being added (Biocycle 2008). Therefore, such impacts would be minimal.

PEF anticipates that LNP would be classified as a conditionally exempt small-quantity generator (CESQG) or a small-quantity generator (SQG) under the Resource Conservation and Recovery Act of 1976, as amended (RCRA) (42 USC 6901 et seq.). CESQGs and SQGs combined generate only 7 percent of the hazardous waste produced in Florida. No known capacity constraints exist for the treatment or disposal of hazardous wastes either within Florida or for the nation (FDEP 2007).

Of the projects listed in Table 7-1, only the renewal and uprate of CREC Unit 3 and the hospitals and industrial facilities that use radioactive material have the potential to generate mixed waste. None of the considered projects are expected to generate mixed waste in significant quantities above current rates, and therefore cumulative impacts would be minimal.

Based on the quantity of nonradioactive and mixed waste projected during LNP operation and the available treatment and disposal capacity, the review team concludes that cumulative impacts of nonradioactive and mixed waste would be SMALL, and additional mitigation would not be warranted.

7.10 Postulated Accidents

As described in Section 5.11.4, the staff concludes that the potential environmental impacts (risk) from a postulated accident from the operation of proposed LNP Units 1 and 2 would be SMALL. Section 5.11 considers both design-basis accidents (DBAs) and severe accidents.

As described in Section 5.11.1, the staff concludes that the environmental consequences of DBAs at the LNP site would be SMALL for an AP1000 reactor. DBAs are addressed specifically to demonstrate that a reactor design is sufficiently robust to meet NRC safety criteria. The consequences of DBAs are bounded by the consequences of severe accidents.

As described in Section 5.11.2, the NRC staff concludes that the severe-accident probability-weighted consequences (i.e., risks) of an AP1000 reactor at the LNP site are SMALL compared to risks to which the population is generally exposed, and no further mitigation would be warranted. The cumulative analysis considers risk from potential severe accidents at all other existing and proposed nuclear power plants that have the potential to increase risks at any location within 50 mi of the proposed LNP Units 1 and 2. The 50-mi radius was selected to cover any potential risk overlaps from two or more nuclear plants. The only existing reactor within the geographic area of interest is CREC Unit 3.

Tables 5-17 and 5-19 in Section 5.11.2 provide comparisons of estimated risk for the proposed AP1000 units at the LNP site and current-generation reactors. The estimated population dose risk for the proposed AP1000 units at the LNP site is well below the mean and median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For the existing plant within the geographic area of interest, namely CREC Unit 3, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR 51, Appendix B, Table B-1). If the NRC approves the requested 20 percent power uprate at CREC Unit 3, that approval will be based, in part, on the NRC staff's determination that the risk implications of the planned 20 percent power uprate are acceptable. Therefore, the impact would continue to be SMALL. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the LNP likely would be SMALL, and no further mitigation would be warranted.

7.11 Fuel Cycle, Transportation, and Decommissioning

The cumulative impacts related to the fuel cycle, radiological and nonradiological aspects of transportation, and facility decommissioning for the proposed site are described below.

7.11.1 Fuel Cycle

As described in Section 6.1, the NRC staff concludes that the impacts of the fuel cycle due to operation of proposed LNP Units 1 and 2 would be SMALL. Fuel-cycle impacts would occur not only at the LNP site, but would also be scattered among other locations in the United States or, in the case of foreign-purchased uranium, in other countries.

In addition to fuel-cycle impacts from proposed LNP Units 1 and 2, this cumulative analysis considers fuel-cycle impacts from the existing CREC Unit 3, including the planned extended power uprate of 20 percent. There are no other nuclear power plants within 50 mi of the LNP site. The fuel-cycle impacts of CREC Unit 3 would be less than that of LNP Units 1 and 2. In accordance with 10 CFR 51.51(a), the NRC staff concludes that impacts would be acceptable for the 1000-MW(e) reference reactor. As discussed in Section 6.1, advances in reactors since the development of Table S–3 in 10 CFR 51.51 would reduce environmental impacts relative to 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. In Section 6.1, the NRC staff multiplied the values in Table S–3 by a factor of 2.6, to scale the impacts up from the 1000-MW(e) light-water reactor model to address the fuel cycle impacts of LNP Units 1 and 2. Adding the fuel-cycle impacts from CREC Unit 3 would increase the scaling to no more than a factor of four. Therefore, the NRC staff considers the cumulative fuel-cycle impacts related to LNP Units 1 and 2 to be SMALL, and no further mitigation would be warranted.

7.11.2 Transportation

The description of the affected environment in Section 2.5.2.3 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Sections 4.8.3 and 5.8.6, the review team concludes that impacts of transporting personnel and nonradiological materials to and from the LNP site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the LNP site.

Nonradiological transportation impacts are related to the additional traffic on the regional and local highway networks leading to and from the LNP site. Additional traffic would result from shipments of construction materials and movements of construction personnel to and from the site. The additional traffic increases the risk of traffic accidents, injuries, and fatalities. A review of the projects listed in Table 7-1 indicates that other projects in the region could potentially increase nonradiological impacts. The most significant cumulative nonradiological impacts in the vicinity of the LNP site would result from major construction projects, including the decommissioning of the fossil-fuel units at the CREC, the Inglis Lock bypass channel spillway hydropower project, nearby mining projects, and highway improvement projects.

The FDEP Conditions of Certification state that PEF will retire its two oldest coal-fired units, which came online at CREC in the 1960s, after operation of LNP Units 1 and 2 commences (FDEP 2011a). Because decommissioning of the fossil-fuel units is contingent upon completion of the first fuel cycle at LNP Unit 2, it is unlikely that interactions would occur between construction traffic at the LNP site and traffic from decommissioning activities at the CREC. The Tarmac King Road Limestone Mine likely would begin operations before construction at the LNP site. The Florida Department of Transportation has already widened the US-19 bridge and the Florida Gas Transmission Company recently placed into service its liquefied natural-gas pipeline collocated with the existing pipeline in the vicinity of the Crystal River site (Panhandle Energy 2011). Therefore, these projects would not overlap with LNP construction.

The operating facilities with potential for cumulative nonradiological impacts include the CREC with the two remaining fossil-fuel units and the Crystal River Nuclear Power Plant, the Inglis Rock Quarry, the Crystal River Mariculture Center, and other aquaculture facilities. Traffic flow to and from operating facilities in the region would be of lesser importance because fewer workers and material shipments are needed to support operating facilities than major construction projects.

The Goethe State Forest and numerous parks, forests, reserves, and recreational areas are within 50 mi of the LNP site. Development is likely limited in these areas and potential park improvements generally are of smaller scope and have lower resource and personnel requirements than construction at a new nuclear power plant. Therefore, park improvements are not likely to result in a measurable cumulative impact.

In Sections 4.8.3 and 5.8.6, the review team concluded that the impacts of transporting construction material and construction and operations personnel to and from the LNP site would be a small fraction of the existing nonradiological impacts in Levy County, Florida. Based on the magnitude of nuclear power plant construction relative to the other construction activities already listed and the potential closure of the two fossil-fuel units at the CREC, which would result in less employee traffic and fewer coal deliveries, the review team concludes the cumulative nonradiological transportation impacts of constructing and operating the proposed new reactors at the LNP site and other past, present and reasonably forseeable future impacts would be minimal, and no further mitigation would be warranted.

As described in Section 6.2, the NRC staff concludes that impacts of transporting unirradiated fuel to the LNP site and irradiated fuel and radioactive waste from the LNP site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the LNP site.

Historically, the radiological impacts on the public and environment associated with transportation of radioactive materials in the 50-mi region surrounding the LNP site have been associated with shipments of fuel and waste to and from the existing CREC Unit 3 located about 9 mi from the LNP site. Radiological impacts of transporting radioactive materials would occur along the routes leading to and from the LNP site and CREC Unit 3, and fuel fabrication facilities and waste disposal sites located in other parts of the United States. No other major activities with the potential for cumulative radiological impacts were identified in the geographic area of interest. Based on Table S-4 in 10 CFR 51.52, the impacts of transporting unirradiated fuel to CREC Unit 3 and irradiated fuel and radioactive waste from CREC Unit 3 would be minimal. When combined with the impacts of transporting unirradiated fuel to the LNP site and irradiated fuel and radioactive waste from the LNP site, the cumulative impacts of transporting unirradiated fuel to the LNP site and CREC Unit 3 and irradiated fuel and radioactive waste from the LNP site and CREC Unit 3 would also be minimal. The past, present, and reasonably foreseeable impacts in the region surrounding the LNP site are also a small fraction of the impacts from natural background radiation.

Advances in reactor technology and operations since the development of Table S-4 would reduce environmental impacts relative to the values in Table S-4; therefore, the values in Table S-4 remain bounding. For example, improvements in fuel management have been adopted by nuclear power plants to achieve higher performance and reduce fuel requirements. This leads to fewer unirradiated fuel and spent fuel shipments than the 1000-MW(e) reference reactor discussed in 10 CFR 51.52. In addition, advances in shipping cask designs to increase their capabilities would result in fewer shipments of spent fuel to offsite storage or disposal facilities. This would reduce the cumulative impacts of transporting unirradiated fuel to the LNP site and CREC Unit 3 and irradiated fuel and radioactive waste from the LNP site and CREC Unit 3.

Therefore, the NRC staff considers the cumulative radiological and nonradiological transportation impacts of operating the proposed new reactors at the LNP site to be SMALL, and no further mitigation would be warranted.

7.11.3 Decommissioning

As discussed in Section 6.3, the environmental impacts from decommissioning the proposed LNP Units 1 and 2 are expected to be SMALL because the licensee would have to comply with decommissioning regulatory requirements.

In this cumulative analysis, the geographic area of interest is within a 50-mi radius of the LNP site. In addition to proposed Units 1 and 2, the only other nuclear power plant within this geographic area of interest is the existing CREC Unit 3. The impacts of decommissioning nuclear power plants are bounded by the assessment in Supplement 1 to NUREG-0586, *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities.* In that document, 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). In addition, the NRC staff concluded that the impact of greenhouse gas emissions on air quality during decommissioning would be SMALL. Therefore, the cumulative impacts of decommissioning the LNP site and CREC Unit 3 would be SMALL, and further mitigation would not be warranted.

7.12 Staff Conclusions and Recommendations

The review team considered the potential cumulative impacts resulting from construction, preconstruction, and operation of two nuclear units at the Levy County site together with other past, present, and reasonably foreseeable future actions. The specific resources that could be affected by the incremental effects of the proposed action when considered with other actions listed in Table 7-1 in the same geographic area were assessed. This assessment included the impacts of construction and operation for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts of past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed action.

Table 7-4 summarizes the cumulative impacts by resource area. The cumulative impacts for the majority of resource areas would be SMALL, although there could be MODERATE or LARGE impacts for some resources as discussed below.

MODERATE cumulative impacts on land use in the geographic area of interest would result from new transmission lines constructed to connect LNP Units 1 and 2 to the grid and the Tarmac King Road Limestone Mine, in combination with construction, preconstruction and operation of the LNP Units 1 and 2. The incremental impact from NRC-authorized activities on land use would be SMALL because the affects to land use from constructing and operating Units 1 and 2 would be minimal. Cumulative impacts to surface-water quality would be

MODERATE, primarily due to the combined discharges from the operation of CREC Units 1-5, the proposed uprate at Unit 3, and operations at LNP. The incremental impacts from NRC-authorized activities at LNP would be SMALL.

Table 7-4. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Units 1 and 2

Resource Category	Impact level
Land Use	MODERATE
Water-Related	
Water Use – Surface Water	SMALL
Water Use – Groundwater	SMALL
Water Quality – Surface Water	MODERATE
Water Quality – Groundwater	SMALL
Ecology	
Terrestrial Ecosystems	MODERATE
Aquatic Ecosystems	SMALL to MODERATE
Socioeconomic	
Physical Impacts	SMALL
Demography	SMALL
Taxes	SMALL (adverse in Citrus County) to LARGE (beneficial in Levy County)
Economy	SMALL (beneficial)
Housing	SMALL
Transportation	SMALL to MODERATE
Public Services and Education	SMALL to MODERATE
Aesthetics	MODERATE
Recreation	SMALL
Environmental Justice	SMALL
Historic and Cultural Resources	SMALL
Air Quality	SMALL to MODERATE
Nonradiological Health	SMALL
Radiological Health	SMALL
Nonradiological Waste	SMALL
Postulated Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

Cumulative impacts on terrestrial ecological resources would be MODERATE as a result of increased habitat fragmentation, impacts on important species, and loss of wetlands. The incremental impact from NRC-authorized activities would be SMALL to MODERATE, primarily due to the possible effects of groundwater withdrawal on wetlands and associated biota. Although incremental impacts on terrestrial resources could be noticeable near the LNP project, these impacts would not be expected to destabilize the overall ecology of the regional landscape. Cumulative impacts on aquatic ecological resources would be SMALL to MODERATE based on past operation activities of CREC that resulted in noticeable effects on aquatic resources from impingement, entrainment, and thermal discharge. The incremental impact from NRC-authorized activities related to construction and operation of LNP 1 and 2 would be SMALL.

For socioeconomics, the construction of the NRC-authorized increment would result in MODERATE short-term adverse effects on police, emergency service, fire protection, and schools in specific local communities during peak construction and preconstruction employment years. These effects would be expected to become SMALL once local funding has been adjusted after a few years of LNP operation. Cumulative impacts on taxes and economy would be MODERATE to LARGE and beneficial. In Levy County, the cumulative impacts would be LARGE and beneficial once both Units 1 and 2 are operational. MODERATE adverse impacts to local aesthetics would occur along new transmission-line corridors. MODERATE adverse transportation impacts could also occur during periods in which peak operations of the Tarmac King Road Limestone Mine coincide with shift changes at LNP.

For air quality, the cumulative impacts would be SMALL to MODERATE primarily due to national and worldwide impacts of greenhouse gases emissions. The incremental impacts from NRC-authorized activities would be SMALL because such impacts would be minimal.

7.13 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.”

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

Chapter 8 of the U.S. Nuclear Regulatory Commission's (NRC's) NUREG-1555, *Environmental Standard Review Plan* (ESRP) (NRC 2000) guides the NRC staff's review and analysis of the need for power for a proposed nuclear power plant. The guidance states the following:

> Affected states or regions continue to prepare need-for-power evaluations for proposed energy facilities. The NRC will review the evaluation for the proposed facility and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. If the State's or region's need-for-power evaluation is found acceptable, no additional independent review by NRC is needed, and the State's analysis can be the basis for ESRPs 8.2 through 8.4 (NRC 2000).

In a 2003 response to a petition for rulemaking (68 FR 55905), the NRC concluded that "…need for power must be addressed in connection with new power plant construction so that the NRC may weigh the likely benefits (e.g., electrical power) against the environmental impacts of constructing and operating a nuclear power reactor." The NRC also stated in its response to the petition discussed above that (1) the NRC does not supplant the States, which have traditionally been responsible for assessing the need for power-generating facilities, their economic feasibility, and regulating rates and services; and (2) the NRC has acknowledged the primacy of State regulatory decisions regarding future energy options (68 FR 55905). Consequently, the review team's role with regard to a need-for-power review is to identify whether an independently derived needs determination meets the four acceptability criteria, and, if it does, report that independently derived determination's conclusions. No independent assessment of the relevant service area's need for power is necessary or within the scope of the review team's National Environmental Policy Act of 1969, as amended, requirements.

The purpose and need for the Levy Nuclear Plant (LNP) project identified in Chapter 1 is to generate 2200-megawatt electric (MW(e)) baseload power to meet the need for power within Progress Energy Florida, Inc.'s (PEF's) service territory. In 2008, the State of Florida, through its Public Service Commission (FPSC), concluded that by 2016, PEF would need at least as much additional generating capacity as would be available from the proposed LNP Units 1 and 2 to meet its customer's demand and its own reserve margin requirements (FPSC 2008).

After the draft environmental impact statement (EIS) was issued, the review team reviewed the bases for its conclusions regarding the need for power in the PEF service area, including revised population and economic forecasts and new information provided by the applicant regarding planned in-service dates for LNP Units 1 and 2. The review team did not identify any new and significant information that would alter the conclusion reached in the draft EIS. The following sections discuss the need for power in the context of FPSC's determination.

8.1 Description of the Power System

In Florida, investor-owned utilities such as PEF are regulated by a public service commission and serve a well-defined service territory. The State of Florida, through the FPSC, regulates PEF rates, electric service and grid reliability, and the planning and implementation of generation and transmission resources to serve loads within the PEF service territory. In the case of the proposed LNP, PEF obtained a "Determination of Need" from the FPSC, based on Final Order PSC-08-0518-FOF-EI and dated August 12, 2008 (FPSC 2008). In its decision, FPSC provides its full reasoning, based on PEF's petition and FPSC's own analysis, for making its determination. For the purposes of this EIS, the NRC staff identified FPSC's determination of need as an independently derived needs determination that was (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. Therefore, the review team relied upon that FPSC Determination of Need for the remainder of this section of the EIS.

The remainder of this section characterizes the institutional and physical characteristics of the PEF system, and the review team's basis for relying on FPSC's determination of need. Section 8.1.1 reviews the current power system, including geographic considerations, and regional characteristics. Section 8.1.2 provides an assessment of the FPSC's analytical processes in the context of the Agency's four acceptability criteria. It discusses the specific criteria FPSC used to make its determination. Section 8.2 discusses some of the key factors affecting the demand for electricity and provides a table from the PEF Environmental Report (ER) (PEF 2009a) showing the PEF/FPSC analysis of future demand. Section 8.3 describes the PEF/FPSC assessment of the supply of electricity, projected out to 2017 along with a table from the ER showing the PEF/FPSC analysis of the future supply of electricity. Section 8.4 reports the FPSC's conclusions regarding the determination of the need for power as proposed by the applicant and verified by the FPSC evaluation.

8.1.1 Description of the PEF System

PEF is a wholly-owned subsidiary of Progress Energy, an investor-owned diversified energy company operating power generating 21,000 MW of electrical generating capacity at 32 locations in Florida, North Carolina, and South Carolina. PEF's electrical generating technologies and fuel sources include hydroelectric, nuclear, coal, oil, and natural gas. PEF serves an area of about 20,000 mi^2 in 35 of 67 Florida counties, including the cities of Orlando, St. Petersburg, and Clearwater (see Figure 8-1 for a map of PEF's service area counties). The Region of Influence (ROI) for the proposed action is this 35 county area.

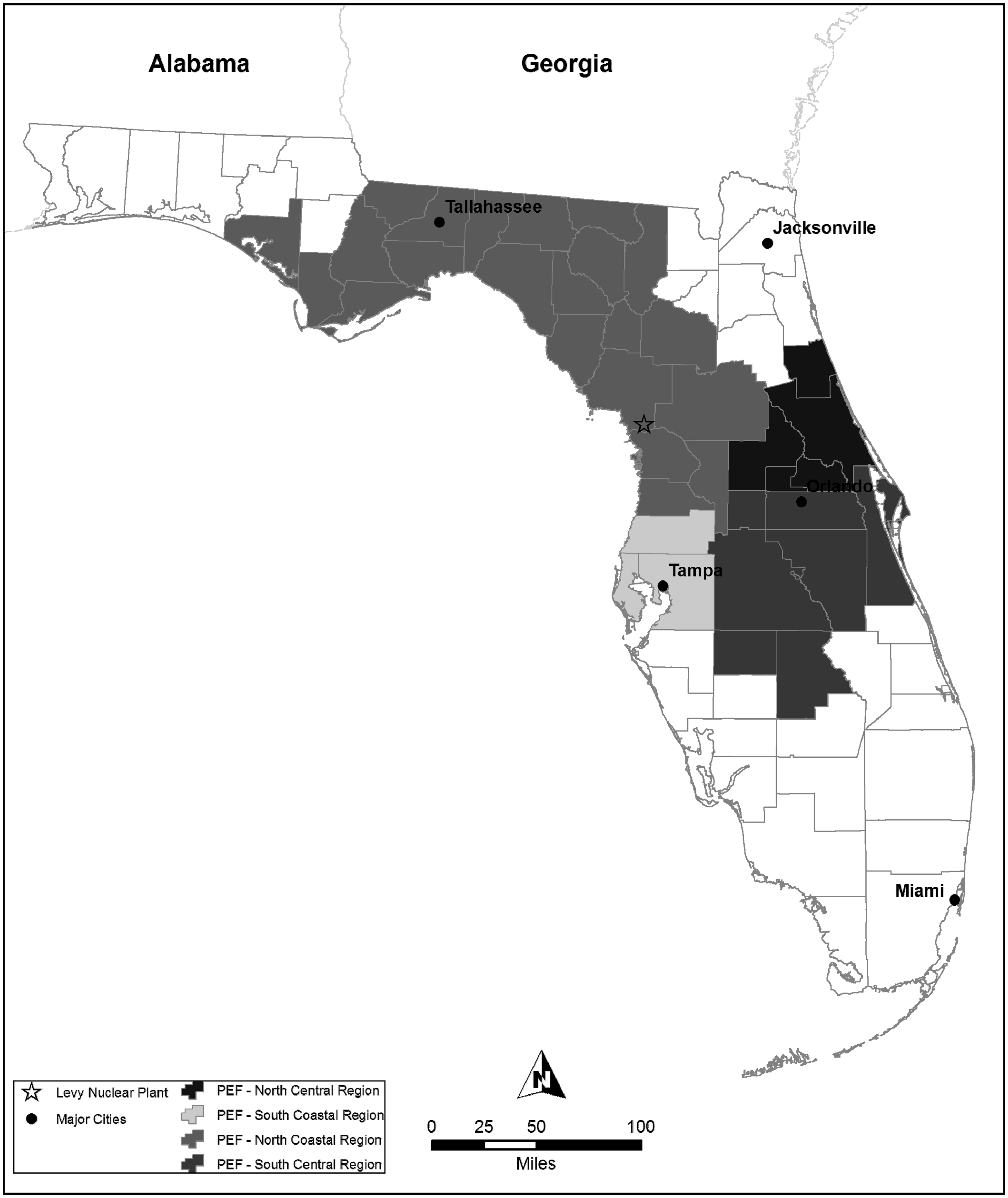

Figure 8-1. The PEF Service Territory (PEF 2009b)

The ROI is within the Florida Reliability Coordinating Council (FRCC), an administrative sub-region of the North American Electricity Reliability Corporation (NERC). The FRCC includes investor-owned utilities, cooperative utilities, municipal utilities, Federal power agencies, power marketers and independent power producers and was created to ensure the reliability and adequacy of current and future bulk electricity supply in Florida and the U.S. The entire FRCC region is within the Eastern Interconnection.

PEF is part of an interconnected power network that enables power exchange between utilities. The PEF transmission system includes 5000 mi of transmission lines in Florida, including about 18,000 mi of overhead distribution conductors and 13,000 mi of underground cable (PEF 2009a). As of December 31, 2008, PEF had total summer capacity resources of approximately 11,197 MW, consisting of installed capacity of 9289 MW (excluding Crystal River Unit 3 joint ownership) and 1908 MW of firm purchased power (PEF 2009b). PEF provided electricity service to over 1.6 million customers in Florida in 2006, including retail sales to about 350 communities and wholesale sales to about 21 Florida municipalities, utilities, and power agencies (PEF 2009b). Table 8-1 illustrates recent trends in electricity sales by customer class based on the 2009 Databook (PEF 2009c). Although total sales have been relatively stable over the recent past, sales to the wholesale market have increased in share by 50 percent in this period, presenting kilowatt-hour sales growth of greater than 56 percent. In the ER (PEF 2009a), PEF explained that it relies on two measures of reliability in its resource planning. First, a deterministic measure known as "reserve margin" is used to reflect PEF's ability to meet its forecasted seasonal peak load with firm capacity. The reserve margin is the percentage of a utility's total available capacity that must be available for service (firm), over and above the system peak load, as insurance against forced outages and other planned or unplanned events that could cause outages. PEF uses a 20 percent minimum reserve margin criterion in its resource-supply planning.

Table 8-1. Shares of Electricity Sales by PEF Customer Class

Customer Class	2003	2004	2005	2006	2007	2008
Residential[(a)]	45.7	44.3	44.8	45.8	44.0	42.8
Commercial[(a)]	27.2	26.9	26.9	27.4	26.9	26.9
Industrial[(a)]	9.4	9.3	9.3	9.5	8.4	8.4
Other[(a)]	7.0	7.0	7.2	7.5	7.4	7.3
Wholesale[(a)]	10.2	11.7	12.3	10.4	13.1	15.0
Unbilled[(a)]	0.5	0.8	−0.5	−0.5	0.2	−0.3
Total (millions of kWh)	42,512	43,653	44,436	43,731	45,300	45,190

Source: PEF 2009c
(a) Percent of PEF customer class

PEF uses another measure of reliability termed “loss of load probability” that reflects the probability that a company will be unable to meet its load throughout the year (PEF 2009b). This measure is a utility industry standard reflecting the maximum of 1 day in 10 years loss of load probability. PEF finds that the reserve margin criterion is triggered before the loss of load probability criterion in its resource planning methodology.

8.1.2 Evaluation of the FPSC Analytical Process

In accordance with NUREG-1555 (NRC 2000), the review team found that the analytical process and need-for-power evaluation performed by the FPSC met the four NRC criteria for being (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. The following details how the four NRC criteria were met.

8.1.2.1 Systematic

The review team found that FPSC used a systematic process for determining the need for the LNP project. Regulatory provisions in Florida state that on an annual basis PEF must provide the most up-to-date forecast and expected resource portfolio, respective of all known current conditions. PEF accomplishes this through an iterative process for load forecasting, which is updated and reviewed annually as directed by the State through the FPSC. Load forecasts use utility industry best practices and methodological approaches to determine the utility’s need for power and the most cost-effective strategies to meet its regulatory obligations. In its Determination of Need proceedings, the FPSC staff and other witnesses indicated that PEF’s forecasts were reasonable for planning purposes and that PEF had provided a reliable and appropriate basis for assessing the need for LNP Units 1 and 2. The FPSC opinion is stated below:

> FPSC “reviewed PEF’s forecast assumptions, regression models, and the projected system peak demands and find that they are appropriate for use in this docket. The forecast assumptions were drawn from independent sources, which we have relied upon in prior cases. The regression models used to calculate the projected peak demand conform to accepted economic and statistical practices. Finally, although slower customer growth could reduce peak demand, the projected peak demands produced by the models used by PEF appear to be a reasonable extension of historical trends.” (FPSC 2008)

Therefore, the regulatory provisions in combination with FPSC’s determination of need proceedings demonstrate to the review team that a systematic process was applied for determining the need for the LNP project.

8.1.2.2 Comprehensive

The review team finds that FPSC's analysis of issues affecting the need for power in the PEF service territory is comprehensive. The factors analyzed by FPSC include electric system reliability, the need for baseload capacity specifically, the bases for forecasts and cost assumptions and whether viable alternatives exist. PEF's peak demand and energy forecasts incorporate key influencing factors, such as economic and demographic trends, weather, and implemented load-reduction programs such as new energy-efficiency and Demand-Side Management (DSM) programs. Forecasts included each sector of the economy, and separate forecasts were developed to determine both short- and long-term demand. Power-supply forecasts included a comprehensive evaluation of present and planned generating capabilities as well as present and planned power purchases and sales in the service territory. PEF identified all existing generators by fuel type, planned expansions, new construction, and potential closure over the relevant time period, all of which FPSC found reasonable. All analyses are performed with forecasting and statistical modeling and methodological approaches appropriate for the power industry.

8.1.2.3 Subject to Confirmation

The NRC staff found that the process, models, and estimations used in the FPSC Determination of Need are subjected to a rigorous confirmation process by expert witnesses and the general public. These proceedings and relevant findings are all documented in the Final Order issued by the FPSC (FPSC 2008). The FPSC performed an independent analysis of the PEF assertions made in its application and affirmed the forecasting methods and results. The NRC staff reviewed the FPSC conclusions and did not identify any areas where PEF or FPSC remained unconfirmed or contradictory. Also, the NRC staff did not find conflicting conclusions from other independent sources, such as NERC's long-term reliability assessment.

The FPSC review process also takes into account the need for a reliable power system, fuel diversity, dependable supply of electricity, baseload power-generating capacity, adequate electricity at reasonable cost, and if the project is the most cost-effective option (FPSC 2008). These factors are outside the authority of the NRC review, but demonstrate the standards of the FPSC Determination of Need review process.

8.1.2.4 Responsive to Forecasting Uncertainty

The review team also finds that the FPSC Determination of Need was based upon a forecasting methodology that incorporated uncertainty by the use of alternative scenario analysis and probabilistic modeling of the electrical system, which are standard industry practices. FPSC relied upon PEF analyses that tested the validity of its overall forecast by analyzing the impact of alternative load forecasts (high, medium, and low). In addition, FPSC quantified uncertainty in the load forecast by evaluating the resource portfolios against variations in future sensitivities, such as fuel and construction costs, load forecasts, environmental laws and regulations, and risk. For example, PEF introduced the potential impact of climate legislation and customer-owned generation, such as photovoltaic systems in manufactured homes, on the project. Also, PEF discussed the potential impact of a reduced demand forecast from poor economic conditions. FPSC deemed these considerations reasonable in their analysis. In doing so, PEF developed resource portfolios that quantify the long-term cost to customers under varying potential sensitivities while understanding the fundamental strengths and weaknesses of various resource configurations.

8.2 Determination of Demand

PEF performs demand forecasts in order to provide continuous service to its regulated service area, meet its contractual commitments to wholesale customers, and to contribute to the reliability of the FRCC region. Forecasts are based on expected growth population and other economic factors. These analyses are contained in PEF's annual Integrated Resource Plan (IRP) and became the basis for PEF's petition to the State of Florida for a Determination of Need for the proposed project. This process is governed by Section 403.519 of the Florida Statutes and by Rule 25-22.080 of Florida Administrative Code. The FPSC reviewed PEF's petition for a Determination of Need, which was submitted on March 11, 2008; and the resulting Final Order granting the petition was issued by the FPSC on August 12, 2008 (FPSC 2008).

8.2.1 Factors in the FPSC Determination of Need

This section discusses key factors affecting the future demand for electricity that FPSC used for the issuance of its Determination of Need Final Order. The FPSC provides an independent review of the PEF forecasts and other assertions to draw its own conclusions regarding the PEF case that a need exists for both proposed units at the LNP site. Each section below describes a specific factor FPSC considered in granting its Determination of Need.

8.2.1.1 Growth in Demand

The principal factor affecting the change in demand for electricity over time is the change in the number and type of customers needing that power. Electrical demand and energy usage in Florida are unique because residential customers make up the largest part of the customer base--comprising over 88 percent of Florida's electricity customers and consuming 53 percent of the State's total generating capacity. Based on the analysis presented in the ER (PEF 2009a), PEF used population projections produced by the Florida Bureau of Economic and Business Research (BEBR) at the University of Florida to estimate growth in its customer base to develop its annual IRPs. PEF (2009a) also applied standard State and national economic assumptions on growth that were produced by the independent group *Economy.com* for Florida forecasts. PEF also projected growth in the demand for electricity based upon demand sectors. PEF determined that Florida has grown recently by about a third of a million new residents each year and by about a third of a million jobs. Consequently, PEF anticipates future growth of about 1.8 percent per year on average between the present and 2017. This is lower than the historic 2.2 percent growth rate of the last 10 years, which is indicative of slower population growth, based on the BEBR projections presented in the ER (PEF 2009a), and less favorable economic conditions.

Florida's industrial demand for electricity amounts to about 11 percent of the total generating capacity in the State. For industrial demand, PEF identified four major customers that accounted for 28 percent of the industrial demand in 2007—all in the phosphate mining sector, which produces agricultural fertilizers. The supply and demand for agricultural products are a function of, among other factors, foreign competition, global agricultural industry conditions, international finance factors, and foreign trade. Industrial load and energy consumption at the PEF-served mining or chemical processing sites depend heavily on plant operations, which are heavily influenced by these global as well as other local conditions. PEF estimates that, barring any major unforeseen contractions in industry (reductions in production or closures of plants), that industry-related energy consumption would increase in the near term, as a new mine operation is expected to open. A significant risk to this projection lies in the volatile price of energy (i.e., natural gas), which is a major cost of both mining and producing phosphoric fertilizers (PEF 2009b).

8.2.1.2 Electric System Reliability

One of the most important functions of an electrical generating unit is to contribute to the protection of the overall electricity distribution system by producing more electricity than its service area demands. This is done as a hedge against unforeseen emergencies that could disrupt the delivery of electricity. This excess production is commonly called a "reserve margin," and PEF applies a 20 percent reserve margin to all of its demand projections (PEF 2009b). FPSC reviewed PEF's assertion that without the proposed action, PEF would be unable to maintain its minimum reserve margin planning requirement beginning in 2016. FPSC found no issue with PEF forecast assumptions, regression models, and projected system peak demands provided for this petition and affirmed PEF's reliance on the 20 percent reserve margin. Table 8-2 presents PEF's reserve margin analysis (PEF 2009b).

Expert witnesses testified to the FPSC that while reserve margins would climb to 33 percent in 2017, they would return to about 20 percent by 2023 under the proposed action. As a result, the FPSC found PEF had demonstrated that new capacity will be needed by 2016 to maintain its 20 percent reserve margin and the proposed action would satisfy PEF's capacity needs through 2023 (FPSC 2008).

Table 8-2. PEF Reserve Margin Forecast by Case

	PEF Reserve Margin (percent)[a]		
Year	**Without LNP Units 1 and 2**	**With LNP Unit 1**	**With LNP Units 1 and 2**
2015	23.0	23.0	23.0
2016	15.4	25.3	25.3
2017	13.4	23.2	33.0
2018	11.5	21.2	30.8
2019	9.7	19.1	28.6
2020	7.9	17.2	26.5
2021	6.2	15.4	24.6

Source: PEF 2009b
(a) PEF's targeted reserve margin equals 20 percent.

8.2.1.3 Demand-Side Management and Energy Efficiency

DSM and energy-efficiency (EE) measures for the production of electricity are a significant factor in the growth of electricity demand. PEF described an active DSM program in its 2008 Ten-Year Site Plan and included it in its IRP and petition for a Determination of Need to the FPSC. According to PEF, about 389,000 customers participated in the energy management program by the end of 2007 and succeeded in reducing the demand for electricity by about 760,500 kW of winter demand; about 273,000 customers participated to reduce summer demand by about 290,000 kW. Other PEF energy-efficiency programs include: aggressive customer education programs, home energy audits, financial incentives, rate incentives, and commercial reduction strategies. Through their EE programs, PEF customers have saved more than $750 million in energy costs over the last 25 years, roughly equivalent to the electricity demand of Orlando for two years (about 10 billion kWh) (PEF 2009b).

8.2.2 PEF's Demand for Electricity

This section reproduces the expected demand for electricity (Table 8-3) developed by PEF for its petition for a Determination of Need and the ER's Chapter 8, Need for Power. These data became the basis for the FPSC's 2008 issuance of a Determination of Need upon which the review team relied for this section of the EIS.

Table 8-3. PEF's Expected Demand for Electricity 2008 - 2017

Year	Additions		Subtractions		Net Firm Demand
	Wholesale	Retail	DSM and EE	Other	
2008	1343	9304	1113	110	9424
2009	1191	9551	1166	125	9451
2010	1265	9762	1213	125	9689
2011	1282	9990	1274	125	9873
2012	1439	10,220	1339	125	10,195
2013	1464	10,449	1394	125	10,393
2014	1463	10,670	1440	125	10,568
2015	1475	10,886	1460	125	10,776
2016	1491	11,087	1492	125	10,961
2017	1510	11,287	1522	125	11,150

Source: PEF 2009b

8.3 Determination of Supply

FPSC reported in its 2008 Determination of Need, that as of June 2006, PEF's generation capacity profile in Florida was approximately as follows: 43 percent coal generated, 30 percent natural gas generated, and 14 percent nuclear.[a] The other 13 percent is a mixture of purchased power from alternative fuels (such as solar, hydro, wood waste, solid waste, and biomass), and oil generated plants (FPSC 2008).

For its power supply and capacity forecasts, PEF considered its present and planned generating capabilities (including planed uprates, closures of facilities, and additional new power generation facilities), present and planned purchases of power from generators outside the service region, and its sales of power to consumers outside the service region. In its analysis of potential competitors to the proposed project, PEF also considered other projects, market purchases, and customer-owned generation, including power from renewable energy sources, especially photovoltaic systems.

(a) In September 2009, PEF shut down Crystal River 3, the 860-MW nuclear generating unit at the Crystal River Energy Complex in Citrus County for routine refueling and to replace its steam generators. During the outage, inspectors found damage to the concrete containment structure that had occurred when workers cut the hole used to extract the steam generators. As of this writing, Crystal River Unit 3 is still shut down. PEF has informed the NRC and the FPSC that it plans to repair the unit and estimates Crystal River Unit 3 would return to service in 2014 (NRC 2011). Based on this information, the review team assumes that, because the repairs would be completed before Levy Units 1 and 2 would be operational, there is no need to adjust the analysis of the need for power in this chapter to account for the lost capacity of Crystal River Unit 3.

FPSC used PEF's 2016 supply of electricity forecast, which is 13,736 MW without Levy 1 and 2. PEF believes that by 2016, it will need 509 MW to meet its 20 percent reserve margin target. By 2017 (the projected start of operation for Levy 2; Levy 1 is projected to begin operation in 2016), PEF determined (and FPSC concurred) that the 2200 MW generated by the proposed project would increase PEF's reserve margin to 33 percent. PEF estimates this would satisfy its reserve margin requirements until about 2023 (FPSC 2008). Table 8-4 below shows the installed and forecasted installed capacity from 2009-2017.

Table 8-4. Forecasted Installed Capacity at Summer Peak (MW)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Installed Capacity[(a)]	9859	9890	9900	10,035	11,065	11,065	11,065	11,961	13,053
Firm Capacity Import[(b)]	1467	1592	1680	1989	1879	1748	1748	1336	1336
Firm Capacity Export	0	0	0	0	0	0	0	0	0
Qualifying Facilities	173	173	323	439	439	439	439	439	439
Total Capacity Available[(c)]	11,499	11,655	11,903	12,463	13,383	13,252	13,252	13,736	14,828

Source: PEF 2009a
(a) Total installed capacity does not include the 143 MW to Southern Company from Intercession City.
(b) FIRM capacity import includes cogeneration, utility and independent power producers, and short-term purchase contracts.
(c) 2016 total capacity includes Levy 1 coming online. 2017 total capacity indicates Levy 2 also coming online.

8.4 Conclusions

The review team finds that the FPSC Determination of Need process was rigorous, subject to public review and oversight, and should lend great weight to the NRC's conclusions. In its determination, FPSC made projections to 2016 that indicate there is a need for at least an additional 2200 MW(e) of baseload electricity generation to meet system needs and to provide for an adequate reserve margin. Because their review process met the NRC's four criteria for reliability, the review team finds no reason to challenge the PEF conclusions.

8.5 References

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9.0 Environmental Impacts of Alternatives

This chapter describes alternatives to the proposed U.S. Nuclear Regulatory Commission (NRC) action for combined construction permits and operating licenses (COLs) and the U.S. Army Corps of Engineers' (USACE's) action for a Department of the Army (DA) Individual Permit 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 reviews Progress Energy Florida, Inc.'s (PEF's) region of interest (ROI) and its alternative site-selection process, and summarizes and compares the environmental impacts for the proposed and alternative sites. Section 9.4 examines system design alternatives. Section 9.5 lists the references cited in this chapter.

The need to compare the proposed action with alternatives arises from the requirement in Section 102(2)(c)(iii) of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321) that environmental impact statements (EISs) include an analysis of alternatives to the proposed action. The NRC implements this comparison through its regulations in Title 10 of the Code of Federal Regulations (CFR) Part 51 and its Environmental Standard Review Plan (ESRP) (NRC 2000). The environmental impacts of the alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality (CEQ) guidelines (40 CFR 1508.27) and set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. The issues evaluated in this chapter are the same as those addressed 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 issue of environmental justice. Although NUREG-1437 was developed for NRC's review of renewal of nuclear power plant operating licenses, it provides useful information for this review and is referenced throughout this chapter.

As part of the evaluation of permit applications subject to Section 404 of the Federal Water Pollution Control Act, as amended (also referred to as the Clean Water Act) (33 USC 1251 et seq.), the USACE is required by regulation to apply the criteria set forth in the Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (Guidelines) (33 USC 1344; 40 CFR Part 230). The Guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404, and stipulate that no discharge of dredged or fill material into waters of the United States (including jurisdictional wetlands) shall be permitted if there is a practicable alternative that would have less adverse impact on the aquatic environment, as long as the alternative does not have other significant adverse environmental consequences. The Guidelines state that an alternative is practicable if

(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.

it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered.

Where the activity associated with a discharge is proposed for a special aquatic site, such as wetlands (as defined in 40 CFR Part 230, Subpart E), and does not require access or proximity to or siting within these types of areas to fulfill its basic project purpose (i.e., the project is not "water dependent"), practicable alternatives that avoid special aquatic sites are presumed to be available, unless clearly demonstrated otherwise. See Section 1.3 for the USACE's determination of the basic purpose and overall purpose to be used for the USACE's alternatives analysis for this project.

Even if an applicant's preferred alternative is determined to be the least environmentally damaging practicable alternative (LEDPA) that meets the project's purpose, the USACE must determine whether the LEDPA is contrary to the public interest. USACE's Public Interest Review, described at 33 CFR 320.4, directs the USACE to consider several factors in a balancing process. A permit will not be issued for a practicable alternative that is not the LEDPA, nor will a permit be issued for an activity that is determined to be contrary to the public interest. In considering both the LEDPA and the Public Interest Review, the USACE must consider compliance with other applicable substantive laws such as the Endangered Species Act of 1973, as amended (ESA) (16 USC 1531 et seq.), and the National Historic Preservation Act of 1966, as amended (NHPA) (16 USC 470 et seq.), as well as consult with other Federal agencies. USACE also must follow procedural laws such as NEPA and other applicable laws described in 33 CFR 320.3.

Since the USACE is a cooperating agency with the NRC in this environmental review and for development of this EIS; the USACE and the NRC have provided information to the maximum extent practicable in this EIS that the USACE will use in its evaluation of the project, including the evaluation of alternatives. While the USACE concurs as part of the review team with the qualitative designation of impact levels for terrestrial or aquatic resource areas for this EIS; in so far as waters of the United States are concerned, the USACE must conduct a quantitative comparison of impacts on waters of the United States as part of the LEDPA analysis.

By written submittal dated December 14, 2009, PEF provided to the USACE additional information in regard to the LEDPA analysis for this project, titled "Levy Nuclear Units 1 and 2 (LNP) Section 404(b)(1) Alternatives Analysis" (PEF 2009a). The USACE reviewed the additional information and in letters dated March 5, 2010 (NRC 2010a) and June 17, 2010 (USACE 2010), provided written comments to PEF in regard to the analysis. PEF responded to the USACE's comments by written submittal dated June 30, 2010 (PEF 2010). The draft EIS was published on August 13, 2010. Comments were received through and past the end of the comment period on October 27, 2010, and included concerns regarding the alternatives analysis. Subsequent to its review of the comments and PEF's June 2010 submittal, the USACE provided additional written comments to PEF regarding the analysis in letters dated June 23, 2011 (USACE 2011a) and September 9, 2011 (USACE 2011b). PEF responded to the USACE's written comments by written submittals dated July 22, 2011 (PEF 2011a), September 20, 2011 (PEF 2011b), October 4, 2011 (PEF 2011c), and October 20, 2011 (PEF 2011d). The USACE evaluation for the determination of the LEDPA is ongoing.

The USACE's Record of Decision (ROD) will document the USACE's evaluation and whether a DA permit will be issued for this project. The ROD will reference the information provided by this final EIS and will include any additional information required by the USACE to support its permit decision.

9.1 No-Action Alternative

For purposes of an application for a COL, the no-action alternative refers to a scenario in which the NRC would deny the COLs requested by PEF, which would result in the proposed units not being built. Likewise, the USACE could also take no action or deny the DA Individual Permit request. Upon such a denial by the NRC or the USACE, the construction and operation of two new nuclear units at the Levy Nuclear Plant (LNP) site in accordance with 10 CFR Part 52 would not occur and the predicted environmental impacts associated with the project would not occur. Some preconstruction impacts associated with activities not within the NRC's definition of *construction* at 10 CFR 50.10(a) and 51.4 may occur nonetheless. If no other power plants were to be built in lieu of the proposed project or other strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided by the project would not occur. If no additional measures (e.g., conservation, importing power, restarting retired power plants, and/or extending the life of existing power plants) were implemented to realize the amount of electrical capacity that would otherwise be required for power in PEF's ROI (see Section 9.3.1), then the need for baseload power, discussed in Chapter 8, would not be met. Therefore, the purpose and need of this project would not be satisfied if the no-action alternative was chosen and the need for power was not met by other means.

If other generation sources were installed, either at another site or using a different energy source, the environmental impacts associated with these other sources would eventually occur. As discussed in Chapter 8, there is a demonstrated need for power. It is reasonable to assume that other options to meet the need for power would be pursued. This needed power may be provided and supported through several alternatives that are discussed in Sections 9.2 and 9.3.

9.2 Energy Alternatives

The purpose and need for the proposed project identified in Section 1.3 is to provide additional baseload electrical generation capacity for use in PEF's current markets. 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 and a combination of energy sources at the LNP site.

For analysis of energy alternatives, PEF assumed a bounding target value of 2200-MW(e) electrical output (PEF 2009b). The review team (composed of NRC staff, its contractor staff, and USACE 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 PEF to construct new generating capacity are as follows:

- Purchase the needed electric power from other suppliers.
- Extend the operating life of existing power plants.
- Reactivate retired power plants.
- Implement conservation or demand-side management programs.

If power to replace the capacity of the proposed 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 NUREG-1437 (e.g., coal, natural gas, or nuclear) (NRC 1996). The environmental impacts of other technologies described in the GEIS for license renewal (NUREG-1437) are representative of the impacts associated with the construction and operation of new generating units at the LNP site. The environmental impacts of coal-fired and natural-gas-fired plants are discussed in Sections 9.2.2.1 and 9.2.2.2, respectively.

Under the purchased power alternative, the environmental impacts of power production would still occur, but they would occur elsewhere in the region, nation, or in another country. If the purchased power alternative was to be implemented, the most significant environmental unknown would be whether new transmission-line corridors would be required. The construction of new transmission lines could have both environmental and aesthetic consequences, particularly if new transmission-line corridors were needed. The review team concludes that the local environmental impacts from purchased power would be SMALL when existing transmission-line corridors are used and could range from SMALL to LARGE if acquisition of new corridors is required. The overall environmental impacts of power generation would depend on the generation technology and location of the generation site and, therefore, are unknown. However, as discussed in Section 9.2.5, the review team concluded that from an environmental perspective, none of the viable energy alternatives would be clearly preferable to construction of a new baseload nuclear power-generation plant located within PEF's ROI.

Nuclear power facilities are initially licensed by the NRC for a period of 40 years. Operating licenses issued by the NRC can be renewed for up to 20 years, and NRC regulations do not preclude multiple renewals. PEF currently operates an 850-MW(e) nuclear power plant at the Crystal River Energy Complex (CREC, an energy facility also owned by PEF); the nuclear plant – CREC Unit 3 – came online in 1977 (NRC 2008). The CREC also includes two coal-fired plants that came online in the 1960s (CREC Units 1 and 2) and two coal-fired plants that came online in the 1980s (CREC Units 4 and 5). In the fall of 2009, PEF replaced the steam generators of CREC Unit 3, which produced a small increase in electrical output to 912 MW(e). PEF's future power-generation plans for CREC Unit 3 include a 168-MW(e) uprate, scheduled to occur during a refueling outage in 2013, which will increase the plant's electrical output to 1080 MW(e) (PEF 2011e).

The environmental impacts of continued operation of a nuclear power plant are significantly less than construction of a new plant. However, solely extending the service life of the CREC nuclear plant without construction of the proposed LNP would not fulfill PEF's Ten-Year Site Plan (PEF 2009b) or meet the need for power discussed in Chapter 8. Extending the service life of the CREC nuclear plant and constructing the proposed LNP are both part of PEF's future baseload generation capacity. Therefore, extending the service life of the CREC nuclear plant alone is not a feasible alternative to the proposed LNP.

Older, existing fossil-fueled plants nearing the end of their useful lives, predominately coal- and natural-gas-fired plants, are likely to need refurbishing to extend plant life for an extensive period (the proposed action assumes a minimum operating period of 40 years) and meet applicable environmental requirements. Currently, there are no deactivated power plants with the potential for future operation, although PEF has two oil-fired power plants scheduled for retirement that may be available for service life extension (Bartow, 444 MW[e], in Pinellas County; and Suwannee River, 129 MW[e], in Suwannee County). In addition, the Florida Department of Environmental Protection (FDEP) Conditions of Certification (FDEP 2011) states that PEF will retire its two oldest coal-fired units, which came online at CREC in the 1960s, by December 31, 2020 if LNP Units 1 and 2 are licensed, built, and begin commercial operation. Given both the costs of refurbishment and the environmental impacts of operating such facilities, the review team concludes that extending the life of older, existing generating plants or reactivating retired plants would not be a reasonable alternative to the proposed action.

Improved energy efficiency and demand-side management (DSM) strategies can potentially cost less than construction of new generation and provide a hedge against market, fuel, and environmental risks. PEF already offers many conservation and DSM programs to its customers to reduce peak electricity demands and daily power consumption. PEF's DSM Plan consists of seven residential programs, eight commercial programs, and one research and development program (PEF 2009c). Since 1981, PEF's energy-efficiency programs have saved more than 10 billion kilowatt hours of electricity (PEF 2009b). DSM programs are very successful in reducing peak load, but they cannot supply 2200 MW(e) of baseload power. The Florida Public Service Commission stated that DSM available today or in the foreseeable future cannot provide enough baseload capacity to avoid the need for the addition of proposed LNP Units 1 and 2 (FPSC 2008).

The need for power discussion in Chapter 8 takes account of conservation and DSM programs. The review team concluded in Chapter 8 that there is a justified need for power in the PEF service territory even with the implementation of conservation and DSM programs.

Based on the preceding discussion, the review team 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 DSM programs are not reasonable alternatives to providing new baseload power-generation capacity.

9.2.2 Alternatives Requiring New Generating Capacity

Consistent with the NRC's evaluation of alternatives to operating license renewal for nuclear power plants, a reasonable set of energy alternatives to the building and operation of two new nuclear units at the LNP site should be limited to analysis of discrete power-generation sources, a combination of sources, and those power-generation technologies that are technically reasonable and commercially viable (NRC 1996). The current mix of baseload power-generation options in Florida is one indicator of the feasible choices for power-generation technology within the State. The electricity produced in Florida in 2007 came mainly from coal (31.3 percent), natural gas (29.1 percent), oil (14.8 percent), and nuclear energy (13.9 percent) (NWF 2008). The other 10.9 percent of the generation mix would have come from other sources not specified in the reference.

This section discusses the environmental impacts of energy alternatives to the proposed action that would require PEF to construct new generating capacity. The three primary energy sources for generating electric power in the United States are coal, natural gas, and nuclear energy (DOE/EIA 2010a). Coal-fired plants are the primary source of baseload generation in the United States (DOE/EIA 2009a). Natural-gas combined-cycle power-generation plants are often used as intermediate generation sources, but they are also used as baseload generation sources (SSI 2010). Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an annual energy outlook. In its *Updated Annual*

Energy Outlook 2009 (DOE/EIA 2009b), EIA's reference case projects that total electric generating capacity additions between 2007 and 2030 will use the following fuels in the approximate percentages: natural gas (55 percent), renewable (27 percent), coal (14 percent), and nuclear (5 percent) (DOE/EIA 2009b). The EIA projection includes baseload, intermittent, and peaking units and is based on the assumption that providers of new generating capacity would seek to minimize cost while meeting applicable environmental requirements.

The discussion in Section 9.2.2 is limited to a reasonable range of the individual energy alternatives that appear to be viable for new baseload generation: coal-fired and natural-gas combined-cycle generation. The impacts discussed in Section 9.2.2 are estimates based on present technology. Section 9.2.3 addresses alternative generation technologies that have demonstrated commercial acceptance but may be limited in application, total capacity, or technical feasibility when based on the need to supply reliable, baseload capacity.

The review team assumed that (1) new generation capacity would be located at the LNP site for the coal- and natural-gas-fired alternatives, (2) the cooling approach planned for proposed Units 1 and 2 (Section 3.2.2.2) would be used for plant cooling, and (3) four new 500-kV electric power transmission lines would be needed to serve a new coal- or natural-gas-fired plant sited at the LNP site, consistent with the LNP proposal.

9.2.2.1 Coal-Fired Power Generation

For the coal-fired generation alternative, the review team assumed construction of four pulverized coal-fired units, each with a total net capacity of 550 MW(e). The team's estimates of coal consumption, coal combustion technology, air emissions, and waste products are based on the U.S. Environmental Protection Agency (EPA) AP-42 *Compilation of Air Pollutant Emission Factors – Bituminous and Subbituminous Coal Combustion* (EPA 1998). The review team also assumed that four additional 500-kV transmission-line corridors would be acquired, as discussed in Section 2.2.2. The plant was assumed to have an operating life of 40 years. These assumptions are consistent with PEF's COL application.

The review team also considered integrated gasification combined cycle (IGCC) coal-fired plants. 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. 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 byproduct. The other large-volume byproduct 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. In spite of the preceding advantages, the review team concludes that, at present, a new IGCC plant is not a reasonable alternative to a 2200-MW(e) nuclear power-generation facility for the following reasons: (1) IGCC plants are more expensive than comparable pulverized coal plants (DOE/NETL 2007), (2) the two existing IGCC plants in the United States have considerably smaller capacity, approximately 250 MW(e) each, than the proposed 2200-MW(e) nuclear plant, (3) system reliability of existing IGCC plants has been lower than pulverized coal plants, and (4) 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.

Therefore, for the coal-fired alternative, the review team assumed that coal and limestone (calcium carbonate) would be delivered to the plant by barge. The review team estimates that the plant would consume 6,552,000 T/yr of pulverized bituminous coal with an ash content of approximately 9 percent (EPA 1998). Slaked lime or limestone, used in the flue gas scrubbing process for control of sulfur dioxide (SO_2) emissions, is injected as slurry into the hot effluent combustion gases to remove entrained SO_2. The limestone-based scrubbing solution reacts with SO_2 to form calcium sulfite or calcium sulfate, which precipitates and is removed from the process as sludge for dewatering and then sold to industry for use in the manufacture of wallboard or other industrial products. The review team estimates that approximately 450,000 T/yr of limestone would be used for flue gas desulfurization, generating approximately 700,000 T/yr of scrubber sludge.

Air Quality

The impacts on air quality from coal-fired generation would vary considerably from those of nuclear generation because of emissions of SO_2, nitrogen oxides (NO_x), carbon monoxide (CO), particulate matter (PM), volatile organic compounds (VOCs), and hazardous air pollutants such as mercury and lead. The review team estimates that a 2200-MW(e) coal-fired plant would also have unregulated carbon dioxide (CO_2) emissions of 18.7 million tons per year (T/yr) that could affect climate change (EPA 1998).

The coal-fired plant emissions were determined based on factors contained in the EPA (AP-42) Compilation of Air Pollutant Emission Factors (EPA 1998). It is noted that estimates of emissions are based on “as fired” and controlled conditions using both combustion and post-combustion technologies to reduce criteria pollutants. Emissions estimates are not necessarily representative of what would be permitted.

The review team assumed a plant design that would minimize air emissions through a combination of boiler and combustion technology as well as post-combustion pollutant removal, and would maintain local and regional attainment status for the criteria pollutants listed below.

A final air permit would likely require applicable Best Available Control Technologies. The review team's estimates of the emissions from the coal-fired generation alternative are approximately as follows[(a)]:

- SO_2 = 7469 T/yr
- NO_x = 1638 T/yr
- CO = 1638 T/yr
- PM = 147 T/yr
- PM_{10} = 34 T/yr.

PM_{10} is particulate matter with an aerodynamic diameter equal to or less than 10 microns (40 CFR 50.6).

The acid rain requirements of the Clean Air Act, as amended (42 USC 7401 et seq.) capped the nation's SO_2 emissions from power plants. PEF 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.

A new coal-fired power-generation plant at the LNP site would need a Prevention of Significant Deterioration (PSD) Permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants in 40 CFR Part 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 review team assumes that fugitive dust emissions from construction activities would be mitigated using best management practices (BMPs), similar to mitigation discussed in Chapter 4 for proposed LNP Units 1 and 2. Such emissions would be temporary.

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 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)). The entire State of Florida is designated as in attainment or unclassified for all criteria pollutants (EPA 2006). National Ambient Air Quality Standards (NAAQSs) for criteria pollutants are in 40 CFR Part 50. Section 169A of the Clean Air Act 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, the State must establish goals that provide for reasonable progress

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(a) Based on 6,552,000 T/yr of bituminous coal and controlled using overfire air in combination with low-NO_x burners and selective catalytic reduction, limestone-based flue gas desulfurization, and conventional particulate capture technology (EPA 1998).

toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility on the most-impaired days over the period of the implementation plan and make sure there is no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a new coal-fired power-generation station was located close to a mandatory Class I area, additional requirements for air-pollution control could be imposed. There are three mandatory Class I Federal areas in Florida:

- Chassahowitzka Wilderness Area – 13 mi south of the LNP site
- St. Marks Wilderness Area – 119 mi northwest of the LNP site
- Everglades National Park – 282 mi southeast of the LNP site.

The GEIS for license renewal considers global warming from unregulated CO_2 emissions and acid rain from emissions of sulfur oxides (SO_x) and NO_x as potential impacts (NRC 1996). Adverse human health effects, such as cancer and emphysema, have been associated with the byproducts of coal combustion. Overall, the review team concludes that air quality impacts from new coal-fired power generation at the LNP site would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

Waste Management

As the NRC has described in NUREG-1437 (NRC 1996) and verified during its preparation of the operating license renewal supplemental EIS analysis, coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction catalyst, and scrubber sludge. The review team estimates that the coal-fired plants would generate approximately 590,000 T/yr of ash (DOE/EIA 2009a). Significant quantities of the fly ash may be recycled for use in commodity products such as concrete, thus reducing the total landfill volume.

In May 2000, the EPA issued a “Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels” (65 FR 32214). The EPA concluded that some form of national regulation is warranted to address coal-combustion waste products (i.e., coal ash) because of health concerns. Accordingly, the EPA announced its intention to issue regulations for disposal of coal ash under the Resource Conservation and Recovery Act of 1976, as amended (RCRA). EPA is considering two proposals for the management of coal ash. The first proposal is to list coal ash as a special waste subject to regulation under RCRA Subtitle C when it is destined for disposal in landfills or surface impoundments. The second proposal is to regulate coal ash under RCRA Subtitle D as non-hazardous waste (75 FR 35128).

Waste impacts on groundwater and surface water could extend beyond the operating life of the plant if leachate runoff from the waste-storage area occurs. Disposal of the waste could noticeably affect land use (because of the acreage needed for waste) 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 some other uses. Construction-related debris would be generated during plant construction activities, and would be disposed of in approved landfills.

For the reasons stated above, the review team 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 worker 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 review team concludes that the human health impacts from radiological doses and inhaled toxins and particulates generated from coal-fired generation would be SMALL.

Other Impacts

Based on NUREG-1437 (NRC 1996), at least 1700 ac of land would need to be converted to industrial use on the LNP site for the powerblock, infrastructure and support facilities, coal and limestone storage and handling, and landfill disposal of ash and scrubber sludge. Additional land would be needed for four new transmission-line corridors. Land-use changes would occur in an undetermined offsite coal-mining area to supply coal for the plant. In NUREG-1437 (NRC 1996), the staff estimated that approximately 22,000 ac would be needed for coal mining and waste disposal to support a 1000-MW(e) coal-fired plant over its operating life (48,000 ac for a 2200 MW[e] plant) (NRC 1996). Based on the amount of land affected for the site, mining, and waste disposal, the review team concludes that land-use impacts would be MODERATE.

The amount of water used and the impacts on water use and quality from constructing and operating a coal-fired plant at the LNP site would be comparable to those associated with a new nuclear plant. The new facility would use closed-cycle cooling. Water consumption due to evaporative cooling would also be comparable to that of a new nuclear facility. All discharges would be regulated by the Florida Department of Natural Resources through a National Pollutant Discharge Elimination System (NPDES) permit. Indirectly, water quality could be affected by acids and mercury from air emissions. However, these emissions are regulated to minimize impacts. In NUREG-1437, the NRC staff determined that some erosion and sedimentation would likely occur during construction of new facilities (NRC 1996). These impacts would be similar to those for a new nuclear plant. Overall, the review team concludes that the water-use and water-quality impacts would be SMALL.

The coal-fired power-generation alternative would introduce ecological impacts from construction and new incremental impacts from operations. The impacts would be similar to those of the proposed action at the LNP site and along the transmission-line corridors. The impacts could include terrestrial and aquatic functional loss, habitat fragmentation and/or loss, reduced productivity, and a local reduction in biological diversity. The impacts could occur at the LNP site and at the sites used for coal and limestone mining. Construction and maintenance of new transmission-line corridors and lines would have ecological impacts. Stack emissions and disposal of waste products could affect aquatic and terrestrial resources. Additional impacts on threatened and endangered species could result from ash disposal and mining activities if the locations of such activities overlap with habitat for such protected species. Overall, the review team concludes that the ecological impacts would be MODERATE, primarily because of potential impacts associated with disposal of ash and the large area of land affected by mining activities.

The review team considered the effects of global climate change on a coal-fired plant at the LNP site, including sea-level rise, changes in precipitation rates, frequency of severe weather events, and changes in the distribution of species. The review team concluded that the impacts of global climate change on a coal-fired plant would be comparable to impacts on a new nuclear facility.

Socioeconomic impacts would result from the peak workforce of approximately 2000 construction workers and the approximately 250 workers needed to operate the coal-fired facility (PEF 2009b). The construction workers are predominantly temporary; however, it is expected that demands on housing and public services during construction would not affect the surrounding areas. Overall, the review team concludes that these impacts would be SMALL, 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. PEF would pay significant property taxes to Levy County. Considering the population and economic condition of the county, the review team concludes that, similar to the proposed action, the taxes would have a LARGE beneficial impact on the county and a SMALL beneficial impact elsewhere in the region.

The four coal-fired powerblock units would be as much as 200 ft tall and visible offsite during daylight hours. The stacks and associated emissions would likely be visible in daylight hours for distances greater than 10 mi. Cooling towers and associated plumes also would have aesthetic impacts. The powerblock units and associated stacks would also be visible at night because of outside lighting. Visual impacts at night could be mitigated by reduced use of lighting and enhanced use of down-facing lighting, provided the lighting meets Federal Aviation Administration requirements, and appropriate use of shielding. The new transmission lines would have a larger aesthetic impact, but would be consistent with the proposed project. Overall, the review team concludes that the aesthetic impacts associated with new coal-fired power generation at the LNP site would be MODERATE. The aesthetic impacts of the transmission lines would also be localized and MODERATE, consistent with the proposed project.

Coal-fired power generation would introduce mechanical sources of noise that would likely 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. 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. The impacts of noise on residents in the vicinity of the facility are considered MODERATE.

As discussed in Section 2.6.2, there are no environmental pathways by which the identified minority or low-income populations within the 50-mi radius surrounding the proposed LNP site (region) would be likely to suffer disproportionately high and adverse environmental impacts. Therefore, environmental impacts on minority and low-income populations associated with a coal-fired plant at the LNP site would be SMALL.

The historic and cultural resource impacts for a new coal-fired plant located at the LNP 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 that would be 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 effects 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 corridors where new construction would occur (e.g., roads and transmission-line corridors). The review team concludes that the historic and cultural resource impacts would be SMALL.

The construction and operational impacts of a 2200-MW(e) coal-fired power-generation plant at the LNP site are summarized in Table 9-1.

Table 9-1. Summary of Environmental Impacts of Coal-Fired Power Generation at the LNP Site

Impact Category	Impact	Comment
Land Use	MODERATE	At least 1700 ac would be needed for powerblock; coal-handling, storage, and transportation facilities; infrastructure facilities; and cooling-water facilities. Additional land would be needed for new transmission-line corridors. Coal mining (offsite) and waste-disposal activities would require an additional 48,000 ac.
Air Quality	MODERATE	SO_2 – 7469 T/yr NO_x – 1638 T/yr CO – 1638 T/yr PM – 147 T/yr PM_{10} – 34 T/yr CO_2 – 18.7 million T/yr Small amounts of hazardous air pollutants. Global warming and acid rain are also of concern.
Water Use and Quality	SMALL	Impacts would be comparable to the impacts for a new nuclear power plant located at the LNP site.
Ecology	MODERATE	Impacts could include terrestrial and aquatic functional loss, habitat fragmentation and/or loss, reduced productivity, and a local reduction in biological diversity. Impacts could occur at the LNP site and vicinity and at the sites used for coal and limestone mining. Disposal of ash could affect the terrestrial and aquatic environments. Additional impacts on threatened and endangered species could result from ash disposal and mining activities. Permanent impact on wetlands within the project footprint would occur.
Waste Management	MODERATE	Total volume of combustion wastes would exceed 1 million T/yr (590,000 T/yr ash and 700,000 T/yr scrubber sludge).
Socioeconomics	LARGE Beneficial to MODERATE Adverse	Positive socioeconomic impacts would result due to the need for approximately 250 people to operate the plant, plus several hundred coal-mining jobs (offsite). The local property tax base would benefit, mainly during operations. Depending on where the workforce lives, the construction-related impacts (e.g., noise, traffic) would be noticeable or minor. Impacts during operation likely would be smaller than during construction. The plant and new transmission-line corridors would have noticeable aesthetic impacts.
Human Health	SMALL	Regulatory controls and oversight are assumed to be protective of human health.

Table 9-1. (contd)

Impact Category	Impact	Comment
Historic and Cultural Resources	SMALL	Any potential impacts could likely be effectively managed. Most of the facility and infrastructure would be built on ground previously disturbed by pine plantations. Impacts may also be associated with new transmission-line corridors.
Environmental Justice	SMALL	Based on analysis of census data, no disproportionately high or adverse impacts on minority or low-income populations would be anticipated.

9.2.2.2 Natural-Gas-Fired Power Generation

For the natural-gas alternative, the review team assumed construction and operation of a natural-gas-fired plant at the LNP site. The review team assumed that the plant would use combined-cycle combustion turbines, which is consistent with PEF's environmental report (ER) (PEF 2009b). The review team assumed four units with a net capacity of 550-MW(e) per unit. The team's estimates of natural-gas consumption, gas-combustion technology, air emissions, and waste products are based on EPA AP-42, *Compilation of Air Pollutant Emission Factors – Stationary Gas Turbines* (EPA 2000). The review team also assumed the construction of four additional transmission-line corridors, as discussed in Chapter 3. The natural-gas-fired plant is assumed to have an operating life of 40 years. The review team estimated that the natural-gas-fired plant would use approximately 114 billion standard cubic feet of gas per year (EPA 2000).

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. The associated emissions estimates were estimated based on factors contained in the EPA Compilation of Air Pollutant Emission Factors (EPA 2000) except where noted. These assumptions are consistent with the application submitted by PEF. It is noted that emissions estimates are based on "as fired" and controlled conditions and are not representative of what would likely be permitted.

A new natural-gas-fired power-generation plant would likely need a PSD 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 Part 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 Part 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 entire State of Florida is designated as in attainment or unclassified for all criteria pollutants (EPA 2006).

Section 169A of the Clean Air Act 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, the EPA regulations provide that for each mandatory Class I Federal area located within a State, the 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 make sure there is 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 was located close to a mandatory Class I area, additional air-pollution control requirements could be imposed. There are three mandatory Class I Federal areas in Florida:

- Chassahowitzka Wilderness Area – 13 mi south of the LNP site
- St. Marks Wilderness Area – 119 mi northwest of the LNP site
- Everglades National Park – 282 mi southeast of the LNP site.

A natural-gas-fired plant equipped with appropriate combustion and post-combustion pollution-control technology would have approximately the following emissions[a]:

- SO_2 – 32 T/yr
- NO_x – 564 T/yr
- CO – 214 T/yr
- PM – 108 T/yr
- PM_{10} – 108 T/yr

Based on data from previous NRC EIS documents, the review team determined that these emissions estimates are reasonable. The review team estimates that a natural-gas-fired power plant would also have unregulated CO_2 emissions of 6.3 million T/yr that could affect climate change (EPA 1998).

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 Part 63) if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 10 T/yr or more of any single hazardous air pollutant or 25 T/yr or more of any combination of hazardous air pollutants (40 CFR 63.6085(b)).

The review team assumes that fugitive dust emissions from construction activities would be mitigated using BMPs, similar to mitigation discussed in Chapter 4 for proposed LNP Units 1 and 2. Such emissions would be temporary.

(a) Emissions based on 114 MMBtu/yr and control technology, including lean-premix combustion, and catalytic control for NO_x at a 90 percent reduction rate and CO at a 75 percent reduction rate.

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 review team concludes that air quality impacts resulting from construction and operation of new natural-gas-fired power generation at the LNP site would be SMALL to MODERATE.

Waste Management

In NUREG-1437, the NRC 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 selective catalytic reduction catalyst (SCR), 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 review team concludes that waste impacts from natural-gas-fired power generation would be SMALL.

Human Health

Natural-gas-fired power generation introduces public risk from inhalation of gaseous emissions. The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contributes to health risk. 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 review team concludes that the human health impacts from natural-gas-fired power generation would be SMALL.

Other Impacts

The natural-gas-fired power-generating plant would require at least 110 ac for the powerblock and support facilities for 2200 MW(e). Construction of a natural-gas pipeline from the LNP site to the closest natural-gas distribution line would require approximately 10 ac. Thus, the total land-use commitment, not including natural-gas wells and collection stations, would be at least 120 ac (NRC 1996). Consistent with the proposed project, additional land would be needed for four new transmission-line corridors as well. A small amount of additional land would also be required for natural-gas wells and collection stations. Due to the proximity of the LNP site to existing natural-gas infrastructure, these impacts would be minimized. Overall, the review team concludes that the land-use impacts from new natural-gas-fired power generation would be MODERATE due mainly to the transmission-line corridor impacts.

The amount of water used and the impacts on water use and quality from constructing and operating a natural-gas-fired plant at the LNP site would be comparable to the impacts associated with building and operating a new nuclear facility. The impacts on water quality from sedimentation during construction of a natural-gas-fired plant were characterized in NUREG-1437 as SMALL (NRC 1996). The NRC staff also noted in NUREG-1437 that the impacts on water quality from operations would be similar to, or less than, the impacts from other power-generating technologies (NRC 1996). Overall, the review team concludes that impacts on water use and quality would be SMALL.

A natural-gas-fired plant at the LNP site would have fewer ecological impacts than a new nuclear facility because less land would be affected. Constructing a new underground gas pipeline to the site would result in permanent loss of some terrestrial and aquatic function as well as conversion and fragmentation of habitat; however, because the distance to connect to natural-gas distribution systems would be minimal, no important ecological attributes would be noticeably altered. Impacts on threatened and endangered species would be similar to the impacts from a new nuclear facility located at the LNP site. Overall, the review team concludes that ecological impacts would be SMALL.

The review team considered the effects of global climate change on a natural-gas-fired plant at the LNP site, including sea-level rise, changes in precipitation rates, frequency of severe weather events, and changes in the distribution of species. The team concluded that the impacts of global climate change on a natural-gas-fired plant would be comparable to impacts on a new nuclear facility.

Socioeconomic impacts would result from the approximately 1200 construction workers (NRC 1996) and 150 workers needed to operate the natural-gas-fired facility (PEF 2009b), demands on housing and public services during construction, and the loss of jobs after construction. Overall, the review team 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. PEF would pay property taxes to Levy County. Considering the population and economic condition of the county, the review team concludes that the taxes would have a LARGE beneficial impact on Levy County and SMALL and beneficial throughout the rest of the region.

The turbine buildings, four exhaust stacks (each approximately 200 ft high) and associated emissions, and the gas pipeline compressors would be visible during daylight hours from offsite. Noise and light from the plant would be detectable offsite. The new transmission lines would have an aesthetic impact. Overall, the review team concludes that the aesthetic impacts associated with new natural-gas-fired power generation at the LNP site would be SMALL. The impact along new transmission lines would be localized and MODERATE, similar to the proposed project.

Historic and cultural resource impacts for a new natural-gas-fired plant located at the LNP 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 gas wells, collection stations, and waste-disposal sites, and along associated corridors where new construction would occur (e.g., roads and any new pipelines). The review team concludes that the historic and cultural resource impacts associated with new natural-gas-fired power generation at the LNP site would be SMALL.

As described in Section 2.6.2, there are no environmental pathways by which the identified minority or low-income populations within the region would be likely to suffer disproportionately high and adverse environmental impacts. Therefore, environmental impacts on minority and low-income populations associated with a natural-gas-fired plant at the LNP site would be SMALL.

The impacts of natural-gas-fired power generation at the LNP site are summarized in Table 9-2.

Table 9-2. Summary of Environmental Impacts of Natural-Gas-Fired Power Generation

Impact Category	Impact	Comment
Land Use	MODERATE	At least 120 ac would be needed for powerblock, cooling towers, and support systems, and connection to a natural-gas pipeline. Additional land would be needed for transmission-line corridors, infrastructure, and other facilities.
Air Quality	SMALL to MODERATE	SO_2 – 32 T/yr NO_x – 564 T/yr CO – 214 T/yr PM – 108 T/yr PM_{10} – 108 T/yr CO_2 – 6.3 million T/yr 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 LNP site.
Ecology	SMALL	Constructing a new underground gas pipeline to the site would result in permanent loss of some terrestrial and aquatic function as well as conversion and fragmentation of habitat. Impacts on threatened and endangered species would be similar to the impacts from new nuclear generating units. Most impacts from pipeline construction would be temporary. Permanent impact on wetlands within the project footprint would occur.
Waste Management	SMALL	The only significant waste would be from spent selective catalytic reduction catalyst used for control of emissions of NO_x.

Table 9-2. (contd)

Impact Category	Impact	Comment
Socioeconomics	LARGE 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, would still be significant. Construction-related impacts would be noticeable. Impacts during operation would be minor because of the small workforce involved. The new transmission lines would have noticeable adverse aesthetic impacts.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and Cultural Resources	SMALL	Most of the facility and infrastructure would be built on ground previously disturbed by pine plantations. Impacts may also be associated with new transmission-line corridors.
Environmental Justice	SMALL	No disproportionately high or adverse impacts on minority or low-income populations would be anticipated based on analysis of census data.

9.2.3 Other Alternatives

This section discusses other energy alternatives, the review team's conclusions about the feasibility of each alternative, and the review team's basis for its conclusions. New nuclear units at the LNP site would be baseload generation units. Any feasible alternative to the new units would need to generate baseload power. In evaluating other energy technologies, PEF used the technologies discussed in the GEIS for license renewal (NRC 1996). The review team reviewed the information submitted by PEF in its ER and also conducted an independent review. The review team determined that the other energy alternatives are not reasonable alternatives to two new nuclear units that would provide baseload power. Also, the Florida Public Service Commission stated that renewable generation available today or in the foreseeable future cannot provide enough baseload capacity to avoid the need for the addition of proposed LNP Units 1 and 2 (FPSC 2008).

The review team has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, as noted above, the generation alternatives are not feasible for providing 2200 MW(e) of baseload power. In addition, some of the generation alternatives would have to be installed at a location other than the LNP site, and any attempt to assign significance levels would require the staff's speculation about the unknown site.

9.2.3.1 Oil-Fired Power Generation

The EIA's reference case in its *Updated Annual Energy Outlook* 2009 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 2009b). 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 electricity generation. In Section 8.3.11 of NUREG-1437, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac of land (NRC 1996). Operation of an oil-fired power plant would have air emissions that would be similar to those of a comparably sized coal-fired plant (NRC 1996).

For the aforementioned economic and environmental reasons, the review team concludes that an oil-fired power plant would not be a reasonable alternative to construction of a 2200-MW(e) nuclear power-generation facility that would be operated as a baseload plant within PEF's ROI.

9.2.3.2 Wind Power

The LNP site is 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 generation of wind energy and 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 world's largest operating wind farm, the Horse Hollow Wind Energy Center in Texas, is 735 MW (TSECO 2008a), but most are well under 200 MW. A utility-scale wind power-generation plant in open, flat terrain would generally require about 60 ac/MW of installed capacity, although much of this land could be used for other compatible purposes such as farming or ranching (AWEA 2007). With modern wind turbine designs, more than 1000 wind turbines would be required to produce the 2200 MW(e) of the proposed nuclear units.

For the reasons cited above, the review team concludes that a wind-energy facility at the LNP site or elsewhere within PEF's ROI would not currently be a reasonable alternative to construction of a 2200-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 energy can be converted to electricity using solar thermal technologies or photovoltaics. Solar thermal technologies use concentrating devices to create temperatures suitable for power production. Concentrating thermal technologies are currently less costly than photovoltaics for bulk power production. They can also be provided with energy storage or auxiliary boilers to allow operation during periods when the sun is not shining (NPCC 2006). The largest operational solar thermal plant is the 310-MW(e) Solar Energy Generating System located on approximately 1500 ac in the Mojave Desert in southern California (NextEra 2009).

Solar insolation has a low energy density relative to other common energy sources. Consequently, a large total acreage is needed to gather an appreciable amount of energy. Typical solar-to-electric power plants require 5 to 10 ac for every megawatt of generating capacity (TSECO 2008b). For PEF's target capacity of 2200 MW(e) for LNP Units 1 and 2, land requirements would be approximately 11,000 to 22,000 ac. Solar thermal electric technologies also typically require considerable water supplies.

For the preceding reasons, the review team concludes that a solar-energy facility at or in the vicinity of the LNP site would not currently be a reasonable alternative to construction of a 2200-MW(e) nuclear power-generation facility that would be operated as a baseload plant.

9.2.3.4 Hydropower

The EIA's reference case in its *Updated Annual Energy Outlook* 2009 projects that U.S. electricity production from hydropower plants will remain essentially stable through the year 2030 (DOE/EIA 2009b). In NUREG-1437, the NRC staff estimated that land requirements for hydroelectric power are approximately 1 million ac per 1000 MW(e) (NRC 1996). For the target capacity of 2200 MW(e) for proposed LNP Units 1 and 2, land requirements would thus be 2.2 million ac.

Because of the extremely low amount of undeveloped hydropower resource in Florida and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to produce 2200 MW(e), the review team 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 proposed 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 2008a). Geothermal systems have a relatively small footprint and minimal emissions (MIT 2006). Florida has high-temperature geothermal resources that are suitable for space heating applications, but not for baseload power generation (DOE 2010). A recent study led by the Massachusetts Institute of Technology concluded that a $300 to $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 review team concludes that a geothermal energy facility at the LNP site or elsewhere in PEF's ROI would not currently be a reasonable alternative to construction of a 2200-MW(e) nuclear power-generation facility operated as a baseload plant.

9.2.3.6 Wood Waste

In NUREG-1437, the NRC 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 (e.g., soil erosion and loss of wildlife habitat), and the relatively small size of wood power-generation plants, the review team concludes that wood waste would not be a reasonable alternative to a 2200-MW(e) nuclear power-generation facility operated as a baseload plant.

9.2.3.7 Municipal Solid Waste

Municipal solid-waste combustors incinerate waste and can use the resultant heat to produce steam, hot water, or electricity. The combustion process reduces the volume of waste and the need for new solid-waste landfills. Mass-burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste with little or no sizing, shredding, or separation before combustion. More than one-fifth of the U.S. municipal solid-waste incinerators use refuse-derived fuel. In contrast to mass burning – where the municipal solid waste is introduced "as is" into the combustion chamber – refuse-derived fuel facilities are equipped to recover recyclables (e.g., metals, cans, and glass) followed by shredding the combustible fraction into fluff for incineration (EPA 2008).

In NUREG-1437, 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 SO_2 and NO_x emissions and an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to the 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 (EPA 2009a).

Currently, approximately 87 waste-to-energy plants are operating in the United States (EPA 2009a). These plants generate approximately 2500 MW(e), or an average of approximately 29 MW(e) per plant (EPA 2009a). Given the small average output of existing plants, the review team concludes that generating electricity from municipal solid waste would not be a reasonable alternative to a 2200-MW(e) nuclear power-generation facility operated as a baseload plant within PEF's ROI.

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). EIA estimates that wind and biomass will be the largest sources of renewable electricity generation among the non-hydropower renewable fuels through 2030 (DOE/EIA 2009b). However, in NUREG-1437, the NRC 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 power-generating plant (NRC 1996). The major operating waste from biomass plants would be the fly ash and bottom ash that results from the combustion of the carbonaceous fuels.

Co-firing biomass with coal is possible when low-cost biomass resources are available. Co-firing is the most economic option for the near future to introduce new biomass power generation. These projects require small capital investments per unit of power-generation capacity. Co-firing systems range in size from 1 to 30 MW(e) of biopower capacity (DOE 2008b).

The review team concludes that given the relatively small average output of biomass power-generation facilities, biomass-derived fuels do not offer a reasonable alternative to a 2200-MW(e) nuclear power-generation facility operated as a baseload plant within PEF's ROI.

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 byproducts are heat, water, and CO_2. 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 2008c).

The review team 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 proposed site would not currently be a reasonable alternative to construction of a 2200-MW(e) nuclear power-generation facility operated as a baseload plant.

9.2.4 Combination of Alternatives

Individual alternatives to the construction of two new nuclear units at the LNP site might not be sufficient on their own to generate PEF's target value of 2200 MW(e) because of the limited availability 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. It would not be reasonable to examine every possible combination of alternatives in an EIS. Doing so would be counter to CEQ guidance that an EIS should be analytic rather than encyclopedic, should be kept concise, and should be no longer than absolutely necessary to comply with NEPA and CEQ regulations (40 CFR 1502.2(a), (b)). Given that PEF's objective is for a new baseload generation facility, a fossil-fuel energy source, most likely natural gas or coal, would need to be a significant contributor to any reasonable alternative energy combination.

Section 9.2.2.2 assumes the construction of four 550-MW(e) natural-gas-fired, combined-cycle power-generating units at the LNP site using closed-cycle cooling with cooling towers. For a combined alternatives option, the review team assessed the environmental impacts of an assumed combination of three 550-MW(e) natural-gas-fired, combined-cycle power-generating units at the LNP site using closed-cycle cooling with cooling towers, and the following contributions from within PEF's ROI: 200 MW(e) from conservation and DSM programs beyond what is currently planned, 150 MW(e) from solar, 100 MW(e) from wind, and 100 MW(e) from biomass sources, including municipal solid waste. Solar and wind energy would need to be combined with an energy-storage mechanism, such as compressed air energy storage, to be baseload resources. The review team believes that the preceding contributions are reasonable and representative for PEF's ROI. The contributions reflect the review team's analysis in Sections 9.2.2 and 9.2.3.

The review team considered the effects of global climate change on a combination of alternatives at the LNP site, including sea-level rise, changes in precipitation rates, frequency of severe weather events, and changes in the distribution of species. Global climate change could have an impact on some of the alternative generation sources (solar, wind, and biomass) considered in the combination of alternatives. For example, increased cloud cover could affect solar-power generation and biomass production, and severe weather events could affect wind-power generation. The review team concluded, however, that the impacts of global climate change on the gas-fired component of the combination of alternatives would be comparable to impacts on a new nuclear facility. A summary of the review team's characterizations of the environmental impacts associated with the construction and operation of the preceding assumed combination of alternatives is provided in Table 9-3.

Because the combination of alternatives used in this analysis relies upon natural gas for almost 80 percent of its generating capacity, the review team determined the socioeconomic and environmental justice impacts discussed in Section 9.2.2.2 of this EIS provide a reasonable upper bound to the expected impacts from the combination of alternative generating technologies.

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 the powerblock, new transmission-line corridors, cooling towers, and support systems, and connection to a natural-gas pipeline. Solar, wind, and biomass facilities and associated transmission lines would also have land-use impacts because of the large footprints required for these facilities.
Air Quality	SMALL to MODERATE	Emissions from the natural-gas-fired plant would be approximately: SO_2 – 24 T/yr NO_x – 423 T/yr CO – 161 T/yr PM – 81 T/yr PM_{10} – 81 T/yr CO_2 – 4.7 million T/yr Some hazardous air pollutants. Biomass would also have some emissions.
Water Use and Quality	SMALL	Impacts would be comparable to the impacts for a new nuclear power plant located at the proposed site.

Table 9-3. (contd)

Impact Category	Impact	Comment
Ecology	SMALL to MODERATE	Wind-energy facilities could result in increased avian and bat mortality. Permanent impact on wetlands within the project footprint would occur.
Waste Management	SMALL to MODERATE	The only significant waste would be from spent selective catalytic reduction catalyst used for control of NO_x emissions and ash from biomass and municipal solid waste.
Socioeconomics	LARGE 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, would still be significant. Construction-related impacts would be noticeable. Impacts during operation would be minor because of the small workforce involved. The power plants and new transmission lines would have noticeable aesthetic impacts.
Human Health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and Cultural Resources	SMALL	Most of the facilities and infrastructure at the LNP site would likely be built on ground previously disturbed by pine plantations. Impacts may also be associated with new transmission-line corridors.
Environmental Justice	SMALL	Some impacts on housing availability and prices during construction may occur, as might beneficial impacts from property tax revenues.

9.2.5 Summary Comparison of Alternatives

Table 9-4 contains a summary of the review team's environmental impact characterizations for constructing and operating new nuclear, coal-fired, and natural-gas-fired power-generating units, and a combination of alternatives at the LNP site. The combination of alternatives shown in Table 9-4 assumes siting of three natural-gas-fired, combined-cycle units at the LNP site and siting of other alternative power-generating units within PEF's ROI. The significance levels used in the comparison table for the nuclear category originate from Chapters 4 and 5, construction and preconstruction as well as operational impacts.

The review team reviewed the available information on the environmental impacts of power-generation alternatives compared to the construction of new nuclear units at the LNP site. Based on this review, the review team concludes that, from an environmental perspective, none of the viable energy alternatives is environmentally preferable to construction of a new baseload nuclear power-generation plant at the LNP site.

Table 9-4. Summary of Environmental Impacts of Construction and Operation of New Nuclear, Coal-Fired, and Natural-Gas-Fired Power-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	SMALL to MODERATE
Waste Management	SMALL	MODERATE	SMALL	SMALL to MODERATE
Socioeconomics	LARGE Beneficial to MODERATE Adverse	LARGE Beneficial to MODERATE Adverse	LARGE Beneficial to MODERATE Adverse	LARGE Beneficial to MODERATE Adverse
Human Health	SMALL	SMALL	SMALL	SMALL
Historic and Cultural Resources	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL

Because of current concerns related to greenhouse gas (GHG) emissions, it is appropriate to specifically discuss the differences among the alternative energy sources regarding CO_2 emissions. The CO_2 emissions for the proposed action and energy-generation alternatives are discussed in Sections 5.8.1, 9.2.2.1, and 9.2.2.2. Table 9-5 summarizes the CO_2 emission estimates for a 40-year period for the alternatives considered by the review team to be viable for baseload power generation. These estimates are limited to the emissions from power generation and do not include CO_2 emissions for workforce transportation, construction fuel cycle, or decommissioning.

On June 3, 2010, the EPA issued a rule tailoring the applicability criteria that determine which stationary sources and modifications to existing projects become subject to permitting requirements for GHG emissions under the PSD and Title V Programs of the Clean Air Act (75 FR 31514). According to the source permitting program, if the source (1) is otherwise subject to PSD (for another regulated New Source Review [NSR] pollutant) and (2) has a GHG potential to emit equal to or greater than 75,000 T/yr of CO_2-e (adjusting for different global warming potentials for different GHGs), it would be subject to Best Available Control Technologies (BACT). The use of BACT has the potential to reduce the amount of GHGs emitted from stationary source facilities. The implementation of this rule could reduce the amount of GHGs from the values indicated in Table 9-5 for coal and natural gas, as well as from other alternative energy sources that would otherwise have appreciable uncontrolled GHG emissions. The emission of GHGs from the production of electrical energy from a nuclear power source is orders of magnitude less than those of the reasonable alternative energy sources. Accordingly, the comparative relationship between the energy sources listed in Table 9-5 would not change meaningfully because GHG emissions from the other energy source alternatives would not be sufficiently reduced to make them environmentally preferable to the proposed project.

Table 9-5. Comparison of Carbon Dioxide Emissions for Energy Alternatives

Generation Type	Years	CO_2 Emissions (metric tons [MT])
Nuclear Power[a]	40	22,500
Coal-Fired Generation[b]	40	678,000,000
Natural-Gas-Fired Generation[c]	40	229,000,000
Combination of Alternatives[d]	40	171,000,000

(a) From ER (PEF 2009b)
(b) From Section 9.2.2.1
(c) From Section 9.2.2.2
(d) From Section 9.2.4 (assuming only natural-gas generation has significant CO_2 emissions)

Considering the addition of life-cycle GHG emissions from the production of electricity from a nuclear power source, i.e., those from the fuel-cycle and transportation of workers, total emissions for plant operation over a 40-year period would increase to about 44,000,000 MT (Appendix I). This amount is still significantly lower than the emissions from any of the other alternatives; such emissions could be reduced further if the electricity from the assumed fossil fuel source powering the fuel cycle is subject to BACT controls.

The CO_2 emissions associated with generation alternatives such as wind, solar, and hydropower would be associated with workforce transportation, construction, and decommissioning of the facilities. Because these power-generation alternatives do not involve combustion, the review team considers the emissions to be minor and concludes that the emissions would have a minimal cumulative impact. Other energy-generation alternatives involving combustion of oil, wood waste, municipal solid waste, or biomass-derived fuels would have CO_2 emissions from combustion as well as from workforce transportation, plant construction, and plant decommissioning. It is likely that the CO_2 emissions from the combustion process for these alternatives would dominate the other CO_2 emissions associated with the generation alternative. It is also likely that the CO_2 emissions from these alternatives would be the same order of magnitude as the emissions for the fossil-fuel alternatives. However, because the review team determined that these alternatives do not meet the need for baseload power generation, the review team has not evaluated the CO_2 emissions quantitatively.

As discussed in Chapter 8, the review team concludes that the need for additional baseload power generation has been demonstrated. Also, as discussed earlier in this chapter, the review team concludes that the viable alternatives to the proposed action all would involve the use of fossil fuels (coal or natural gas). Consequently, the review team concludes that the proposed action results in the lowest level of emissions of GHGs among the viable alternatives.

9.3 Alternative Sites

This section discusses PEF's alternative site-selection process for possible siting of a new nuclear power plant. It provides the review team's description of the alternative sites selected and the building and operational impacts of locating two new units at each alternative site. Finally, the construction and operational impacts of the proposed and alternative sites are compared.

9.3.1 Alternative Sites Selection Process

NRC EISs prepared in conjunction with a COL application are to analyze alternatives to the proposed action (10 CFR 51.71(d)). This section discusses PEF's process for selecting its proposed and alternative sites and the review team's evaluation of the process. PEF's site-selection process was based on guidance in the following documents (PEF 2009b): the NRC's ESRP (NRC 2000), Regulatory Guide 4.2 (NRC 1976), Regulatory Guide 4.7 (NRC 1998), and the Electric Power Research Institute's (EPRI) Siting Guide (EPRI 2002). In evaluating sites, PEF assumed that a twin-unit Westinghouse Electric Company, LLC (Westinghouse) AP1000 pressurized water reactor would be built and operated (PEF 2009b).

NRC's site-selection process guidance calls for identification of an ROI, followed by successive screenings to identify candidate areas, potential sites, candidate sites, and the proposed site (NRC 2000). Candidate areas are those areas within an ROI that remain after areas unsuitable for nuclear power plant construction or operation have been excluded. Potential sites are those sites within candidate areas that meet minimum size and other siting criteria. Candidate sites are chosen from potential sites using a defined site-selection methodology and are those that would be expected to be granted construction permits or COLs. Candidate sites include both the proposed site and alternative sites.

9.3.1.1 Selection of Region of Interest

The ROI is the geographic area considered by an applicant in searching for candidate areas and potential sites for a new nuclear power plant. The ROI is typically the state in which the proposed site is located or the relevant service area for the proposed plant (NRC 2000). PEF selected as its ROI the land area included in the PEF service territory and all or parts of the Florida counties surrounding PEF's service territory, including Bay, Calhoun, Jackson, Suwannee, Columbia, Union, Bradford, Alachua, Clay, Putnam, Flagler, Volusia, Seminole, Brevard, Indian River, Okeechobee, St. Lucie, Glades, Highlands, De Soto, Hardee, Manatee, Pasco, Polk, and Hillsborough (see Figure 8-1) (PEF 2009b). PEF expanded the ROI around the periphery of its service territory to provide additional flexibility and to make sure it would not overlook any viable sites within a reasonable distance of the service territory. PEF's service territory is further discussed in Section 8.1.

9.3.1.2 Selection of Candidate Areas

Candidate areas are one or more areas within the applicant's ROI that remain after unsuitable areas for a new nuclear power plant (e.g., due to high population, lack of water, fault lines, or distance to transmission lines) have been removed from consideration (NRC 2000). PEF systematically reviewed candidate areas within the ROI using the ESRP guidance (NRC 2000) and the EPRI Siting Guide (EPRI 2002) as the basis for its selections. The following broad criteria were applied in screening for candidate areas within the ROI: population density, availability of cooling-water sources, dedicated Federal and State land uses, and regional ecological features (e.g., threatened or endangered species habitats) (PEF 2009a, b,). Areas were removed from consideration if they did not meet the required characteristics (e.g., population density no more than 300 persons/mi^2, no Federal or State parks). Nine areas that met the required characteristics were designated candidate areas and were plotted on a map of Florida. The following nine candidate areas were identified by PEF (PEF 2009b):

- Western Panhandle along the Gulf Coast/St. Joseph Bay (Bay and Gulf counties)
- Apalachicola and Chipola River basin areas (Calhoun, Gulf, and Liberty counties)
- Ochlockonee River basin along borders of Liberty, Franklin, Leon, and Wakulla counties
- Gulf Coast along Taylor and Dixie, Levy, Citrus, and Hernando counties
- Tampa Bay area/Manatee River south of Tampa/St. Petersburg area (Hillsborough and Manatee counties)
- Suwannee River basin (Dixie, Levy, Gilchrist, and Lafayette counties)
- Kissimmee River near Lake Okeechobee (Highlands, Okeechobee and Glades counties)
- St. Johns River basin (Seminole, Volusia, and Putnam counties)
- Atlantic Coastal areas (numerous locations between Flagler County to the north, and Indian River County to the south).

9.3.1.3 Selection of Potential Sites

Potential sites are those sites within a candidate area that have been identified by an applicant for preliminary assessment in establishing candidate sites (NRC 2000). Within the nine candidate areas, PEF used aerial photographs and other geographic information to identify potential sites for its planned new nuclear units.

In the first phase of the potential site-selection process, PEF used the following considerations to identify a number of general siting areas within the candidate areas (PEF 2009d):

- at least one potential site for each major water source
- proximity to transmission/load centers
- avoidance of high-population areas in the area
- consideration of ecologically sensitive and special designation areas, both along the coast and river corridors (e.g., Outstanding Florida Waters as defined by the FDEP (2009a)
- proximity to transportation (e.g., railroad lines, barge terminals)
- diversity of potential sites within the ROI (coastal and inland waterways)
- areas particularly compatible with PEF's business objectives.

PEF then searched within the general siting areas to identify potential sites, using the following factors:

- flexibility to optimize site layout and design to minimize costs and to avoid or mitigate environmental impacts
- minimization of the number of land parcels contained within the site
- optimization of site engineering factors (e.g., topography, foundation conditions, grading requirements).

Finally, the following criteria were applied in locating potential sites (PEF 2009b):

- distance to existing transmission-load centers in the Orlando and Tampa/St. Petersburg areas was minimized to the extent possible.
- distance from towns, villages, and developed areas was maximized.
- distance from industrial areas identifiable from the aerial photographs and topographic maps (e.g., airports, industrial complexes) was maximized.

- when possible, land near existing water-supply sources (rivers, lakes, and coastal areas) was identified.
- the optimal topography was assumed to be a relatively flat area above the 100-year floodplain for construction of the plant, adjacent to streams with surrounding topography showing some relief.
- vehicle transportation access to the potential sites was qualitatively evaluated. Land areas around major highways were avoided, but those within a reasonable distance of State highways were considered.
- potential sites up to 6000 ac in size were considered, although some sites as small as 2000 ac were also considered (PEF 2009e). PEF selected 20 potential sites for new nuclear units based mainly on the availability of sufficient land for two AP1000 reactors and the availability of sufficient cooling water for the units. As shown in Figure 9-1, the 20 potential sites are located in the following counties: Calhoun, Liberty (two sites), Gilchrist, Putnam (three sites), Volusia, Seminole, Highlands and Glades, Manatee, Hillsborough, Citrus, Levy (three sites), Dixie, Lafayette, Taylor, and Gulf (PEF 2009b).

9.3.1.4 Selection of Candidate Sites

Candidate sites are those potential sites within the ROI that are considered in the comparative evaluation of sites to be among the best that can reasonably be found for the siting of a nuclear power plant (NRC 2000).

PEF's technical evaluation and screening of the 20 potential sites were based on criteria derived from the EPRI Siting Guide (EPRI 2002) as well as PEF staff expertise on transmission issues, environmental issues, community support, economic development, and State and local regulations at each of the sites. The following nine screening criteria were used to select candidate sites:

- availability of an adequate cooling-water supply
- flooding potential
- distance to nearest population center and regional population density
- distance from hazardous land uses (e.g., airports, pipelines)
- numbers of threatened or endangered species within the site area
- acreage of wetlands within the site area
- railroad access
- transmission-line access
- estimated cost of acquiring the land at the site.

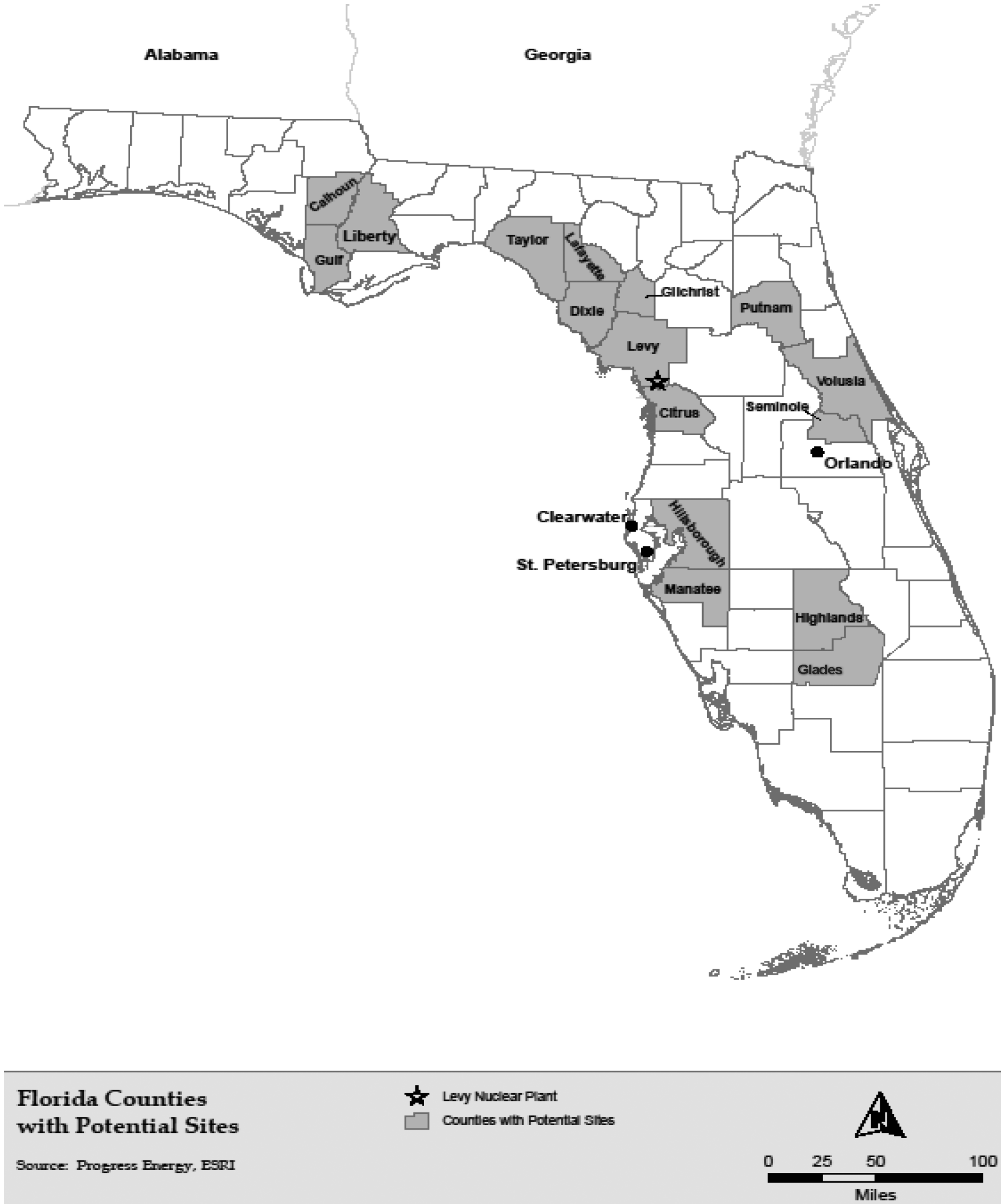

Figure 9-1. Map Highlighting the Florida Counties in Which the Top 20 Potential Sites for New Nuclear Units Are Located

Numerical ranges were defined for each of the nine criteria. For example, for the wetlands criterion, the metric used in the screening process was the number of acres of wetlands within the potential site area, and the following ratings were defined (PEF 2009b):

- 5 = less than 60 ac
- 4 = less than 300 ac
- 3 = less than 600 ac
- 2 = less than 1200 ac
- 1= greater than 1200 ac.

Each of the 20 potential sites was assigned a rating of 1, 2, 3, 4, or 5 on the wetlands criterion, and a rating was also assigned for the other eight screening criteria. PEF staff obtained criteria weights from previous nuclear power plant siting studies to reflect the relative importance of each criterion. The overall score for each potential site, reflecting its overall suitability for construction of a nuclear power plant, was developed by multiplying each criterion rating by its corresponding criterion weight, and then summing over all nine criteria. The potential sites with the highest overall scores were selected for more detailed analysis (PEF 2009d).

PEF's technical evaluation identified the following eight candidate sites for more detailed evaluation:

- Crystal River
- Dixie
- Gilchrist
- Hillsborough
- Lafayette
- Levy 2
- Levy 3
- Taylor.

For the reasons described below, PEF decided to make several modifications to the initial list of candidate sites (PEF 2009b):

- Gilchrist was removed from the list due to the need for a supplemental reservoir and related water supply constraints.
- Hillsborough was removed from the list due to water supply uncertainties and potential transmission connection constraints.
- Putnam 3 was added to the list based on its location allowing an alternative water source (St. Johns River), proximity to PEF load centers, rail and transmission access advantages, and real estate considerations.

- Highlands was added to the list based on its location allowing an alternative water source (Kissimmee River) and proximity to PEF load centers.

So the final list of eight candidate sites selected by PEF for more detail evaluation was as follows (PEF 2009b):

- Crystal River
- Dixie
- Highlands
- Lafayette
- Levy 2
- Levy 3
- Putnam 3
- Taylor.

9.3.1.5 Selection of Alternative Sites

The next step in the site-selection process was to select from the eight candidate sites a suite of alternative sites for detailed evaluation and consideration. General siting criteria derived from the EPRI Siting Guide (EPRI 2002) were tailored to specific issues applicable to the candidate sites. PEF used 40 criteria related to health and safety (e.g., geology and seismology, extreme weather conditions, surface-water radionuclide pathway), environmental considerations (e.g., disruption of important species/habitats, dewatering effects on adjacent wetlands, thermal discharge effects), socioeconomics (e.g., construction-related effects, operations-related effects, environmental justice), and engineering and cost considerations (e.g., pumping distance, highway access, land rights) to screen the candidate sites and identify the five alternative sites.

The process used for this more-detailed analysis was analogous to the process described in Section 9.3.1.4. Each of the eight candidate sites was assigned a rating from 1 to 5 on each of the 40 criteria. PEF staff obtained criteria weights from other siting studies to reflect the relative importance of each criterion. The overall score for each candidate site, reflecting its overall suitability for construction of a nuclear power plant, was developed by multiplying each criterion rating by its corresponding criterion weight, and then summing over all 40 criteria (PEF 2009b). In addition to this quantitative analysis, helicopter flyovers of the sites provided additional input to the decision (PEF 2009d).

Following this analysis, PEF selected the following alternative sites:

- Crystal River
- Dixie
- Highlands

- Levy 2
- Putnam 3.

The other three candidate sites (Taylor, Levy 3, and Lafayette) were dropped from further consideration based on a number of factors. Even though Taylor had ranked in the top 5 sites using the 40-criteria evaluation, Taylor, along with Levy 3, would require extended pipelines in estuarine areas between the sites and the Gulf of Mexico, which could result in permitting and regulatory concerns. Both sites are also located along the coast, which makes them vulnerable to storm surge flooding. The Lafayette site would require zoning and land-use changes due to existing residential and recreational land uses (PEF 2009b).

9.3.1.6 Selection of the Proposed Site

To screen the five alternative sites to identify a proposed site, PEF performed a technical evaluation of each alternative site that included the following components: transmission-line evaluations, geotechnical studies, environmental assessments, reliability analyses, and land-acquisition analyses. PEF's evaluations considered the land-use, water-related, ecological, and socioeconomic impacts of locating two new reactors at each of the five alternative sites. PEF concluded that all five alternative sites represented a cross-section of siting tradeoffs available within the ROI, including a variety of water sources, locations, and transmission connection strategies (PEF 2009b). The Crystal River and LNP sites were ranked highest mainly due to geological conditions and the availability of cooling-water sources (PEF 2009b).

PEF also evaluated whether the advantages of collocating new nuclear power-generating units with its existing power plant at the Crystal River site outweighed the potential advantages of the other alternative sites. The following potential advantages of collocation were identified in the application (PEF 2009b):

- The total number of required power-generating sites is reduced.
- Construction of new transmission-line corridors may not be required due to potential use of existing corridors.
- No additional land acquisitions would be necessary because PEF already controls the property.
- The site has already gone through the alternatives review process mandated by NEPA, and was the subject of extensive environmental screening during the original site-selection process.
- The site-development costs and environmental impacts of any preconstruction activities would be reduced.
- Construction, installation, and operation and maintenance costs would be reduced because of the existing site infrastructure.

However, PEF indicated that, based on strategic considerations, the LNP site would be preferable to the Crystal River site because it is located farther from the Gulf Coast and at a higher elevation, providing increased protection from hurricane-induced wind and flood damage. In addition, adding new nuclear generating capacity at the CREC would result in a significant concentration of PEF's generating assets at one location, which would make the PEF system overly vulnerable to a major hurricane or other natural or man-made disaster. It was also important to PEF to select a site that would address the projected effects of future climate-related changes (PEF 2010), including an expected 3-ft rise in sea levels by the end of the century and increased hurricane intensity, resulting in increased winds, rain, and storm surge heights (GCRP 2009). On the basis of its environmental analysis and strategic business considerations, PEF selected the Levy 2 area as its proposed site.

9.3.1.7 Review Team Evaluation of PEF's Site-Selection Process

The review team evaluated the methodology used by PEF to select its proposed and alternative sites. PEF's designated ROI is consistent with the description in NRC's guidance for preparation of ERs for nuclear power stations (NRC 2000). PEF established candidate areas based on a group of exclusionary criteria similar to those described in ESRP 9.3. The staff evaluated the exclusionary criteria and determined that they were reasonable. Next PEF identified potential sites within the candidate areas based on aerial photographs and other geographic information, and evaluated them against a set of high-level criteria. PEF then used more specific criteria to evaluate the potential sites and identify candidate sites, including the alternative sites and its preferred site. The staff reviewed the specific criteria used to identify potential sites, candidate sites, and alternate sites and concluded that application of the criteria would result in the identification of alternate sites that are among the best that can reasonably be found in the candidate areas. In addition, the staff reviewed the technical evaluation used to evaluate each of the identified alternative sites and found the criteria and the application of the criteria to each alternative site reasonable.

Based on its review of PEF's site-selection process using NRC's guidance, the review team concludes that PEF's process for selecting its ROI, candidate areas, potential sites, candidate sites, alternative sites, and the proposed LNP site was reasonable; resulted in the identification of alternative sites that were among the best that could reasonably be found in the ROI; did not arbitrarily exclude locations that might be suitable choices for siting two new nuclear generating units to satisfy the need for power identified in Chapter 8; and was consistent with the guidance in ESRP 9.3 and the EPRI siting guidance (EPRI 2002).

9.3.1.8 Evaluation of the Alternative Sites

The four alternative sites examined in detail in this chapter are Crystal River, located in Citrus County; Dixie, located in Dixie County; Highlands, located in Highlands and Glades counties; and Putnam, located in Putnam County – all in Florida. The NRC staff visited each of the four alternative sites and the proposed site. The review team used information in PEF's ER related to the four alternative sites and also independently collected and analyzed reconnaissance-level information for each of the alternative sites using ESRP 9.3 (NRC 2000) as guidance.

In the discussion of the alternative sites that follows, the review team evaluated cumulative impacts of building and operating two new nuclear units at each site for each resource category, considering the impacts of other nearby projects on that resource. Included in the cumulative analysis are past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the proposed action. For purposes of this analysis, the past is defined as the time period before receipt of the COL application. The present is defined as the time period from the receipt of the COL application until the start of building the proposed Units 1 and 2. The future is defined as the start of building Units 1 and 2 through operation and eventual decommissioning.

Using Chapter 7 as a guide, the specific resources and components that could be affected by the incremental effects of the proposed action if implemented at the alternative site and other actions in the same geographic area were identified. The affected environment that serves as the baseline for the cumulative impacts analysis is described for each alternative site and includes a qualitative discussion of the general effects of past actions. For each resource area, the geographic area over which past, present, and future actions could reasonably contribute to cumulative impacts is defined and described in later sections. The analysis for each resource area at each alternative site concludes with a cumulative impact finding (SMALL, MODERATE, or LARGE). For those cases in which the impact level for a resource was greater than SMALL, the review team also discussed whether building and operating the nuclear units would be a significant contributor to the cumulative impact. In the context of this evaluation, "significant" is defined as a contribution that is important in reaching that impact-level determination.

The nonradiological waste impacts described in Sections 4.10 and 5.10 would not vary significantly from one site to another. The types and quantities of nonradiological and mixed waste would be approximately the same for the construction and operation of two AP1000 reactors at any of the alternative sites. For each alternative, all wastes destined for land-based treatment or disposal would be transported offsite by licensed contractors to existing, licensed, disposal facilities operating in compliance with all applicable Federal, State, and local requirements, and all nonradioactive, liquid discharges would be discharged in compliance with the provisions of the applicable NPDES permit. For these reasons, these impacts are not discussed separately in the evaluation of each alternative site.

The impacts described in Chapter 6 (e.g., nuclear fuel cycle, decommissioning) would not vary significantly from one site to another. This is true because all of the alternative sites and the proposed site are in low-population areas and because the review team assumes the same reactor design (therefore, the same fuel-cycle technology, transportation methods, and decommissioning methods) for all of the sites. As such, these impacts would not differ between the sites and would not be useful in the determination of whether an alternative site is environmentally preferable to the proposed site. For this reason, these impacts are not discussed in the evaluation of the alternative sites.

The cumulative impacts are summarized for each resource area at each site in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area. The findings for each resource area at each alternative site then are compared in Table 9-31 at the end of this chapter to the cumulative impacts at the proposed site (brought forward from Chapter 7). The results of this comparison are used to determine if any of the alternative sites is environmentally preferable to the proposed site.

9.3.2 Crystal River Site

This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant adjacent to the CREC. The CREC is located in a rural area of Citrus County about 9 mi southwest of the LNP site, approximately 5 mi south-southwest of Inglis, and about 8 mi northwest of Crystal River. The Crystal River alternative site (hereafter Crystal River site) proposed for additional units would be located adjacent to the current CREC footprint on land owned by PEF. The Gulf of Mexico would be the source for water for plant cooling and other plant uses, and construction of a new water-storage reservoir would not be required. The CREC is an industrial site currently owned and operated by PEF (PEF 2009b). Conceptual routes of transmission lines necessary to connect the Crystal River site would follow the corridors for LNP without the need for an LNP-to-CREC corridor.

The following sections include a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if implemented at the Crystal River site and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction and operations and impacts of preconstruction activities. Also included in the assessment are past, present, and reasonably foreseeable future Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Crystal River site. Other actions and projects considered in this cumulative analysis are described in Table 9-6.

The geographic area of interest for cumulative impacts considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Crystal River site. An accident at a nuclear plant within 100 mi of the Crystal River site could potentially increase this risk. However, other nuclear plants in Florida, Alabama, and Georgia that are more than 100 mi from the Crystal River site are not included in the cumulative impact analysis.

Table 9-6. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Analysis of the Crystal River Alternative Site

Project Name	Summary of Project	Location	Status
Energy Projects			
Operation and decommissioning of CREC Units 1 to 5	The CREC consists of five power-generating plants operated by PEF, four fossil-fuel plants, and one nuclear plant. The fossil-fuel plants began operations in 1966, 1969, 1982, and 1984. The nuclear plant began operations in 1977.	Adjacent to the Crystal River site	Operational. The nuclear plant (Unit 3) is shut down due to damage to the containment. The State of Florida's Siting Board's Conditions of Certification for LNP would require PEF to discontinue the operations of two fossil-fuel units by December 31, 2020, assuming licensing, construction and commencement of operation of LNP occurs in a timely manner[(a)] (PEF 2011e, DOE/EIA 2010b; FDEP 2011).
Renewal of the CREC nuclear Unit 3 Operating License	Extension of operations of CREC Unit 3 for an additional 20-year period beyond the end of the current license term, which is valid through midnight December 3, 2016	Adjacent to the Crystal River site	Proposed. If granted, the license renewal would provide PEF the authority to continue operations through 2036. The draft Supplemental EIS for the license was issued on May 26, 2011 (NRC 2011a).

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Uprate at CREC Unit 3	CREC Unit 3 has requested a power uprate to increase the maximum power level at which the nuclear power plant may operate. The project would also include construction of a new helper cooling tower	Adjacent to the Crystal River site	Proposed. The application submitted to the State of Florida was approved in August 2008. USACE issued a public notice on May 25, 2010 (USACE 2010a). PEF submitted an application to NRC on June 15, 2011 (PEF 2011f).
Inglis Lock bypass channel spillway hydropower project	2-MW hydroelectric project at the existing Inglis Lock bypass spillway. This project would include construction of an intake structure, intake and discharge channels, turbines, and a transmission line.	About 5 mi northeast of the Crystal River site	Proposed. An application has been submitted to the Federal Energy Regulatory Commission (FERC 2009a).
Florida Gas Transmission Company, LLC (FGT) Phase VIII Expansion Project	Construction and expansion of natural-gas pipelines, new compressor, meter, regulator stations, and other appurtenant facilities	Various counties in Alabama and Florida, including Levy, Citrus, and Hernando. Route passes 2 mi east of Crystal River site.	Placed in service on April 1, 2011 (FERC 2009b; Panhandle Energy 2011)
Mining Projects			
Tarmac King Road Limestone Mine	A 9400-ac aggregate mining site. The mining site would be 4800 ac (including 900 ac set aside for wetlands); with remaining 4600 ac donated to Florida for preservation.	The southern border of the site is about 8 mi north-northeast of the Crystal River site	Proposed. A permit application was submitted to USACE in September 2007. A draft EIS is expected to be completed in 2012 (USACE 2008; PEF 2009e).

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Holcim Mine	Limestone quarry	About 1 mi north of the Crystal River site	Operational (FDEP 1997)
Inglis Quarry	Limestone quarry	About 3 mi north of the Crystal River site	Operational (EPA 2010a)
Crystal River Quarries – Red Level	Limestone quarry	About 3 mi east of the Crystal River site	Operational (EPA 2010b)
Crystal River Quarries – Lecanto	Limestone quarry	About 16 mi east-southeast of the Crystal River site	Operational (EPA 2010c)
Gulf Hammock Quarry	Limestone quarry	About 19 mi north of the Crystal River site	Operational (EPA 2010d)
Transportation Projects			
Cross Florida Barge Canal (CFBC)/ Marjorie Harris Carr Cross Florida Greenway	The CFBC was a proposal to connect the Gulf of Mexico to the Atlantic Ocean. Two sections were partially constructed between 1964 and 1971. A constructed section extends westward from Lake Rousseau to the Gulf of Mexico. Portions of the CFBC are currently used as part of the Marjorie Harris Carr Cross Florida Greenway (FDEP 2010a).	About 3 mi north of the Crystal River site	Operational downstream of Lake Rousseau. Marjorie Harris Carr Cross Florida Greenway is currently managed as a protected greenbelt corridor. Construction was suspended January 1971 (FDEP 2010a).
Widening of the US-19 bridge and highway at the CFBC	The project widened the bridge from two lanes to four lanes on two spans	About 3 mi north of the Crystal River site	The project was completed in July 2011 (FDOT 2010a, 2011)

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Parks and Aquaculture Facilities			
Parks, forests, and reserves	Numerous State and national parks, forests, reserves, and other recreational areas, including: Goethe State Forest, Big Bend Seagrasses Aquatic Preserve, St. Martens Marsh, Fanning Springs State Park, Chassahowitzka National Wildlife Refuge, Fort Cooper State Park, Cedar Keys National Wildlife Refuge; Cummer Sanctuary, Crystal River National Wildlife Refuge, Lower Suwannee National Wildlife Refuge; Withlacoochee State Forest; Ocala National Forest; Crystal River Preserve State Park; Silver River State Park; and the Homosassa Springs Wildlife State Park	Throughout 50-mi region	Development likely limited in these areas (PEF 2008)
Crystal River Mariculture Center	Multi-species marine hatchery	Adjacent to Crystal River site	Operational (FFWCC 2011)
Other aquaculture facilities	Multi-species marine hatcheries	Throughout region	Operational
Other Actions/Projects			
Commercial forest management	Managed forests for timber production	Throughout region	Operational
Commercial dairies	Several dairies are located within the 50-mi region, including the Levy County Dairy, Alliance, and Piedmont Dairies, Hill Top Dairy, and Oak Grove Dairy, Inc.	Throughout region	Operational
Minor water dischargers and wastewater-treatment plants	NPDES-permitted dischargers in Fanning Springs, Trenton, Blitchville, Bell, Chiefland, Cedar Key, Suwannee, and other locations	Throughout region	Operational

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Concrete companies	Two ready-mixed concrete suppliers	Northern Levy County	Operational (EPA 2010e, f)
Various hospitals and industrial facilities that use radioactive materials	Medical and other industrial isotopes	Within 50 mi	Operational in nearby cities and towns
Future urbanization	Construction of housing units and associated commercial buildings such as the proposed Port District near Inglis; roads, bridges, and railroads, such as the Suncoast toll road expansion; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents	About 3 mi north of the CREC and throughout region	Construction would occur in the future, as described in local land-use planning documents (FTE 2010; Citrus County 2009)

(a) Although the timeline for licensing, construction, and operation of the LNP has shifted since the Conditions of Certification were published, it is reasonable to expect that CREC Units 1 and 2 will discontinue operations when the LNP comes online.

9.3.2.1 Land-Use Impacts

The following analysis includes impacts from building and operating two nuclear units at the Crystal River site, along with the necessary transmission lines to connect them to the electrical grid. The analysis also considers other past, present, and reasonably foreseeable future actions that affect land use, including the other Federal and non-Federal projects listed in Table 9-6. For this analysis, the geographic area of interest is the area within a 15-mi radius of the Crystal River site and the area within the transmission-line corridors. The review team determined that a 15-mi radius would represent the smallest area that would be directly affected because it includes the primary communities (such as Crystal River, Homossassa Springs, Inglis, and Yankeetown) that would be affected by the proposed project if it were located at the Crystal River site. The review team is aware that PEF has made minor revisions (PEF 2011a; CH2M HILL 2010) to the proposed site layout and associated offsite facilities in coordination with USACE to minimize impacts on wetlands. These minor changes did not change the land-use impact determinations since the draft EIS, therefore the following evaluation was completed with original information provided by PEF and was not updated.

Historically, Citrus County was known for mining and timber operations as well as its namesake citrus orchards, but today only one large grove remains. From 1964 to 1972, the CFBC was partially constructed from the Gulf of Mexico to Lake Rousseau. Currently, this area and other lands that were acquired to construct the CFBC are managed as the Marjorie Harris Carr Cross-Florida Greenway to conserve natural resources and provide recreational opportunities. Construction of the CREC, which consists of five power-generating plants operated by PEF, four fossil-fuel plants, and one nuclear plant, began in the 1960s. The fossil-fuel plants began operations in 1966, 1969, 1982, and 1984. The 850-MW nuclear plant began operations in 1977. From 1960 until 1985, the population of Citrus County increased from about 10,000 to about 70,000, and the population of Levy County increased from about 10,000 to about 22,000 (USCB 2000a). Thus, residential land use in the region increased dramatically during that period.

The Crystal River site is adjacent to the existing CREC and has level terrain that gradually slopes west toward the Gulf of Mexico. The land uses in the region are a mix of industrial development, agriculture, forestry, and mining. The site already includes both nuclear and fossil-fuel power plants, so zoning is compatible with additional nuclear power-generating plants. The Crystal River site is subject to the Florida Coastal Management Act (FDEP 2011a), because the plant is located within one of the designated Florida coastal zone counties. There are several public properties within the region, including the Goethe State Forest, Cedar Keys National Wildlife Refuge, Cummer Sanctuary, Crystal River National Wildlife Refuge, Lower Suwannee National Wildlife Refuge, Withlacoochee State Forest, Ocala National Forest, Crystal River Preserve State Park, Fanning Springs State Park, Silver River State Park, Chassahowitzka National Wildlife Refuge, Fort Cooper State Park, and Homosassa State Park (PEF 2009b).

PEF would not have to acquire new land for the siting of new nuclear reactor units at Crystal River. Like the LNP site, the footprint of new power-generating units would be approximately 627 ac, with about 150 ac of additional land needed for temporary facilities and laydown yards. Because the Crystal River site already has been developed as a power station, the review team expects additional land conversions to industrial or utility use would be minimal.

Additional land-use impacts include possible additional growth and land conversions to accommodate new workers and services. Because the workforce would be dispersed over larger geographic areas in the labor supply region, the impacts from land conversion for residential and commercial buildings induced by new workers relocating to the local area can be absorbed into the wider region. Therefore, the review team concludes that such impacts would be minimal.

Although transmission-line corridors exist to serve the Crystal River site, approximately 180 mi of additional transmission system infrastructure would be needed. The review team estimated the linear run of the expected transmission-line corridors by referring to Table 4-3, which addresses the potentially affected land use in the conceptual transmission-line corridors. In the case of Crystal River, this routing is somewhat similar to that described for LNP Units 1 and 2 in

Section 4.1.2 and would amount to about 180 linear miles. For purposes of land-use impact analysis, the review team made the assumption that 10 ac/mi would be disturbed, based on the LNP case where 1790 ac are expected to be disturbed over the 180 mi of corridor, as discussed in Section 4.1.2. The review team concludes that this assumption is reasonable because siting in Florida through the Site Certification Application process is a rigorous process and the applicant would be bound by permit conditions resulting from that process, which would force it to use existing corridors to the extent practicable. The review team expects the FDEP Conditions of Certification for the LNP site (FDEP 2011b) would be consistently applied anywhere transmission lines are proposed in Florida, which would lessen the overall environmental impacts.

As stated above, the State of Florida requires that new transmission lines be collocated within existing transmission-line corridors to the extent possible, thereby minimizing potential terrestrial impacts (FDEP 2011b). In addition, transmission-line corridors, towers, and access road would be situated to avoid critical or sensitive habitats and species and historical and cultural resources to the extent possible. Transmission-line corridor width would be dependent on the size, voltage, and whether existing corridors could be used, and would vary from 55 ft to 460 ft. These widths were used in the analysis of the hypothetical routes for each alternative site to determine land-use cover types (CH2M HILL 2009). Existing transmission-line corridors run through counties designated under the Florida Coastal Management Program (FDEP 2009b).[a] Any expansion of these transmission-line corridors would require review under the procedures established under the Florida Coastal Zone Management Act (FDEP 2011a). Procedures for siting new transmission lines in Florida are discussed in Section 4.1.2. The review team assumes that the Conditions of Certification issued to PEF by the FDEP would apply at all of the alternative sites. Similar to the case at the LNP site, the review team concludes that land-use impacts from developing about 180 mi of new transmission-line corridor to connect new units at the Crystal River site would be noticeable, but not destabilizing, and additional mitigation beyond the measures identified by PEF and conditions identified by the State of Florida would not be warranted.

Cumulative Impacts

Within the geographic area of interest, the reasonably foreseeable project with the greatest potential to affect cumulative land-use impacts would be the Tarmac King Road Limestone Mine. The 9400-ac mine site is located 1 mi west of the intersection of U.S. Highway 19 (US-19) and King Road in Levy County, within about 8 mi of the Crystal River site. About 2700 ac would be mined over about a 100-year period, with an additional 1300 ac disturbed to

(a) The Florida Coastal Management Program makes funds awarded under the Coastal Zone Management Act available as pass-through grants to State agencies, water-management districts, local governments, national estuary programs, and national estuarine research reserves for priority projects that protect coastal resources and communities.

site a quarry processing plant, roads, and other infrastructure and 900 ac set aside for wetlands. The company plans to donate another 4500 ac of land to the State of Florida for preservation. Tarmac America LCC (Tarmac) has applied for permits to begin operations in 2013; USACE has not yet issued the EIS for this permitting action. Tarmac estimates that at the height of mining activity, about 500 trucks would leave the mine site daily and enter US-19 (Tarmac America 2010). The potential impacts from this increased traffic, coupled with traffic from the CREC site, are considered in Section 9.3.2.5. Completion of the new US-19 bridge expansion, which occurred in July 2011, and the future expansion of the Suncoast toll road will help alleviate some of the traffic issues. Because the mine would include less than 7 percent of the geographic area of interest, excluding the Gulf water area, the review team expects that the proposed Tarmac mine would have a detectable, but not noticeable, effect on land use.

In the State of Florida's Conditions of Certification (FDEP 2011b), CREC Unit 1 and 2, two coal-fired plants, would stop operating by December 31, 2020, as long as PEF completes the licensing process, construction activities, and commences commercial operation of LNP Units 1 and 2 within a timely manner. If the Crystal River site were selected, the review team expects the same condition would apply. If CREC Units 1 and 2 are shut down, land use at the units likely would remain industrial. Depending on economic conditions, PEF sells 60 to 95 percent of the coal plant ash to cement and building materials manufacturers, with the remainder going to Citrus Central Landfill in Lecanto, Florida. With the closure of CREC Units 1 and 2, this source of ash no longer would be available locally. The review team expects land-use impacts associated with this project would be minimal.

Future urbanization in the review area could contribute to additional decreases in open areas, forests, and wetlands and generally result in some increased residential and industrialized areas. Currently, only about 18 percent of Citrus County is in residential land use (PEF 2008), but local land-use planning documents describe future construction of residential and commercial buildings. The University of Florida, Bureau of Economic and Business Research (BEBR) projects that the Citrus County population will increase approximately 40 percent from 2000 to 2020, which constitutes an average annual increase of about 2 percent (Citrus County 2008).

Increased urbanization, especially long linear projects such as new or expanded roads or pipelines, would also contribute to the loss of open or forested areas and increase fragmentation of habitats along or near the transmission lines. Due to the extent of new transmission lines that would be built, the review team expects that the corridors would have a noticeable impact on the local area. The Florida Department of Transportation (FDOT) has already widened the US-19 bridge and plans to expand the Suncoast toll road. Florida Gas Transmission Company recently placed into service its LNG pipeline collocated with the existing pipeline in the vicinity of the Crystal River site (Panhandle Energy 2011). These projects would have limited impacts on land use because a small incremental amount of land would be converted to a new land use, and it would be adjacent to the current roads or pipelines. Development would likely be limited in the nearby Goethe State Forest and other parks and recreational areas. Therefore, the incremental impacts associated with increased urbanization would be minimal.

Global climate change could increase temperature and reduce precipitation, which could result in reduced crop yields and livestock productivity (GCRP 2009), which, in turn, may change portions of agricultural and ranching land uses in the geographic area of interest. In addition, global climate change could increase sea level and storm surges in the geographic area of interest (GCRP 2009), thereby changing land use through inundation and loss of coastal wetlands and other low-lying areas. However, existing State and national forests, parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by sea-level rise. Because other projects identified in Table 9-6 that are within the geographic area of interest would be consistent with applicable land-use plans and control policies and would occur in dispersed locations, the review team considers their contribution to the cumulative land-use impacts to be relatively minor and manageable.

Based on the information provided by PEF and the review team's independent review, the review team concludes that the cumulative land-use impacts of building and operating two new nuclear power units at the Crystal River site and other projects would be MODERATE. The incremental impact from the proposed project would be a significant contributor to the MODERATE impacts due to the extent of new transmission lines that would be built.

9.3.2.2 Water Use and Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that could affect water use and quality, including the other Federal and non-Federal projects listed in Table 9-6.

The geographic area of interest for surface water at the Crystal River site includes the Gulf of Mexico and the Springs Coast watershed in the vicinity of the site and for groundwater, the surficial aquifer at the site and the Upper Floridan aquifer within 20 mi of the site. These regions are of interest because they represent the water resource potentially affected by building and operating the proposed project at the Crystal River site.

Building Impacts

PEF has not determined whether new cooling-water intake and discharge structures would be required for the Crystal River site, but use of the existing intake configuration for existing CREC Units 4 and 5 and the existing discharge canal are likely sites for these respective structures. CREC Units 4 and 5 use water discharged from CREC Units 1 to 3 for cooling water, and the effluents may be a possible source of cooling water for the additional two units (CH2M HILL 2009). Similarly, the discharge canal receives discharge from all five existing units, and the discharge for the additional two units could outfall into the existing canal, or tie into blowdown pipelines from one of the existing units.

Consistent with the proposed water use at the LNP site, the review team assumed that no surface water would be used to build the units at the Crystal River site. Therefore, the review team determined that there would be no impacts on surface-water use.

Wetlands located on or adjacent to the site could be affected by surface-water runoff during site preparation and the building of the facilities. The FDEP would require PEF to develop an Erosion and Sediment Control Plan (E&SCP) and a stormwater pollution prevention plan (SWPPP) (PEF 2009b). These plans would be developed before initiation of site-disturbance activities and would identify control measures to be used during site-preparation activities to mitigate erosion and control stormwater runoff (PEF 2009b). The plan would identify BMPs to control stormwater runoff. The review team anticipates that PEF would construct new detention and infiltration ponds and drainage ditches to control delivery of sediment from the disturbed area to onsite waterbodies. Sediment carried with stormwater from the disturbed area would settle in the detention ponds and stormwater would infiltrate into the shallow aquifer. Implementation of BMPs should minimize impacts on bodies of surface water near the Crystal River site. Therefore, the impacts on surface-water quality near the Crystal River site would be temporary and minimal.

The review team assumes that the groundwater use for building activities at the Crystal River site would be identical to the proposed groundwater use for the LNP site. During building, the maximum groundwater withdrawal rate is projected to be 550,000 gpd and the projected average groundwater withdrawal rate would be 275,000 gpd (see Table 3-2). Groundwater would be used for potable and sanitary use as well as various building-related activities. The groundwater withdrawal rate during building activities would be less than the potential operation withdrawal rate. PEF provided no specific information about where it would obtain water for building the units at the Crystal River site. However, PEF currently draws water from the Upper Floridan aquifer for the operation of the existing units at the CREC (PEF 2008). The U.S. Geological Survey (USGS) estimates that the current groundwater withdrawal in Citrus County to be about 30 Mgd (PEF 2007a). The additional water that would be withdrawn to build the new units would be a small fraction of this current withdrawal. The review team concludes that the impact of groundwater use for building the potential plant at the Crystal River site would be minimal and limited to the building period.

While building the potential plant at the Crystal River site, groundwater quality may be affected by leaching of spilled effluents into the subsurface. The review team assumes that the BMPs PEF has proposed for the LNP site would also be in place at the Crystal River site during building activities and therefore the review team concludes that any spills would be quickly detected and remediated. In addition, groundwater impacts would be limited to the duration of these activities, and therefore, would be temporary. The review team evaluated the BMPs that could be implemented at such a site (FDEP 2011b). Because any spills related to building activities would be quickly remediated under BMPs, and the activities would be temporary, the review team concludes that the groundwater-quality impacts from building at the Crystal River site would be minimal.

Operational Impacts

PEF has proposed a closed-cycle cooling system for two additional units at the LNP site. PEF indicated that the Gulf of Mexico would be the source of cooling water. The review team assumed that the cooling water system for the proposed units, if they were to be built and operated at the Crystal River site, would be similar to that proposed at the LNP site; specifically, the cooling water system would use cooling towers. The blowdown discharge from the additional units would be mixed with the CREC discharge. Because the two additional units at the Crystal River alternative site would also withdraw makeup water for their closed-cycle cooling systems, the review team assumed that the makeup water withdrawal rate and the blowdown discharge rate would be the same as that at the LNP site, specifically 84,780 gpm (190 cfs) and 57,923 gpm (129 cfs), respectively.

Because the Gulf of Mexico is a virtually unlimited source of water, the review team determined that the use of Gulf of Mexico waters for cooling the additional units at the Crystal River site would have a minimal impact. Therefore, the impact on surface-water resources due to plant use during operations would not be noticeable.

During the operation of the additional units at the Crystal River site, impacts on surface-water quality could result from stormwater runoff, discharges of treated sanitary and other wastewater, and blowdown from cooling towers into the Gulf of Mexico. The FDEP would require PEF to develop a SWPPP (PEF 2009b). The plan would identify measures to be used to control stormwater runoff (PEF 2009b). The blowdown would be regulated by FDEP pursuant to 40 CFR Part 423, and all discharges would be required to comply with limits established by FDEP in an NPDES permit.

The review team analyzed the impact of discharging effluent from the proposed Units 1 and 2 at the LNP site on the CREC discharge canal. The review team determined that the impact on water quality in the Gulf of Mexico would be small if the two proposed units were located at the LNP site. If the proposed units were located at the Crystal River site, the effluent would still be discharged to the Gulf of Mexico via the CREC discharge canal. Therefore, the review team determined that the assessment of surface-water quality impacts for the LNP site (see Section 5.2.3.1) would remain applicable to the Crystal River site. Therefore, the impact on surface-water quality due to operation of additional units at the Crystal River site would be minimal.

PEF currently relies on groundwater at the CREC to meet operational needs for potable water and other plant systems requiring freshwater (PEF 2008). PEF currently has seven active groundwater wells and three inactive groundwater wells at the CREC to supply groundwater to the existing power plants. The wells are currently permitted to withdraw 2 Mgd, and PEF is anticipating increasing the permitted amount by 265,000 gpd once the inactive wells are permitted. As indicated above, the USGS estimates the current groundwater withdrawal in Citrus County to be about 30 Mgd (PEF 2007a).

PEF indicated that the annual average groundwater withdrawal to support operations of two units at the LNP site would be 1.58 Mgd (PEF 2009e). The review team assumes that the groundwater use for operation of additional units at the Crystal River site would be similar to the proposed groundwater use for the LNP site. This would be an increase in groundwater withdrawal in the vicinity of the CREC of approximately 70 percent, and an increase in groundwater withdrawal in Citrus County of approximately 5 percent. Permits would be required for the additional withdrawal and the permitting process would make sure impacts on surrounding users would not be significant (SWFWMD 2010).

During the operation of the additional units at the Crystal River site, impacts on groundwater quality could result from accidental spills. Because BMPs would be used to quickly remediate spills and no intentional discharge to groundwater would occur, the review team concludes that the groundwater-quality impacts from operation of the additional units at the Crystal River site would be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that affect the same water resources.

The geographic area of interest for surface water includes the Gulf of Mexico in the vicinity of the Crystal River site. The geographic area of interest for groundwater includes the surficial aquifer at the site and the Upper Floridan aquifer in the region. These areas are of interest because they represent the water resource potentially affected by building and operating the additional units at the Crystal River site. Key actions that have past, present, and future potential impacts on water supply and water quality near the Crystal River site include the operation and decommissioning of the existing units at the CREC and the power uprate proposed for Unit 3 at the CREC.

The FDEP Conditions of Certification for the LNP Units 1 and 2 (FDEP 2011b) indicate that Crystal River Unit 1 and Unit 2 may cease to be operated as coal-fired units by December 31, 2020. The document indicates the shutdown of these units may be linked to the startup of the proposed units. If the additional units are located at the Crystal River site, the staff assumes that the same conditions would apply.

Cumulative Water Use

The only surface-water-use impacts of building and operating the additional units at this site are the water demands occurring during operation. Because the Gulf of Mexico is a virtually unlimited source of water supply compared to the makeup-water requirements for additional units at the site and the makeup-water requirements for the other units at the CREC including Unit 3 after the proposed power uprate, the review team determined that the use of water from the Gulf of Mexico would have essentially no impact on surface water. Therefore, the review team concludes that cumulative impacts on surface-water use would be SMALL.

Groundwater would be used during the building and operation of additional units at the LNP site. The analysis included above considered groundwater withdrawal to support the existing units at the CREC and the groundwater withdrawal associated with two additional units at the Crystal River site. As mentioned above, PEF currently has permits to withdraw 2 Mgd and is anticipating increasing the permitted amount by 265,000 gpd once its inactive wells are permitted. An additional 1.58 Mgd (PEF 2009e) on average would be required to operate the additional units at the Crystal River site. Permits would be required for the additional withdrawal and the permitting process would make sure impacts on surrounding users would not be significant, or, otherwise alternative sources of freshwater would need to be developed (SWFWMD 2010). Therefore, the review team concludes that cumulative impacts on groundwater use would be SMALL. The impacts of other projects listed in Table 9-6 are either considered in the analysis included above or would have little or no impact on surface-water and groundwater use.

Cumulative Water Quality

As described above, the impacts from building and operating two additional units at the Crystal River site on surface-water quality would be minimal. Other present and reasonably foreseeable future actions in the geographic area of interest of the Crystal River site include the operation of CREC Units 1–5, the power uprate and renewal of the operating license for Unit 3, and the shutdown of Unit 1 and Unit 2. As discussed in Chapter 7, the areal extent of the influence of these facilities on water quality is small, and the influence of these facilities would be minor in the Springs Coast watershed. The FDEP, under the Federal Water Pollution Control Act (Clean Water Act) Section 305(b), prepares a statewide Water Quality Inventory. The FDEP also identifies impaired waterbodies during this process and lists them on the 303(d) list.

Historically, streams, lakes, estuaries, and bays near the Crystal River site have been listed on the 303(d) list as impaired because of the presence of bacteria, nutrients, low dissolved oxygen, and mercury in fish. Therefore, the review team concludes that past and present actions in the region have noticeably affected the water quality adversely. Based on its evaluation, the review team concludes that the cumulative surface-water-quality impacts would be MODERATE.

Building and operating the proposed units at the Crystal River alternative site would not be a significant contributor to these impacts on surface-water quality, because industrial and wastewater discharges from the proposed units would comply with NPDES permit limitations and any stormwater runoff from the site during operations would comply with the SWPPP (PEF 2009b).

As stated in Section 7.2.2.2, global climate change can result in a rise in sea level that may induce saltwater intrusion in the surficial and Floridan aquifers. Projected changes in the climate for the region during the life of the proposed units include an increase in average temperature and a decrease in precipitation. These changes are likely to result in changes to agriculture including crops, pests, and the associated changes in application of nutrients, pesticides, and herbicides that may reach groundwater. As a result, groundwater quality may be altered by the infiltration of chemicals. While the changes in groundwater quality that are indirectly attributable to climate change may not be insignificant, the review team did not identify anything that would alter its conclusion regarding groundwater quality above. The review team also concludes that with the implementation of BMPs, the impacts of groundwater quality from building and operating two additional units at the Crystal River site would likely be minimal, and therefore, the cumulative impact on groundwater quality would be SMALL. The impacts of other projects listed in Table 9-6 are either considered in the analysis included above or would have little or no impact on surface-water and groundwater quality.

9.3.2.3 Terrestrial and Wetland Resources

Site Description

The following impact analysis includes direct, indirect, and cumulative impacts from construction and preconstruction activities and operations. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including the other Federal and non-Federal projects and the projects listed in Table 9-6 For the analysis of terrestrial ecological impacts at the Crystal River site, the geographic area of interest is considered to be a 20-mi-wide radius centered on the Crystal River site and the corridors surrounding the entire length of the proposed route for the associated transmission lines. This area within the 20-mi radius and transmission-line corridor is expected to encompass the ecologically relevant landscape features and species.

The Crystal River site was predominately pine flatwoods before the mid-twentieth century, but most flatwoods have been converted from natural longleaf pine (*Pinus palustris*) and slash pine (*P. elliottii*) communities to managed forests made up of slash pine and loblolly pine (*P. taeda*). The surrounding landscape is predominately rural and habitats are typical of the Gulf Coast Flatwoods ecoregion, consisting of slash pine and remnant longleaf pine with bottomland oak-gum-cypress forest in some low-lying areas along most rivers (EPA 2010g). The site terrain is generally level and gradually slopes west toward the Gulf of Mexico. At an elevation of about

9 ft above sea level, the site is located entirely within the 100-year floodplain. There are also vast coastal estuaries and numerous protected natural areas near the site.

The area immediately surrounding the proposed site is a mix of hardwood hammock forest, pine forest, salt marsh, and freshwater swamp (PEF 2008). Hardwood hammock habitats found on the proposed site are characterized by magnolia (*Magnolia grandiflora*), laurel oak (*Quercus laurifolia*), and blue-beech (*Carpinus caroliniana*), although species composition is varied (PEF 2008). Pine forests on the proposed site are dominated by slash pine and loblolly pine (PEF 2008). The salt marshes on the proposed site are dominated by smooth cordgrass *(Spartina alterniflora)* and black rush *(Juncus roemerianus)* and are typical of coastal marshes of central western Florida (PEF 2008). Freshwater swamps on the Crystal River site are characterized by pond cypress (*Taxodium ascenduns*), swamp tupelo, (*Nyssa biflora*) and swamp ash (*Fraxinus pauciflora*) (PEF 2008).

Common wildlife, including important species, that are known to occur in the habitats present on the Crystal River site include American alligator (*Alligator mississippiensis*); Florida white-tailed deer (*Odocoileus virginianus seminolus*); bobcat (*Lynx rufus*); feral hog (*Sus scrofa*); multiple squirrel species; northern bobwhite (*Colinus virginianus*); mourning dove (*Zenaida macroura*); several species of woodpecker, skunk, and river otter; and raccoon (*Procyon lotor*). Various bird, reptile, and amphibian species also reside on the Crystal River site (PEF 2008; USDA 2006; FNAI 2009).

The associated proposed transmission-line corridors begin in the Gulf Coast Flatwoods ecoregion and cross the Southwestern Florida Flatwoods and Central Florida Ridges and Uplands ecoregions. Vegetation community types in the Southwestern Florida Flatwoods ecoregion include slash pine, longleaf pine, cabbage palm (*Sabal palmetto*), and live oak (*Quercus virginiana*) with typical understory species of saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra*), and grasses such as bluestems and wiregrasses (USDA 2006). Vegetation community types in the Central Florida Ridges and Uplands ecoregion include sand hill vegetation such as turkey oak (*Quercus laevis*), bluejack oak (*Quercus incana*), and longleaf pine for the dominant canopy species along with common understory species of running oak (*Quercus pumila*), gopher apple (*Licania michauxii*), and bluestem and panicum grasses (USDA 2006).

Important Species

Common wildlife, including important species, associated with the above-mentioned ecoregions that may occur in the associated transmission-line corridors includes recreationally important species such as Florida white-tailed deer, bobcat, feral hog, squirrel, northern bobwhite, mourning dove, as well as several woodpecker species, skunk, and raccoon. Various bird, reptile, and amphibian species also have the potential to reside on the Crystal River site and associated proposed transmission-line corridors (USDA 2006; FNAI 2009).

PEF consulted with the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and the Florida Fish and Wildlife Conservation Commission (FFWCC) in support of the CREC operating license renewal application, and determined that other than the Critical Habitat for the Florida manatee (*Trichechus manatus latirostris*) designated adjacent to the Crystal River site in King's Bay, there are no other areas designated as Critical Habitat for endangered species (PEF 2008). Table 9-7 lists all Federally and State-listed threatened and endangered species that could occur on the Crystal River site and in the vicinity, in the associated offsite facilities and corridors, as well as in the counties crossed by the associated proposed transmission-line corridors. Counties crossed by the proposed transmission-line corridors for the Crystal River site would be similar to those proposed for LNP and include Citrus, Marion, Hernando, Hillsborough, Lake, Pinellas, Polk, and Sumter counties (PEF 2011g). PEF has stated that on-the-ground field surveys would be conducted before commencement of ground-disturbing activities on the site or within transmission-line corridors (once final routes are determined) (PEF 2009b; CH2M HILL 2010).

Table 9-7. Federally and State-Listed Species That May Occur on and in the Vicinity of the Alternative Sites and Offsite Facilities and Corridors, and Associated Transmission-Line Corridors

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Mammals				
Eumops floridanus	Florida bonneted bat	SE	Roosts in palms and hollow trees and in buildings	Highlands
Trichechus manatus latirostris	West Indian (Florida) manatee	FE/SE	Marine and freshwater habitats; prefer warm-water sites	Crystal River, Dixie, Putnam
Microtus pennsylvanicus dukecampbelli	Florida salt marsh vole	FE/SE	Periodically flooded high salt marsh zone (FWS 2009)	Crystal River, Dixie
Myotis grisescens	Gray bat	FE	Caves are in limestone karst areas; the bats hibernate in deep caves in winter and roost in caves along rivers in summer (FWS 2010)	Dixie
Peromyscus polionotus niveiventris	Southeastern beach mouse	FT/ST	Sea oats (*Uniola paniculata*) zone of primary coastal dunes	Putnam
Puma concolor coryi	Florida panther	FE/SE	Heavily vegetated mixed swamp forests and hammock forests	Crystal River, Dixie, Highlands, Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Ursus americanus floridanus	Florida black bear	ST	Large areas of forested uplands and forested wetlands	Crystal River, Dixie, Highlands, Putnam
Birds				
Ammodramus savannarum floridanus	Florida grasshopper sparrow	FE/SE	Large (greater than 50 ha), treeless, relatively poorly-drained grasslands that have a history of frequent fires	Highlands
Aphelocoma coeruluscens	Florida scrub-jay	FT/ST	Low-growing oak scrub habitat	Crystal River, Dixie, Highlands, Putnam
Charadrius alexandrinus	Snowy plover	ST	Open, dry sand near dunes	Crystal River, Dixie
Charadrius melodus	Piping plover	FT/ST	Tidal mudflats	Crystal River, Dixie, Putnam
Polyborus plancus audubonii	Audubon's crested caracara	FT/ST	Open country, dry prairies/pastures with cabbage palm/live oak hammocks, and shallow ponds and sloughs	Highlands, Putnam
Falco sparverius paulus	Southeastern American kestrel	ST	Open pine habitats, woodland edges, prairies, and pastures	Crystal River, Dixie, Highlands, Putnam
Grus americana	Whooping crane	ST	Along lake margins among rushes and sedges; estuarine marshes, shallow bays and tidal flats	Highlands
Grus canadensis pratensis	Florida sandhill crane	ST	Prairies, freshwater marshes, and pastures	Crystal River, Dixie, Highlands, Putnam
Mycteria americana	Wood stork	FE/SE	Cypress strands and domes, mixed hardwood swamps	Crystal River, Dixie, Highlands, Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Picoides borealis	Red-cockaded woodpecker	FE	Mature longleaf and slash pine forests	Crystal River, Dixie, Highlands, Putnam
Rostrhamus sociabilis plumbeus	Snail kite	FE/SE	Freshwater marshes and shallow vegetated edges of lakes (natural and man-made)	Crystal River, Dixie, Highlands, Putnam
Sterna antillarum	Least tern	ST	Coastal areas, beaches, lagoons, bays, estuaries	Crystal River, Dixie, Highlands, Putnam
Reptiles				
Alligator mississippiensis	American alligator	FT/SC	Most permanent bodies of freshwater, including marshes, swamps, lakes, and rivers	Crystal River, Dixie
Crocodylus acutus	American crocodile	FT/SE	Freshwater and brackish coastal habitats	Crystal River, Dixie
Drymarchon corais couperi	Eastern indigo snake	FT/ST	Broad range of habitats, from scrub and sandhill to wet prairies and mangrove swamps; often commensal with gopher tortoises	Crystal River, Dixie, Highlands, Putnam
Eumeces egregius lividus	Blue-tailed mole skink	FT/ST	Well-drained sandy uplands with loose sand for burrowing	Highlands
Gopherus polyhemus	Gopher tortoise	ST	Dry upland habitats, including sandhills, scrub, xeric oak hammock, and dry pine flatwoods; also pastures, old fields	Crystal River, Dixie, Highlands, Putnam
Lampropeltis extenuate	Short-tailed snake	ST	Restricted to upland pine-turkey oak woodlands; found on dry, sandy soil found in coastal live oak hammocks and sand pine scrub (FMNH 2011)	Dixie
Neoseps reynoldsi	Sand skink	FT/ST	Rosemary scrub, sand pine and oak scrubs, scrubby flatwoods, turkey oak ridges within scrub, citrus groves occupying former scrub	Dixie, Highlands, Putnam
Nerodia clarkii taeniata	Atlantic salt marsh snake	FT/ST	Coastal marshes and mangrove swamps along shallow tidal creeks and pools; often associated with fiddler crab burrows	Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Stilosoma extenuatum	Short-tailed snake	ST	Sandhills, xeric hammock, and sand pine scrub	Crystal River, Dixie, Highlands, Putnam
Amphibians				
Ambystoma cingulatum	Flatwoods salamander	FT	Seasonally wet pine flatwoods near cypress ponds	Putnam
Vascular Plants				
Acrostichum aureum	Golden leather fern	ST	Brackish and freshwater marshes	Crystal River, Dixie, Putnam
Adiantum tenerum	Brittle maidenhair fern	SE	Limestone outcrops, grottoes, sinkholes	Crystal River, Dixie
Agrimonia incisa	Incised groove-bur	SE	Sandhills and scrub	Crystal River, Dixie, Putnam
Andropogon arctatus	Pine-woods bluestem	ST	Wet pine flatwoods	Crystal River, Dixie, Highlands, Putnam
Arnoglossum diversifolium	Variable-leaf Indian plantain	ST	Freshwater and riparian habitats	Crystal River, Dixie
Asplenium dentatum	American toothed spleenwort	SE	Tropical hardwood hammock	Putnam
Asplenium erosum	Auricled spleenwort	SE	Pinelands	Crystal River, Dixie, Putnam
Asplenium pumilum	Dwarf spleenwort	SE	Pinelands	Crystal River, Dixie, Putnam
Asplenium verecundum	Modest spleenwort	SE	Rockland hammocks, limestone outcrops, grottoes, sinkholes	Crystal River, Dixie
Adiatum tenerum	Brittle maidenhair fern	SE		Crystal River, Dixie
Balduina atropurpurea	Purple honeycomb-head	SE		Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Bigelowia nuttallii	Nuttall's rayless goldenrod	SE	Sand pine scrub in Pinellas County	Crystal River, Dixie
Blechnum occidentale	Sinkhole fern	SE	Moist woodlands, hammocks, rocky creek banks, woodlands with open shade	Crystal River, Dixie
Bonamia grandiflora	Florida bonamia	FT/SE	Openings or disturbed areas in white sand scrub	Crystal River, Dixie, Highlands, Putnam
Calaminntha ashei	Ashe's savory	ST	Sandhills and scrub	Highlands, Putnam
Calopogon multiflirus	Many-flowered grasspink	SE	Dry to moist flatwoods with longleaf pine, wiregrass, saw palmetto	Highlands
Calycanthus floridus	Sweet shrub	SE	Slopes and in covers of mesic woods; found along streams on moist soil (Floridata 2011)	Dixie
Calydorea coelestina	Bartram's Ixia	SE		Putnam
Campanula robinsiae	Brooksville bellflower	FE/SE	Wet, grassy slopes and drying pond edges in vicinity of Chinsegut Hill in Hernando County	Crystal River, Dixie
Carex chapmanii	Chapman's sedge	SE	Grasslands, pinelands	Crystal River, Dixie, Highlands, Putnam
Centrosema arenicola	Sand butterfly pea	SE	Sandhill, scrubby flatwoods, dry upland woods	Crystal River, Dixie, Highlands, Putnam
Chamaesyce cumulicola	Sand-dune spurge	SE	Coastal scrub and stabilized dunes	Crystal River, Dixie, Putnam
Cheilanthes microphylla	Southern lip fern	SE	Coastal habitats	Crystal River, Dixie
Chionanthus pygmaeus	Pygmy fringe tree	SE	Scrub, sandhill, and xeric hammock	Highlands, Putnam
Chrysopsis (=Heterotheca) floridana	Florida golden aster	FE/SE	Sand pine scrub, sand ridges of excessively well-drained, fine sands, railroad and highway corridors	Crystal River, Dixie, Highlands

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Cladonia perforata	Perforate reinder lichen	FE/SE	High, xeric white sand rosemary scrub (FNAI 2010)	Highlands
Clitoria fragrans	Scrub pigeon-wing	FT/SE	Turkey oak barrens with wire grass, bluejack and turkey oak; scrubby high pine	Highlands, Putnam
Coelorachis tuberculosa	Piedmont jointgrass	ST	Freshwater habitats	Highlands, Putnam
Conradina brevifolia	Short-leaved rosemary	FE/SE	White sand scrub with sand pine and evergreen scrub oaks	Highlands
Conradina grandiflora	Large-flowered rosemary	ST	Deep, fine sandy soils on or in the vicinity of ancient dunes (CPC 2010)	Highlands, Putnam
Conradina etonia	Etonia rosemary	FE/SE	Deep, white-sand scrub with sand pine and oak shrubs in natural or artificial clearings	Putnam
Corallorhiza odontorhiza	Autumn coralroot	SE	Upland hardwood forests (FDACS 2010)	Dixie
Crotalaria avonensis	Avon Park rabbit bells	FE/SE	White sand scrub dominated by rosemary and oaks and/or sand pine; mostly in open areas with bare sand.	Highlands
Ctenium floridanum	Florida toothache grass	SE	Sandhills and dry pinelands	Dixie, Putnam
Cucurbita okeechobeensis	Okeechobee gourd	FE/SE	Pond apple swamps and mucky soils on Lake Okeechobee shores and islands and along the St. Johns River (CPC 2010)	Putnam
Deeringothamnus rugelii	Rugel's pawpaw	FE/SE	Poorly-drained slash pine/saw palmetto flatwoods (FWS 2009)	Putnam
Dennstaedtia bipinnata	Hay scented fern	SE	Hydric hammocks, wet woods (FNAI 2010)	Putnam
Dicerandra christmanii	Garrett's scrub balm	FE/SE	Exclusively on well-drained yellow sands in oak-dominate Florida scrub (ABS 2003a)	Highlands
Dicerandra cornutissima	Longspurred mint	FE/SE	Sand pine and oak scrub	Crystal River, Dixie, Putnam
Dicerandra frutescens	Scrub mint	FE/SE	Well-drained yellow soils (ABS 2003b)	Highlands
Drosera intermedia	Spoon-leaved sundew	ST	Freshwater habitats	Crystal River, Dixie, Highlands, Putnam
Eleocharis rostellata	Beaked spikerush	SE	Prairies and swamps (FDACS 2010)	Dixie
Eltroplectris calcarata	Spurred neottia	SE	Mesic hammock, rockland hammock (FNAI 2010)	Highlands

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Eragrostis pectinacea var. *tracyi*	Sanibel lovegrass	SE	Disturbed beach dunes, maritime hammocks, coastal strands, coastal grasslands, old fields, clearings, and other disturbed sites	Crystal River, Dixie
Eryngium cuneifolium	Wedge-leaved button-snakeroot	FE/SE	Sand pine scrub, mostly in gaps on rosemary balds (FNAI 2010)	Highlands
Eriogonum logifolium var. *gnaphalifolium*	Scrub wild buckwheat	FT/SE	Sandhill, oak-hickory scrub	Crystal River, Dixie, Highlands, Putnam
Euphorbia coommutata	Wood spurge	SE	Riparian habitats	Crystal River, Dixie, Putnam
Forestiera godfreyi	Godfrey's swampprivet	SE	Upland hardwood forests with limestone at or near the surface, often on slopes above lakes and rivers	Crystal River, Dixie, Putnam
Gladularia maritima	Coastal vervain	SE	Back dunes, dune swales, coastal hammocks	Crystal River, Dixie, Putnam
Gladularia tampensis	Tampa vervain	SE	Live oak–cabbage palm hammocks and pine-palmetto flatwoods	Crystal River, Dixie, Putnam
Gossypium hirsutum	Wild cotton	SE	Coastal strands and disturbed areas	Crystal River, Dixie
Harrisia fragrans	Fragrant prickly apple	FE/SE	Scrubby flatwoods and xeric hammocks with sand live oak, myrtle oak, cabbage palm, and prickly pear (FNAI 2010)	Putnam
Harrisia simpsonii	Simpson's prickly apple	SE	Mangroves and coastal thickets and strands (FNAI 2010)	Putnam
Hartwrightia floridana	Hartwrightia	ST	Seepage slopes, edges of baygalls and springheads, wet prairies, flatwoods	Highlands, Putnam
Hasteola robertiorum	Florida hasteola	SE	Saturated, peaty soils of river and creek floodplain swamps; hydric hammocks with cabbage palm, cypress, or hardwood canopy	Crystal River, Dixie, Putnam
Helianthus carnosus	Lake-side sunflower	SE	Wet flatwoods and prairies (FNAI 2010)	Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Hypericum cumicola	Highlands scrub hypericum	FE/SE	Openings in white sand and rosemary scrubs; sometimes found in scrubby flatwoods and oak scrubs in yellow sands.	Highlands
Hypericum edisonianum	Edison's ascyrum	SE	Depressions in scrub, cutthroat seeps, flatwoods ponds, lake margins, wet prairie	Highlands
Illicium parviflorum	Star anise	SE	Banks of spring-run or seepage streams, bottomland forest, hydric	Highlands, Putnam
Justicia cooleyi	Cooley's water-willow	FE/SE	Mesic hardwood hammocks over limestone	Crystal River, Dixie
Justicia crassifolia	Thick-leaved water willow	SE		Highlands
Lantana depressa var. *floridana*	Atlantic coast Florida lantana	SE	Dunes and sandy inland ridges (FNAI 2010)	Putnam
Lechea cernua	Nodding pinweed	ST	Usually ancient dunes with evergreen scrub oaks, mature scattered pine or oak forest	Crystal River, Dixie, Highlands, Putnam
Lechea divaricata	Pine pinweed	SE	Scrub and scrubby flatwoods	Crystal River, Dixie, Highlands
Leitneria floridana	Corkwood	ST	Edges of marshy openings and along small drainages in coastal hydric hammocks; fresh or tidal marshes	Crystal River, Dixie
Liatris ohlingerae	Florida blazing star	SE	Rosemary balds, edges of oak scrub; scrubby flatwoods and disturbed scrub (FNAI 2010)	Highlands
Litsea aestivalis	Pondspice	SE	Edges of baygalls, flatwoods ponds, and cypress domes. May form thickets around edges of ponds	Crystal River, Dixie, Putnam
Lupinus aridorum	Scrub lupine	FE/SE		Highlands
Matalea floridana	Florida spiny-pod	SE	Pinelands and temperate forests	Crystal River, Dixie, Highlands, Putnam
Minuartia godfreyi	Godfrey's sandwort	SE	Creek banks and seepage areas (FDACS 2010)	Dixie
Monotropa hypopithys	Pinesap	SE	Temperate forests	Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Monotropsis reynoldsiae	Pygmy pipes	SE	Upland mixed hardwood forest, mesic and xeric hammock, sand pine and oak scrub	Crystal River, Dixie, Putnam
Najas filifolia	Narrowleaf naias	ST	Freshwater habitats	Highlands, Putnam
Nemastylis floridana	Celestial lily	SE	Freshwater habitats	Crystal River, Dixie, Highlands, Putnam
Nolina atopocarpa	Florida beargrass	ST	Grasslands, pinelands	Highlands, Putnam
Nolina brittoniana	Britton's beargrass	FE/SE	Scrub, sandhill, scrubby flatwoods, and xeric hammock	Crystal River, Dixie, Highlands, Putnam
Ophioglossum palmatum	Hand fern	SE	Old leaf bases of cabbage palms in maritime and wet hammocks	Crystal River, Dixie, Highlands, Putnam
Panicum abscissum	Cutthroat grass	SE		Highlands, Putnam
Parnassia grandifolia	Large-leaved grass-of-parnassus	SE	Seepage slopes, wet prairies, edges of cypress strands	Putnam
Paronychia chartacea ssp. *chartacea*	Paper-like nailwort	FT/SE		Highlands, Putnam
Pecluma dispersa	Widespread polypody	SE	Tree branches and limestone outcrops in dry hammocks	Crystal River, Dixie, Putnam
Pecluma plumula	Plume polypody	SE	Tree branches or limestone in hammocks, wet woods, and limesinks	Crystal River, Dixie, Highlands, Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Pecluma ptilodon	Swamp plume polypody	SE	Rockland hammocks, strand swamps, wet woods	Crystal River, Dixie, Highlands, Putnam
Phyllanthus leibmannianus	Pinewood dainties	SE	Hydric hammocks, floodplain and bottomland forests	Crystal River, Dixie
Peperomia humilis	Terrestrial pepperomia	SE	Shell mounds and limestone outcrops in mesic hammocks, coastal berms, cypress swamps	Crystal River, Dixie, Highlands
Platanthera integra	Yellow fringeless orchid	SE	Wet pine flatwoods, wet prairies, depressions within pinelands	Highlands
Polygala lewtonii	Lewton's polygala	FE/SE	Oak scrub, sandhill	Highlands, Putnam
Polygonella basiramia	Florida jointweed	FE/SE		Highlands
Polygonella myriophylla	Small's jointweed	FE/SE	Open, sandy areas within scrub	Highlands, Putnam
Prunus geniculata	Scrub plum	FE/SE	Sandhill and oak scrub	Highlands, Putnam
Pteroglossaspis ecristata	Giant orchid	ST	Sandhill, scrub, pine flatwoods, pine rocklands	Crystal River, Dixie, Highlands, Putnam
Pycnanthemum floridanum	Florida mountain-mint	ST	Pinelands, sandhills, scrub	Crystal River, Dixie, Putnam
Rudbeckia triloba var. *pinnatiloba*	Pinnate-lobed coneflower	SE	Freshwater habitats, grasslands, pinelands	Crystal River, Dixie
Salix Floridana	Florida willow	SE	Springheads, edges of spring runs, hydric hammocks, floodplains	Dixie, Highlands, Putnam
Schizachurium niveum	Scrub bluestem	SE	Rosemary, sand pine, and oak scrub	Crystal River, Dixie, Highlands
Schwalbea Americana	Chaffseed	FE/SE	Moist, grassy ecotones around ponds in longleaf pine sandhills and savannas (FNAI 2010)	Putnam
Sideroxylon alachuense	Silver buckthorn	SE	Upland hardwood forests around limesinks	Putnam

Table 9-7 (contd)

Scientific Name	Common Name	Legal Status	Suitable Habitat	Alternate Site
Sideroxylon lycioides	Buckthorn	SE	Wooded slopes, floodplains, and bluffs	Dixie, Putnam
Spigelia loganioides	Pinkroot	SE	Floodplain forests, upland and hydric hardwood hammocks over limestone	Crystal River, Dixie, Putnam
Spiranthes polyantha	Green ladies'-tresses	SE	Rock outcrops in mesic hammock, rockland hammock, maritime hammock	Crystal River, Dixie
Stylisma abdita	Scrub stylisma	SE	Pinelands, sandhills, scrub	Crystal River, Dixie, Highlands, Putnam
Thelypteris reptans	Creeping maiden fern	SE	Limestone grottoes and sinkholes	Crystal River, Dixie
Thelypteris serrata	Toothed maiden fern	SE	Cypress swamps, sloughs, floodplains	Crystal River, Dixie, Highlands
Trichomanes punctatum ssp. *Floridanum*	Florida filmy fern	SE	Rock outcrops	Crystal River, Dixie
Triphora amazonica	Broad-leaved nodding-caps	SE	Rich damp hardwood hammocks	Crystal River, Dixie
Triphora graigheadii	Craighead's nodding-caps	SE	Mesic hardwood hammocks	Crystal River, Dixie
Vicia ocalensis	Ocala vetch	SE	Open, wet thickets along margins of spring runs and streams	Putnam
Warea amplexifolia	Clasping warea	FE/SE	Sandhill with longleaf pine and wiregrass	Highlands, Putnam
Warea carteri	Carter's warea	FE/SE	Sandhill, scrubby flatwoods, scrub	Highlands, Putnam
Zephyranthes simpsonii	Redmargin zepyrlily	FE/SE	Wet flatwoods and meadows (FDACS 2004)	Highlands
Ziziphus celata	Scrub ziziphus	FE/SE		Highlands

Species list sources: FNAI 2009; FWS 2009; FNAI 2011
FE = Federally listed as endangered; FT = Federally listed as threatened; SE = State listed as endangered; ST = State listed as threatened

Building Impacts

Subsequent to the development of the draft EIS, PEF completed its Section 404(b)(1) Alternatives Analysis and concluded that the Crystal River site would not meet the purpose and need of the project (CH2M HILL 2010). Therefore, PEF did not update its analysis of potential terrestrial impacts for the Crystal River site in the Section 404(b)(1) Alternatives Analysis, as it did for the other alternative sites. The analysis of impacts presented below is therefore the same as was presented in the draft EIS.

Impacts from building two nuclear units and supporting facilities on wildlife, including important species and habitats, would be unavoidable. Activities that would affect terrestrial resources include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the areas of disturbance. Some wildlife, including important species, would perish or be displaced during land clearing for any of the above activities as a consequence of habitat loss, fragmentation and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to areas of disturbance could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some important wildlife species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer (*Odocoileus virginianus*), northern bobwhite, eastern meadowlark (*Sturnella magna*), and the gopher tortoise (*Gopherus polyphemus*). Birds of prey, such as red-tailed hawks (*Buteo jamaicensis*) would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in an herbaceous or scrub-shrub condition that could provide improved foraging habitat for waterfowl and wading birds. However, fragmentation of upland and wetland forests could adversely affect species that are dependent on large tracts of continuous forested habitat.

To accommodate the building of two nuclear units on the Crystal River site, PEF would need to clear approximately 442 ac of terrestrial habitats for the nuclear facility and approximately 61 ac for associated offsite structures and corridors; not including transmission lines, which are discussed in the paragraph below (see Table 9-8 and Table 9-8) (CH2M HILL 2009). The proposed facility footprint of approximately 442-ac parcel lies within the CREC boundary (CH2M HILL 2009). Based upon Florida Land Use, Cover and Forms Classification System (FLUCFCS) analysis, approximately 27 ac of wetlands on the site would be filled (CH2M HILL 2009). PEF states that the nuclear facility would be sited to avoid wetlands whenever possible and that potential impacts on wetlands would be minimized through the use of established BMPs (PEF 2009b). Approximately 6 ac of wetlands would be filled to build the associated offsite facilities (other than transmission lines) (CH2M HILL 2009).

Table 9-8. Summary of Impacts by Land-Use Class for the Crystal River Site

Land-Use Class (FLUCFCS) (acreage)	Onsite	Offsite Corridors (Except Transmission)	Transmission Corridors[a]
Urban and Built Environment (percent of area)	9 (2%)	0 (0%)	1769 (19%)
Agriculture	129 (29%)	4 (7%)	1714(19%)
Upland Nonforested	0 (0%)	1 (2%)	172 (2%)
Upland Forested	277 (63%)	35 (57%)	1654 (18%)
Water	0 (0%)	1 (1%)	114 (1%)
Wetlands	27 (6%)	6 (10%)	1516 (16%)
Barren Lands	0 (0%)	0 (0%)	9 (<1%)
Transportation, Communication and Utilities	0 (0%)	14 (23%)	2091 (22%)

Source: CH2M HILL 2009
(a) Acreages are the total acres of each land-use class (FLUCFCS) cover type present in the transmission-line corridor, not acres affected.

Table 9-9. Total Terrestrial Habitat Impacts for the Crystal River Site

Impact Areas	Acres[a]
Onsite Impact Areas	442
Reservoir Impact Areas	Not applicable
Transmission-Line Corridor Areas	9038[a]
Offsite Impact Areas	61
Total Impact Areas	503 (plus portion of 9038 ac transmission corridor)

Source: CH2M HILL 2009
(a) Transmission-line acreages are the total acres available, not total acres affected. Only a portion of the total available would be affected.

New transmission system infrastructure would be needed to support a nuclear power facility at the Crystal River site and would include approximately 180 mi of transmission lines (estimates made by measuring the approximate distance of hypothetical corridors provided by CH2M HILL [2009]; see Section 9.3.2.1). The proposed transmission-line corridors are situated mostly in or adjacent to existing transmission lines; however, some new right-of-way would have to be created to accommodate the new lines (CH2M HILL 2009). The total acreage of transmission-line corridor for the Crystal River site is approximately 9038 ac, of which approximately 1516 ac are wetlands and approximately 1653 ac are forested habitat (see Table 9-8) (CH2M HILL 2009). Some portion of the total 1653 ac of forested habitat and 1516 ac of wetland habitat present in the corridors would be affected; however, because actual routes have not been determined, impacts on forests and wetlands cannot be quantified. Under Federal and State permitting requirements, PEF would be obligated to mitigate any unavoidable construction impacts on jurisdictional wetlands and listed species (PEF 2009b; FDEP 2011b).

PEF stated that all land clearing associated with the nuclear facility, offsite structures, and transmission-line corridor development would be conducted according to Federal, State, and local regulations, permit requirements, existing procedures, and established BMPs (PEF 2009b).

Building two new nuclear reactors at the Crystal River site would result in the loss of approximately 503 ac of terrestrial habitat on the site and offsite corridors (excluding transmission-line corridors) (see Table 9-9).

Clearing land within the 9038-ac transmission-line corridor would further increase forested habitat losses and increase habitat fragmentation. Other sources of impacts on terrestrial resources such as noise, increased risk of collision and electrocution, and displacement of wildlife would likely be temporary and result in minimal impacts on the resource. Because of the extent of unavoidable terrestrial habitat losses, building the two new units and associated offsite facilities, including transmission lines, would noticeably alter the available terrestrial habitat on and in the landscape surrounding the Crystal River Site.

Operational Impacts

Impacts on terrestrial ecological resources, including important species, from operation of two new nuclear units at the Crystal River site include those associated with transmission system structures, maintenance of transmission-line corridors, and operation of the cooling towers. Also, during plant operation, wildlife would be subjected to impacts from increased traffic.

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the specific location of cooling towers at the 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 nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team 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 would be minor.

Outdoor noise levels on the Crystal River site are predicted to range from 90 dBA near the loudest equipment to 65 dBA in areas more distant from major noise sources (PEF 2009b). Noise modeling predicts not perceptible to slight increases in noise from plant operations at the site boundary (PEF 2009b). Except in areas immediately adjacent to major noise sources, expected noise levels would be below the 60- to 65-dBA threshold at which birds and red foxes (a surrogate for small and medium-sized mammals) are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Crystal River site would not be likely to disturb wildlife beyond the site boundary. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

An evaluation of specific impacts resulting from building of transmission lines and transmission-line corridor maintenance cannot be conducted in any detail due to the lack of information, such as the specific locations of new corridors that could result from transmission system upgrades. However, it is assumed that transmission lines and corridors would be similar to those proposed for Levy Units 1 and 2. In general, impacts associated with transmission-line operation consist of bird collisions with transmission lines, electromagnetic field (EMF) effects on flora and fauna, and habitat loss due to corridor maintenance. The impacts associated with transmission-line corridor maintenance activities include alteration of habitat, including but not limited to wetland and floodplain habitat, due to cutting and herbicide application.

Transmission lines and associated structures pose a potential avian collision hazard. Direct mortality resulting from birds colliding with tall structures has been observed (Erickson et al. 2005). Factors that appear to influence the rate of avian impacts with structures are diverse and related to bird behavior, structure attributes, and weather. Migratory flight during darkness by flocking birds has contributed to the largest mortality events. Tower height, location, configuration, and lighting also appear to play a role in avian mortality. Weather, such as low cloud ceilings, advancing fronts, and fog also contribute to this phenomenon. Waterfowl may be particularly vulnerable due to their low, fast flight, and flocking behavior (EPRI 1993). Bird collisions with transmission lines are recognized as being of minor significance at operating nuclear power plants, including transmission-line corridors 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. PEF would also be required to have an Avian Protection Plan in compliance with State certification guidelines (FDEP 2011b). Consequently, the incremental number of bird collisions posed by the addition of new transmission lines for new nuclear units would be negligible.

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). At a distance of 300 ft, the magnetic fields from many lines are similar to typical background levels in most homes. Thus, 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 2003). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2003). Therefore, the incremental EMF impact posed by addition of new transmission lines for new nuclear units would be negligible.

Existing roads providing access to the existing transmission-line corridors at the alternative sites would likely be sufficient for use in any expanded corridors; however, new roads would be required during the construction of new transmission-line corridors. Management activities (cutting and herbicide application) related to transmission-line corridors and related impacts on floodplains and wetlands in transmission-line corridors are recognized as being of minor significance at operating nuclear power plants, including those with transmission-line corridors of variable widths (NRC 1996). The review team assumes that the same vegetation and construction management of corridors currently used by PEF would be used in the establishment and maintenance of the new corridors. Under the Conditions of Certification for Levy County, PEF would also be required to retain existing vegetation whenever practicable and use BMPs that comply with the Florida State regulations (FDEP 2011b). Consequently, the incremental effects of the maintenance of transmission-line corridors and associated impacts on floodplains and wetlands posed by expanding existing corridors or the addition of a new transmission-line corridor for new nuclear units would be negligible.

To summarize, the potential effects of operating two new nuclear reactors at the Crystal River site would be primarily associated with the maintenance of transmission-line corridors and increased traffic. In general, operational impacts on terrestrial resources would be expected to be minimal.

Cumulative Impacts

Past and present actions in the geographic area of interest that have influenced terrestrial resources in a similar way to the proposed two new nuclear units at the Crystal River site include development and operation of the CREC, located adjacent to the Crystal River site; development and operation of the Crystal River Quarries, Inc. mine, approximately 3 mi east of the Crystal River site; and development and operation of the Inglis Quarry, which is approximately 3 mi north of the Crystal River site. All of these projects have contributed to loss of terrestrial habitat in the area. Furthermore, terrestrial habitats throughout the geographic area of interest have been extensively altered by a history of forestry and agricultural practices as well as low density residential development.

Proposed reasonably foreseeable future actions that would affect terrestrial resources in a way similar to development at the Crystal River site include development and operation of the proposed Tarmac King Road Limestone Mine, as close as 8 mi north-northeast of the proposed Crystal River site. The proposed mine would occupy approximately 9400 ac including a quarry, processing plant, roads, and buffers. This proposed project would affect approximately 2700 ac of wetlands and uplands by incremental losses extending over approximately 100 years. In addition to its ongoing quarrying activities noted in the paragraph above, Citrus Mining and Timber Inc. is also proposing to develop a "Port District" approximately 2 mi north of the Crystal River site, which would include waterfront residential, commercial, and industrial development (Citrus County 2009).

The Inglis Lock bypass channel spillway is a proposed project to construct an intake structure, intake and discharge channels, turbines and a transmission line located approximately 5 mi northeast of the Crystal River site. This project would contribute to terrestrial habitat loss and fragmentation within the ROI. The FDOT recently completed an expansion of US-19 at the CFBC, approximately 3 mi north-northeast from the Crystal River site, which included construction of a two-lane bridge and expansion of the existing roadway to a four-lane divided highway (FDOT 2011). Transmission-line creation and/or upgrading throughout the designated geographical ROI, and future urbanization would also be expected to occur. There are, however, several areas within the geographic ROI that are managed for the benefit of wildlife, including (but not limited to) Goethe State Forest, Crystal River National Wildlife Refuge, Waccasassa Bay Preserve State Park, Gulf Hammock Wildlife Management Area, and the Big Bend Seagrasses Preserve.

The other impact on terrestrial resources at the Crystal River site would be the effect of global climate change on plants and wildlife. The impact of global climate change on terrestrial wildlife and habitat in the geographic area of interest is not precisely known. Global climate change could result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation, increases in average temperature, and saltwater intrusion into freshwater wetlands (GCRP 2009). Such changes in climate could alter terrestrial community composition on or near the Crystal River site through changes in species diversity, abundance, and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce terrestrial habitat. Specific predictions on habitat changes in this region due to global climate change are inconclusive at this time. However, because of the regional nature of climate change, the impacts related to global climate change would be similar for all of the alternative sites.

Summary Statement

Impacts on terrestrial ecology resources, including important species, are estimated based on the information provided by PEF and the review team's independent review. Past, present, and reasonably foreseeable future activities in the geographic area of interest could affect terrestrial ecology in ways similar to building and operation of the proposed two new units at the LNP site. The Crystal River site and some of the associated transmission-line corridors are natural habitats that would be substantially altered by development and maintenance activities, noticeably affecting the level and movement of terrestrial wildlife populations in the surrounding landscape. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team therefore concludes that the cumulative impacts on baseline conditions for terrestrial ecological resources would be MODERATE.

This determination is based upon the extent of expected wetland loss and habitat fragmentation from ongoing and planned development projects, continued widespread manipulation of habitats for commercial forest management, and anticipated losses of habitat for important species. The incremental impacts from building and operating the Crystal River project would be a significant contributor to the moderate cumulative impact, primarily because of a loss or modification of habitats that support wildlife, wetlands, and important species. Although incremental impacts on terrestrial resources could be noticeable near the Crystal River project, these impacts would not be expected to destabilize the overall ecology of the regional landscape.

9.3.2.4 Aquatic Resources for the Crystal River Energy Complex Site

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The CREC site is located on Crystal Bay, which is a small embayment of the Gulf of Mexico. CREC has four fossil-fuel units and one nuclear unit, which draw a total of 1897 Mgd from May 1 to October 31, and 1613 Mgd from November 1 to April 30. Water from Crystal Bay is drawn in through three intakes on a common intake canal for Units 1, 2, and 3. Cooling water for Units 4 and 5 is provided from Units 1–3 effluent, and all effluents including blowdown from CREC Units 4 and 5 are ultimately discharged via a discharge canal to the Gulf of Mexico. Mechanical draft helper cooling towers cool the station discharge for thermal compliance (PEF 2008). A two-unit, closed-cycle plant would require 84,780 gpm (190 cfs) of cooling water, which would be obtained from the Gulf of Mexico, and station blowdown would be added to the existing discharge for CREC Units 1–5 (PEF 2009b). The geographic area of interest is considered to be hydrologically related waterbodies surrounding the proposed Crystal River site, which encompasses Levy and Citrus counties offshore areas of the Gulf of Mexico, including the mouth of the CFBC, and the mouth of the Withlacoochee River, and associated transmission-line corridors.

The CREC site is a coastal facility near a shallow inshore estuarine habitat in the Gulf of Mexico. Crystal River enters to the Gulf of Mexico 2 mi to the south, and the Withlacoochee River opens 2 mi to the north. The mouth of the CFBC in the Gulf of Mexico is between the CREC discharge and the Withlacoochee River. There are no sanctuaries or preserves that could be affected by the proposed action. The nearest managed areas are the Big Bend Seagrasses aquatic preserve to the north of the mouth of the Withlacoochee River (FDNR 1988), St. Martins Marsh that includes the estuarine coastal areas between Crystal River and Homosassa River (FDNR 1987), and the Crystal River National Wildlife Refuge (Buckingham 1989). Big Bend Seagrasses is managed by the FDEP and is approximately 5 mi to the north along the Gulf Coast of Florida from the mouth of the CFBC, and extends up along the coast and up to 8 mi offshore to the St. Marks National Wildlife Refuge to cover 945,000 ac.

St. Martins Marsh is also managed by FDEP and encompasses 23,000 ac in the nearshore and offshore region due west of the city of Crystal River, 3.5 mi to the south of the CREC discharge location. Both aquatic preserves were established to protect seagrass bed habitats, which provide nursery areas for finfish and shellfish as well as foraging resources for local birds and aquatic vertebrates. The Crystal River National Wildlife Refuge is managed by the FWS and is the Kings Bay headwaters of Crystal River, which lies 10 mi inland from the mouth of Crystal River on the Gulf of Mexico. The Crystal River National Wildlife Refuge was designated to protect the West Indian (Florida) manatee and its habitat.

Historically, the construction and operation of CREC Units 1–5 have had some impact on fisheries in the Gulf of Mexico, which PEF mitigates by hatchery supplementation. The Crystal River Mariculture Center began operation in October 1991, with red drum (*Sciaenops ocellatus*), spotted seatrout (*Cynoscion nebulosus*), and pink shrimp (*Farfantepenaeus duorarum*) among the primary species cultured. Other species such as pinfish (*Lagodon rhomboides*), pigfish (*Orthopristis chrysoptera*), stone crab (*Menippe mercenaria*), and blue crab (*Callinectes sapidus*) are also cultured and released in the Gulf of Mexico (PEF 2009f). Between 1999 and 2005, 8 loggerhead sea turtles (*Caretta caretta*), 38 green sea turtles (*Chelonia mydas*), 1 hawksbill sea turtle (*Eretmochelys imbricata*), and 92 Kemp's ridley sea turtles (*Lepidochelys kempii*) have been collected at CREC (Eaton et al. 2008). PEF currently has an incidental take permit from NMFS that allows an incidental live take of 75 sea turtles annually, 3 annual causal sea turtle mortalities, and a reporting requirement for non-causal related mortalities of 8 or more within a 12-month period (NMFS 2002). PEF has an ongoing program to monitor the intake canal for the presence of sea turtles, perform rescues for stranded individuals, provide rehabilitation, and release resources when possible. In 2000, NRC found no significant impact on marine turtles from the operation of CREC Unit 3 (NMFS 2002). Aquatic species and habitats associated with the discharge from CREC have been characterized historically from CREC operations (Stone & Webster Engineering 1985), and were again sampled from April through November 2008. The extent of seagrass beds have been surveyed beginning in the early 1990s as a part of quantifying recovery of the CREC offshore Gulf of Mexico habitats following installation of helper cooling towers (MML 1993, 1994, 1995). Previously affected seagrass areas nearest the CREC discharge were observed to recover with 50 percent bottom coverage by colonization by shoal grass (*Halodule wrightii*), a dominant, quick-growing seagrass. However, between 1995 and 2001, overall seagrass abundance declined, likely from a number of environmental influences such as turbidity, salinity, and storm events (Marshall 2002).

The potential for impacts from construction and/or operation of two new units at the Crystal River site on aquatic biota would be primarily to organisms inhabiting the Crystal Bay habitat of the Gulf of Mexico. Aquatic commercial, recreational, and indicator species of importance would include the same species described for the proposed LNP site.

Commercial and Recreational Species

The Crystal River site has the same species as those listed for the proposed LNP site (see Section 2.4.2). Commercial fisheries allowed in the Gulf of Mexico in offshore Florida waters for Citrus and Levy counties include black mullet (*Mugil cephalus*), red grouper (*Epinephelus morio*), crevalle jack (*Caranx hippos*), ladyfish (*Elops saurus*), black grouper (*Epinephelus mystacinus*), gag grouper (*Mycteroperca microlepis*), grunts (family *Haemulidae*), porgies (family Sparidae), pink shrimp (*Farfantepenaeus duorarum*), blue crab, stone crab, and oysters (*Crassostrea viginica*). All of these species are also considered recreationally important and are described in detail in Section 2.4.2.3.

Important Species

Important species and species of concern listed for the Crystal River site are the same as those already described for the proposed LNP site. For species and habitat descriptions, refer to Table 2-13 in Section 2.4.2.

Critical Habitats

There are no critical habitats designated by the NMFS or FWS in the vicinity of the Crystal River site. Critical habitat for the gulf sturgeon (*Acipenser oxyrinchus desotoi*) occurs on the Gulf Coast of Florida in the Suwannee River over 29 mi to the northwest from the mouth of the CFBC, and immediate offshore area and is described further under the Federally and State-listed species subheading for gulf sturgeon (68 FR 13370). Critical habitat for the smalltooth sawfish (*Pristis pectinata*) is currently under review for designation of more than 220,000 ac of coastal habitat in the Charlotte Harbor estuary and more than 619 coastal ac in the Ten Thousand Islands/Everglades region of Florida Bay and are described further under the Federally and State-listed species subheading for smalltooth sawfish (73 FR 70290). Critical habitat for the Florida manatee closest to the Crystal River site includes Crystal River and its Kings Bay headwaters in Citrus County (41 FR 41914).

Essential Fish Habitats

The CREC intake and discharge areas of the Gulf of Mexico are designated by the Gulf of Mexico Fisheries Management Council as Ecoregion 2, which is a management unit that extends from Tarpon Springs north to Pensacola Bay, Florida (GMFMC 2004). Estuarine essential fish habitat has been designated by NMFS for Crystal Bay for species listed in Table 2.14 in Section 2.4.2.3. There are no habitat areas of particular concern near the CREC.

Non-Native and Nuisance Species

No invasive aquatic species have been noted in the aquatic environments at the Crystal River site (PEF 2008).

Federally and State-Listed Species

Federally and State-listed aquatic species that may occur near the Crystal River site and along existing transmission-line corridors include the endangered Florida manatee, green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), smalltooth sawfish, and the threatened gulf sturgeon and loggerhead sea turtle (*Caretta caretta*). Detailed species information is provided in Section 2.4.2.3.

Building Impacts

No onsite waterbodies would be adversely affected by building activities on the Crystal River site. Installation of a new intake and discharge structure in the existing CREC discharge canal would result in the temporary displacement of aquatic biota within the vicinity of these structures. It is expected that these biota would return to the area after installation is complete. Impacts on aquatic organisms from installation activities in the discharge canal would be temporary and minor and largely mitigable through the use of BMPs. Installation activities for makeup water and discharge for two new units at the Crystal River site would have minimal impact on the aquatic ecology of Crystal Bay.

New transmission lines would be required to connect the facility to the existing load centers. The additional transmission lines could be installed in existing corridors when possible to avoid sensitive or critical habitat areas. Transmission-line corridors are assumed to follow those identified for LNP without the need for an LNP-to-CREC corridor (CH2M HILL 2009). PEF anticipates transmission-line corridors would cross 6 streams and 135 open waterbodies and should have minimal impact on aquatic resources (CH2M HILL 2009). Therefore, assuming that no transmission towers are placed in waterbodies and the use of good management practices during construction, the staff concludes that the impacts associated with new transmission lines would be minimal.

Operational Impacts

Impingement and entrainment of organisms from Crystal Bay would be the most likely impacts on aquatic populations that could occur from operation of two new nuclear units at the Crystal River site. After submission of a Clean Water Act Section 316(b) report by PEF (Stone and Webster 1985), the EPA found that entrainment and impingement of fish and shellfish was unacceptable at CREC due to use of once-through cooling for CREC Units 1–3. Mitigation for entrainment and impingement is currently met through seasonal flow reduction and a restocking program at CREC for red drum, spotted seatrout, pink shrimp, striped mullet, pigfish, silver perch, blue crab, and stone crab (PEF 2008).

The NMFS issued a Biological Opinion in 2002 allowing for an incidental take of 75 live sea turtles from CREC intake structures and 3 causally related lethal takes annually. The annual take and release of 75 live turtles annually was determined to have no impact on turtle populations, and the annual lethal take of 3 turtles was considered to represent a small percentage of total sea turtle take in the Southeast United States (NMFS 2002). Due to PEF's commitment to use best available technology, and the small incremental increase in cooling-water withdrawal for the two new units, it is expected that there will be no significant increase in sea turtle mortalities attributable to the operation of two additional closed-cycle units at the Crystal River site.

Assuming a closed-cycle cooling system and a maximum through-screen intake velocity of 0.5 fps or less which meets the EPA's Phase I regulations for new facilities (66 FR 65256), the anticipated additional impacts on aquatic populations from entrainment and impingement are expected to be minimal.

The current NPDES permit for CREC requires that thermal effluents not exceed 96.5°F during the summer months. Helper cooling towers are used to comply with thermal limits, and reduction in power generation from coal-fired CREC Units 1 and 2 is sometimes used during the hottest summer months to ensure thermal compliance. The additional discharge associated with two new units (88 Mgd) would increase the total CREC site discharge volume by less than 5 percent. Thermal impacts could be mitigated by the addition of helper cooling towers as is proposed for the CREC Unit 3 uprate (PEF 2007a). The impact on aquatic populations from the additional discharge of water from two new closed-cycle units into Crystal Bay is expected to be minimal.

The review team concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would also be minimal assuming that appropriate BMPs and transmission-line maintenance procedures are used.

Cumulative Impacts

Cumulative impacts on aquatic resources within Crystal Bay may include the operation of CREC Units 1–5 for impingement, entrainment effects, and chemical and thermal impacts from discharge. The commencement of operation of CREC induced thermal effects in Crystal Bay that resulted in noticeable loss of seagrass beds, and caused significant numbers of aquatic organisms to become entrained and impinged, which resulted in the requirement for mariculture activities in an effort to mitigate the loss of aquatic organisms. The operation of CREC has had noticeable impacts on the aquatic environment within the Levy geographic ROI. Two new units would require 122 Mgd of makeup water that is likely to come from discharge effluent from the existing CREC Units. The incremental contribution of two new units related to construction and operation is not expected to contribute additional adverse impacts. Discharge for two additional units would likely increase overall discharge to Crystal Bay by less than 5 percent (CH2M HILL

2009). Addition of helper cooling towers to control the temperature of discharge to Crystal Bay, and compliance with FDEP NPDES permitting requirements would minimize the potential for thermal and chemical discharge impacts, respectively. The proposed uprate of CREC Unit 3, when combined with existing CREC Units 1–5 discharge would result in no thermal increase with the operation of a new South Cooling Tower to augment the current modular helper cooling towers (PEF 2007a).

In addition, in the FDEP Conditions of Certification, there is a condition that PEF will retire its two oldest coal-fired plants (Units 1 and 2) when LNP Units 1 and 2 are licensed, built, and begin commercial operation (FDEP 2011b). If this occurs, the two new units would still require 122 Mgd of makeup water that would likely come from the discharge effluent of CREC Units 3, 4, and 5. It is again expected that intake operations would have minimal impact on impingement and entrainment rates. The discharge for the two additional units, with CREC Units 1 and 2 shut down, would decrease the discharge volume to Crystal Bay. With the cessation of operations for CREC Units 1 and 2, the thermal and chemical discharge plume to Crystal Bay, even with the addition of the two new units, would likely not result in an increase in impacts over current operating conditions at CREC.

Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility can present additional constraints on aquatic resources. Future activities may include shoreline development (i.e., removal of habitat), increased water needs, and increased discharge of effluents into the Gulf of Mexico near Crystal Bay. Shoreline development is currently proposed by Citrus Mining and Timber, Inc. for commercial, industrial, and residential waterfront development along the CFBC to the west of US-19 (Citrus County 2009). The effects of future development could result in additional habitat loss and/or degradation due to water use using surface waters and groundwater withdrawal, point and non-point source pollution, siltation, and bank erosion. The review team is also aware of the potential for global climate change affecting aquatic resources. The impact of global climate change on aquatic organisms and habitat in the geographic area of interest is not precisely known. Global climate change would result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation, and increases in average temperature (GCRP 2009). Such changes in climate could alter aquatic community composition on or near the Crystal River site through changes in species diversity, abundance, and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce aquatic habitat, but specific predictions of aquatic habitat changes in this region due to global climate change are inconclusive at this time. The level of impact resulting from these events would depend on the intensity of the perturbation and the resiliency of the aquatic communities.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by PEF, the State of Florida, and the review team's independent review. There are past and future activities in the geographic area of interest that could affect aquatic ecology resources in ways similar to the building and operation of two additional units at the Crystal River site. The use of Gulf of Mexico water for cooling eliminates much of the potential impact associated with water development needed for closed-cycle cooling for a new site. Proper siting of associated transmission lines, avoiding habitat for protected species, minimizing interactions with waterbodies and watercourses along the corridors, and the use of BMPs during corridor preparation and tower placement would minimize impacts related to the transmission system. The review team concludes that the cumulative impacts of past, present, and reasonably foreseeable future activities on the aquatic resources of Crystal Bay would be SMALL to MODERATE, primarily due to the continued operation of CREC. However, building and operating two new nuclear units at the Crystal River site would not contribute significantly to the MODERATE impact.

9.3.2.5 Socioeconomics

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affect socioeconomics, including the other Federal and non-Federal projects listed in Table 9-6. For the analysis of socioeconomic impacts at the Crystal River site, the geographic area of interest is considered to be the 50-mi radius (region) centered on the Crystal River site with special consideration of Citrus, Levy, and Marion counties, because that is where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of site development and operation at the Crystal River site in Citrus County, the review team undertook a reconnaissance survey of the site using readily obtainable data from the Internet or published sources.

The Crystal River site is in Citrus County, approximately 5 mi south-southwest of Inglis and 8 mi northwest of the City of Crystal River. The review team drew upon U.S. Census Bureau (USCB) 2010 data (USCB 2010a) to find the available total construction workforce within the host county, adjacent counties, and any nearby counties with a major population center within a reasonable commuting distance from the site. For the Crystal River site, this included Citrus, Levy, Marion, Hernando, Sumter, and Pasco counties. The total average construction workforce available in these counties between the fourth quarter 2008 and third quarter 2009 was 20,941. Based on this availability, the review team assumed that 50 percent of the 3440 construction workforce, or 1720 workers would migrate into the area (PEF 2011h).

The review team identified Citrus County and the immediately adjacent Levy and Marion counties as a primary Economic Impact Area (EIA) for the two new nuclear units in Citrus

County on the basis of expected effects of in-migrating construction workers and families. The review team expects that a few of the in-migrating workers would choose to reside in Alachua County, more than an hour's commute distance, because of the amenities available in the large City of Gainesville, but the county's economy and community infrastructure are sufficiently large that the review team expects the effects would not be noticeable. Hernando, Pasco, and Sumter counties offer few amenities beyond those offered by the immediately adjacent counties that would encourage a longer commute; consequently, the review team expects few in-migrating construction workers would live in these counties and associated effects would not be noticeable. The review team focused on effects of the construction workforce because the operations workforce would be smaller, with expected smaller socioeconomic impacts.
Table 9-10 provides some socioeconomic data for the EIA.

Table 9-10. Selected Socioeconomic Data for the EIA for the Crystal River Site

	Citrus	Levy	Marion	Data Source
Population				
1980	54,703	19,870	122,488	(a)
1990	93,515	25,923,	194,833	(a)
2000	118,085	34,450	259,914	(b)
2010	141,236	40,801	331,298	(c)
Median Household Income (2009)	$37,861	$32,528	$38,988	(c)
Vacant Housing Units				
2000	9570	2703	15,908	(b)(d)(e)
2005	14,165	3360	24,860	(b)(d)(e)
2010	14,722	3719	26,324	(b)(d)(e)
Total Housing Units				
2000	62,204	16,570	122,663	(b)(d)(e)
2005	73,070	17,701	152,624	(b)(d)(e)
2010	78,026	20,123	164,050	(b)(d)(e)
Workforce				
Employed	27,459	5971	78,536	(f)
Construction	2322	648	7238	(f)
Total schools	0 E, 5M, 10 E-M, 4H, 1 E-H, 1 E-M-H	1 E, 1 E-M-H, 4 E-M, 3 M-H, 2 M, 2 H	2 E, 9 M, 29 E-M, 8 H, 1 M-H, 1 E-M-H	(g)
Number of Schools Failing Student-Teacher Ratio	4	0	4	(g)

Table 9-10. (contd)

	Citrus	Levy	Marion	Data Source
Sheriff and Police	Crystal River	Inglis, Williston, Chiefland, Cedar Key	Dunnellon, Belleview, Ocala	(h)
Emergency Services	23 fire stations; 29 paid and 98 volunteer firefighters	14 fire stations; 8 paid and 183 volunteer firefighters	27 fire stations; 351 paid and 100 volunteer firefighters	(i)
Population				
White	93	85.5	81.0	(c)
African American	2.8	9.4	12.3	(c)
Hispanic	4.7	7.5	10.9	(c)
Low-Income	15.8	21.8	15.9	(c)

(a) USCB 1990
(b) USCB 2000b
(c) USCB 2010b
(d) USCB 2007
(e) USCB 2010c
(f) USCB 2010a
(g) FDOE 2009a
(h) Section 2.5.2.6
(i) Citrus, Levy: Section 2.5.2.6; Marion: Marion EM (2009), Marion Fire (2009)
E = elementary school; M = middle school; H = high school

For purposes of this analysis the review team projected that about 15 percent, or 258, of the in-migrating workers would choose to reside outside the EIA, with the remaining 1462 in-migrating workers distributed in the remainder of the 50-mi region. The review team considered three key factors that would influence in-migrating worker housing patterns: available housing, amenities, and commute time. From these factors, the review team assumed that in-migrating workers into the EIA at peak construction-related employment would be distributed 45 percent in Marion County, 45 percent in Citrus, and 10 percent in Levy. The review team further assumed that all workers would bring families; this is unlikely but provides an upper bound to population increase associated with the project. The review team used the 2.49 average Florida family size to project the distribution of new jobs and population in the EIA due to in-migrating workers listed in Table 9-11.

Table 9-11. Projected Distribution of Workers and Associated Population Increase in the EIA for the Crystal River Site

County	Percent Population Increase 1990–2000[a]	Percent Population Increase 2000–2010[b]	Workers In-Migrating to Construct Two New Units at Crystal River Site	Population of In-Migrating Workers and Families	Population of Workers and Families (as a percent of 2010 population
Citrus	26.3	19.6	658	1638	1.15
Marion	32.9	27.5	658	1638	0.49
Levy	32.9	18.4	146	364	0.88

(a) Based on USCB data, as reported in PEF (2007b).
(b) Based on USCB 2010b.

Physical and Aesthetics Impacts

The physical impacts on workers and the public of building and operation at the Crystal River site would be similar to those described for the LNP site, with the primary differences due to the presence of the existing facilities and their workforces. People who work or live around the site could be exposed to noise, fugitive dust, and gaseous emissions from construction activities. Construction workers and personnel working onsite could be the most affected. Air-pollution emissions are expected to be controlled by applicable BMPs and Federal, State, and local regulations. During operation of the two units, 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. The review team anticipated that the annual average exposure from gaseous emission sources at the site boundary would not exceed applicable regulations during normal operations. The impacts of operations on air quality are expected to be minimal. As with building impacts, potential offsite receptors during operations are generally located well away from the site boundaries.

Residential and commercial areas are located away from the site boundaries, applicable air-pollution regulations would have to be met by PEF, and applicable BMPs would be put in place. Therefore, based on information provided by PEF and the review team's independent review of reconnaissance-level information, the staff concludes that the physical impacts of station building and operation on workers and the local public around the Crystal River site would be minimal.

Building and operations activities are not expected to affect 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 site, which could suffer noticeable temporary and short-term effects. No long-term physical impacts on structures, including any residences near the site boundaries, would be expected.

Therefore, based on consideration of reconnaissance-level information, the review team concludes that the physical impacts of building and operating the two units at the Crystal River site on onsite and offsite buildings would be minor.

Although transmission-line corridors already exist to serve the Crystal River site, approximately 180 mi of additional transmission system infrastructure would be needed (estimates made by measuring the approximate distance of hypothetical corridors provided by CH2M HILL [2009]). PEF has assumed that new transmission lines would be collocated within existing transmission-line corridors to the extent possible, thereby minimizing potential impacts. The width of the transmission-line corridor would depend on the size, voltage, and whether or not existing corridors could be used, and would vary from 55 ft to 460 ft wide. The buildings, cooling towers, and other onsite infrastructure would add to the industrial landscape around the CREC site and impacts would be minor. However, any new transmission lines and corridors associated with the new reactors would create a noticeable, localized aesthetic impact.

Demographic Impacts

Table 9-11 shows that the population in Citrus and Marion counties increased between 1990 and 2000 at a slightly greater rate than between 2000 and 2010; while Levy County grew at about half the rate between 2000 and 2010 than for the prior decade. Based on the projections that the peak in-migrating population associated with the proposed project would constitute less than a 2 percent increase over the 2010 populations, the review team found that the in-migrating population associated with building two new nuclear generating units would have a minor demographic impact in the EIA.

Economic Impacts

The review team determined that the impact of jobs associated with construction and preconstruction would have a minor effect on total employment in the EIA. The projected in-migrating workers would account for less than 2 percent of the year 2010 employee base of the EIA. The impact of approximately 541 jobs (70 percent of operations jobs) filled by in-migrating operations workers within a 1-hour commute of the site and the associated 519 indirect jobs would be minor on employment levels in the EIA. See Section 4.4.3.1 for derivation of indirect labor.

The review team assumed that tax revenues generated from sales and use taxes associated with construction and operation of two additional units at the Crystal River site would be similar to those evaluated for the LNP site in Sections 4.4.3.3 and 5.4.3.3, with a similar minimal impact on revenues in the EIA and the region.

As discussed in Section 5.4.3.3, the State of Florida Conditions of Certification for LNP would require PEF to discontinue the operations of two fossil-fueled units at the CREC in Citrus County by December 31, 2020, assuming licensing, construction, and operation of LNP were to occur in a timely manner (DOE/EIA 2010b; FDEP 2011b). Because of the age and size of the two units planned for closure, the review team does not expect their value to be very high, but Citrus County would still lose a small component of its property tax base. However, this loss would be offset by the new property taxes derived from the two new nuclear units,. The review team concluded that increased property taxes from two new operating units at the Crystal River site following reassessment for improvements and for its expanded use as a utility would have a substantial beneficial impact on Citrus County and a minor beneficial impact elsewhere. The review team found that additional property taxes on new houses built by in-migrating workers would constitute a small percentage increase in the local tax base in the EIA; thus the impact of operations on residential property tax revenues would be minor.

Housing

The review team compared the 2010 figures for vacant housing in the EIA listed in Table 9-10 with the number of in-migrating workers projected for peak workforce years listed in Table 9-11. Table 9-10 housing figures do not include recreational vehicle (RV) parks, campgrounds, or hotels, and thus provide a lower bound of what would be available to house workers. In the EIA, about 3 percent of the year 2010 vacant housing units would be needed to house in-migrating workers, assuming that each worker occupied a separate housing unit. Even by analyzing the housing availability using a lower bound, the review team concludes that the EIA could easily absorb the projected increase. Based on this analysis, the review team concluded that impacts on housing availability related to the building and operation of a plant at the Crystal River site would be minor in the EIA.

Public Services

As discussed in Section 2.5, Citrus County has the capacity in community infrastructure to absorb incoming populations; the review team concluded that the impacts of building and operating two new nuclear generating units at Crystal River would be minimal on public services. Some localized noticeable effects would be felt in Levy County (fire-protection services serving Yankeetown and Inglis) and Marion County (police, and emergency services) for the reasons discussed in Section 4.4.4.4.

Traffic

The review team considered that the primary roads used to access the Crystal River site would be US-19, County Road 40 (CR-40), State Route 44 (SR-44), and SR-121, with US-19 linking to the site access road. US-19 has a level of service (LOS) standard of "B," and SR-44, CR-40, and SR-121 have an LOS standard of "C." The review team considered the impact of project-related traffic in terms of the likelihood that it would lower the LOS along US-19 below the assigned standard "B." One-way annual average daily traffic (AADT) counts for US-19 range from 1600 to 8600 vehicles per day in southern Levy County, 4600 in northern Citrus County, 9300 north of the intersection with SR-44, and 13,000 south of the intersection with SR-44 (FDOT 2008). The review team assumed 2281 trips daily (following the LNP site analysis in Section 4.4.4.1); split 30 percent to/from the north and 70 percent to/from the south, based on the split of in-migrating worker residence patterns discussed above. At morning shift change, this would add 1977 cars to the total flow on US-19, 397 incoming from the north, 1025 from the south; and 165 outgoing to the north, 385 to the south. This would add about 10 percent volume to traffic coming south into northern Citrus County and about 10 percent coming north from the intersection with SR-44. The review team found no evidence that the LOS for US-19 would change as a result of project-related traffic, and concluded that building two new units at the Crystal River site would have a minor transportation impact.

Recreation

Because of the close proximity of the Crystal River alternative site to the proposed site, the review team determined that impacts on recreational facilities and on the quality of the recreational experience during building would also be minor at the Crystal River alternative site.

Education

Table 9-12 provides data about schools in the EIA. All schools met the State teacher-student ratio classroom requirements in 2007–2008 with the exception of four schools in Citrus County and four schools in Marion County. The review team assumed that school districts in the EIA, like those analyzed for the LNP site, would address short-term gains in student population with mobile classrooms. However, as discussed in Section 4.4.4.5, schools in Yankeetown, Inglis, and Dunnellon would most likely experience noticeable adverse impacts from overcrowding during peak building employment. The review team used the same ratios of students by households as listed in Table 2-35 and assumed that students would accompany each in-migrating worker family. The results are listed in Table 9-12.

Table 9-12. Educational System Impacts from In-Migrating Families at Peak Workforce Years

County	In-Migrating Worker Households	New Elementary School Students	Elementary School Rooms[a]	New Middle School Students	Middle School Rooms[b]	New High School Students	High School Rooms[c]
Citrus	658	76	5	39	2	45	2
Marion	658	104	6	51	2	60	3
Levy	146	29	2	15	1	16	1

Source: Table 4-14 and State of Florida 2002
(a) 18 students per teacher required by State law.
(b) 22 students per teacher required by State law.
(c) 25 students per teacher required by State law.

The review team found that the addition of up to 9 classrooms in Citrus County, 11 classrooms in Marion County, and 4 classrooms in Levy County would amount to less than 1 additional classroom per school, a minor impact during the period when the greatest number of project-related students would be present in the EIA, with the exception of Inglis, Yankeetown, and Dunnellon, where peak employment period education impacts would be noticeable.

Summary of Socioeconomics

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. Based on information provided by PEF and its own independent evaluation, the review team finds that the socioeconomic effects of building of two additional nuclear units at Crystal River site would be minor for the EIA and region with the following exceptions. There could be noticeable adverse effects on public services in Levy County (fire protection and schools serving Yankeetown and Inglis) and Marion County (Dunnellon schools, police, and emergency services) until local funding is adjusted after the units are operating. In addition, the review team anticipates long-term localized and noticeable aesthetic affects for viewers of the new structures and transmission lines/corridors. The region surrounding the alternative site would experience minor beneficial tax impacts while Citrus County, the host county for the project, would experience substantial beneficial tax impacts once the units are operational.

Cumulative Impacts

In addition to assessing the incremental socioeconomic impacts from the building and operation of two nuclear units on the Crystal River site, the cumulative impact assessment considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on the region, including other Federal and non-Federal projects and the projects listed in Table 9-6. As indicated in Table 9-6, the Crystal River site, the location of the CREC, contains four fossil-fuel units that began operating in 1966, 1969, 1982, and 1984 and a nuclear plant that began operating in 1977. This table also identifies other projects that might contribute to socioeconomic impacts.

Within the wider region, the resident population is concentrated around the cities of Gainesville to the north-northeast, Crystal River to the southeast, and Ocala to the east-northeast. In the EIA, Levy is the least populated and most rural county; followed by Citrus, which gained population and urban development after construction of the CREC; and then followed by Marion the most populated and least rural.

Within the region, the two reasonably foreseeable projects listed in Table 7-1 with the greatest potential to affect cumulative socioeconomic impacts would be the Tarmac King Road Limestone Mine during construction and preconstruction of the LNP and the closure of two coal-fired units at CREC that would possibly occur during operation of the LNP. The other projects involve continuation of restricted development in existing parkland and open space, little or no change in current levels of employment at existing establishments, or new development consistent with controls in existing county comprehensive plans. The effects of these projects have been included in population and demand projections in the county comprehensive plans and in other public agency planning processes referenced in Sections 4.4 and 5.4, and have therefore been taken into consideration in the discussion above. Tarmac has applied for permits to begin construction of the Tarmac King Road Limestone Mine in 2011, with operations beginning in 2013. The 4900-ac mine site is located 1 mi west of the intersection of US-19 and King Road in Levy County, within about 10 mi of the Crystal River site. Tarmac estimates that at the height of mining activity, about 500 trucks would leave the mine site daily and enter US-19 (Tarmac America 2010). These 500 trucks would add to the approximately 800 new trips heading south along US-19 and to the approximately 2000 total new trips during morning shift changes while the new units are being built at the Crystal River site. Given the distance of the Tarmac site from the Crystal River site, the review team determined that this would not be sufficient to change the LOS of US-19, because the potential impacts from this increased traffic, coupled with increased traffic from the Crystal River site during building of new units at the site, would be minor except during shift changes.

When operations begin for the two proposed units the EIA would experience reduced direct construction employment and related indirect jobs. This reduction would be somewhat offset by the introduction of new operations workers at the new units. The planned closure of two of the four coal-fired units at CREC that is expected to occur after the proposed two nuclear power units are operating would slightly increase the differential between peak construction and long-term employment. In addition, Citrus County would see a loss in tax revenue paid by PEF for the two coal-fired units at CREC, but the review team determined the loss in revenue would not be destabilizing given the new revenue from the two nuclear units and other remaining revenue sources. If the operating license for the existing nuclear unit at CREC were not renewed (it is currently valid through midnight December 3, 2016) and the unit closed, the loss of employment, income, and tax revenues would be larger.

In addition to socioeconomic effects directly related to building and operating the new units, cumulative socioeconomic impacts include economic, infrastructure, and community services impacts associated with the items listed in Table 9-6: operation of a new limestone mine, continued operation of a local quarry, continued and uprated operation of an existing nuclear unit at CREC, some expanded residential and commercial development consistent with county comprehensive plans, and some loss of employment and taxes associated with the potential shutdown of two coal-fired units at CREC.

The review team found that physical, demographic, economic, infrastructure, and community service impacts of building and operating the new units at Crystal River would be generally minor. The review team identified noticeable short-term adverse effects on police, emergency, and fire-protection services and schools in specific local communities during peak employment years. The short-term adverse effects would be expected to become minor once local funding has been adjusted after a few years of operation. There would be long-term localized and noticeable aesthetic effects for viewers of the new structures and Citrus County would see long-term noticeable and substantial beneficial tax impacts from two nuclear units.

The review team determined that the cumulative socioeconomic effects of the Crystal River nuclear expansion and other past, present, and reasonably foreseeable projects would be SMALL with the following exceptions attributable to building and operating the two new nuclear units at the Crystal River site. There would be MODERATE short-term adverse effects on police, emergency service, fire protection, and schools in specific local communities during peak construction and preconstruction employment years. The short-term adverse effects would be expected to become SMALL once local funding has been adjusted after a few years of LNP operation. There would be long-term MODERATE adverse aesthetic effects for viewers of the new structures at the Crystal River site. Revenues from property taxes and sales taxes from operating the two new nuclear units at the site would result in a LARGE beneficial impact level. This LARGE and beneficial tax benefit would fully offset the loss of tax revenues to Citrus County that would occur if the coal-fired CREC Units 1 and 2 are decommissioned; but the net beneficial impact to tax revenues from the two new units at the Crystal River site would still be LARGE.

9.3.2.6 Environmental Justice

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that could have environmental justice effects, including the other Federal and non-Federal projects listed in Table 9-6. The cumulative environmental justice impacts were assessed for a 50-mi radius centered on the Crystal River site (NRC 2000).

Because of the proximity of the Crystal River alternative site to the proposed Levy site, approximately 9 mi southwest of the LNP site, the review team used the distribution of minority and low-income populations around the proposed LNP site to determine distributions around the nearby Crystal River site. As shown in Figures 2-26 through 2-29, the closest aggregate minority census block group with a population of interest is in Levy County and borders the Levy site on the east. Another block group with an aggregate minority population of interest is within within 2 mi of the Levy site to the west. One hundred forty-four census block groups within the 50-mi radius have aggregate minority populations that meet at least one of the NRC's criteria for containing a population of interest, and 147 census block groups have African-American populations that meet at least one of the two significance criteria. The closest block groups with a significant African-American population are the same census block groups identified as having an aggregate minority population of interest. There are significant concentrations of African-

American populations around the urban centers of Gainesville and Ocala, as well as in more rural areas in Levy, Marion, and Sumter counties.

One hundred thirteen block groups currently contain Hispanic ethnicity populations of interest in the 50-mi region, the closest being about 6 mi east-northeast of the Levy site on the western boundary of Marion County. Figure 2-28 shows the block groups within the 50-mi radius in which the Hispanic ethnicity population meets at least one of the two criteria.

One hundred eleven census block groups have low-income populations of interest in the 50-mi region. The closest low-income population of interest to the Levy site is less than 1 mi away to the west on the southern border of Levy County. As discussed in Section 2.6.2, the review team did not identify any evidence of unique characteristics or practices in minority or low-income communities that may result in different socioeconomic impacts for the LNP site compared to the general population. This conclusion holds for the Crystal River site.

As discussed in Section 9.3.3.5, the review team expects that building and operating two new nuclear units at the Crystal River site would have minimal physical impacts on all populations in Citrus and surrounding counties, including minority and low-income populations, because of their distance from the site, with the exception of long-term noticeable aesthetic affects for viewers of the new structures, including transmission lines and corridors. Because of the proximity of the Crystal River alternative site to the proposed Levy site, the review team expects impacts on minority and low-income populations would be the same as those discussed in Sections 4.5 and 5.5. For the Crystal River alternative site, there is no evidence that impacts would be disproportionately high and adverse towards minority or low-income populations. Therefore, the review team concludes that the adverse impacts on minority and low-income populations resulting from construction and operation of two new nuclear reactors at the Crystal River site would be minimal. Because the review team found no evidence of unique characteristics or practices among minority or low-income populations that would lead to a disproportionately high and adverse impact, the review team concludes that environmental justice impacts would be minor.

Cumulative Impacts

The review team concluded that, as for socioeconomics effects discussed in Section 9.3.3.5, within the region, the two reasonably foreseeable projects listed in Table 9-6 with the greatest potential to affect cumulative environmental justice impacts would be the proposed Tarmac King Road Limestone Mine during building of LNP and the possible closure of two coal-fired units at CREC during operation of LNP. The other projects involve continuation of restricted development in existing parkland and open space, little or no change in current levels of employment at existing establishments, or new development consistent with controls in existing county comprehensive plans. The review team believes the effects of these projects have been included in population and demand projections in the county comprehensive plans and in other public agency planning processes.

The review team found no evidence that the minor traffic contribution of the new mine and the net minor employment and tax effects of the possible closure of two CREC coal-fired units could impose disproportionately high and adverse affects on minority or low-income populations. The review team concluded that, in addition to other past, present, and reasonably foreseeable future projects, building and operating two new nuclear units at Crystal River would impose only a minor impact on minorities or low-income populations. Therefore, the environmental justice impacts would be SMALL.

9.3.2.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the Crystal River site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect historic and cultural resources, including the other Federal and non-Federal projects listed in Table 9-6. For the analysis of cultural impacts at the Crystal River site, the geographic area of interest is considered to be the Area of Potential Effect (APE) that would be defined for this site. This includes the direct effects APE, defined as the area physically affected by the site-development and operation activities at the site and within transmission-line corridors. The indirect effects APE is defined as the area visually affected and includes an additional 0.5-mi-radius APE around the transmission-line corridors and a 1-mi-radius APE around the cooling towers.

Reconnaissance activities in a cultural resource review have particular meaning. Typically, they include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing this EIS, the review team relied upon reconnaissance-level information to perform its alternative site evaluation in accordance with ESRP 9.3 (NRC 2000). Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. The following information was used to identify the historic and cultural resources at the Crystal River site:

- PEF ER (PEF 2009b)
- Atomic Energy Commission Final EIS for Crystal River Unit 3 (CREC Unit 3) (AEC 1973)
- PEF Crystal River Unit 3 License Renewal ER (PEF 2008)
- PEF Crystal River Unit 3 License Renewal Draft Supplemental EIS (NRC 2011b)
- National Register of Historic Places database (NPS 2010)
- Florida Historical Markers Program (FDOS 2010)
- NRC Alternative Sites Visit, October 14–17, 2008 (NRC 2009).

The Crystal River site is owned by PEF and is located adjacent to the CREC. Five existing power-generation units are located on the CREC site – four coal-fueled plants and one nuclear unit. Power generation at the CREC began in 1966. Historically, the site and vicinity were largely undisturbed and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, the area has been disturbed by development associated with phosphate mining, cattle ranching, citrus farming, and timber production (PEF 2008). Cultural resource investigations, related to the initial construction and operation of CREC Nuclear Unit 3, have been ongoing at the CREC since the 1970s.

A search of the Florida Historical Markers Program revealed that there is one historic marker located in Citrus County – the Historic Citrus County Courthouse, which was built in 1887 (FDOS 2010). The courthouse is also in the National Register of Historic Places (NRHP or National Register). A search of the NRHP database revealed that there are nine places in the NRHP, including the Floral City Historic District and the Crystal River Indian Mounds (NPS 2010). According to the Final EIS completed for the CREC Unit 3, the Crystal River Historical Memorial, a Native-American ceremonial center and burial site is located near the CREC Unit 3 location (AEC 1973).

According to the ER for the license renewal of CREC Unit 3, the Florida Master Site File records list 37 archaeological studies that have been conducted in the vicinity of the CREC. Two of the studies appear to have been conducted in support of CREC Unit 3 projects and activities. Of particular interest is the archaeological survey of the CREC conducted in 1972 that included some additional investigations within a 5-mi radius of the facility. As a result of this survey, 43 archaeological sites were inventoried, 20 within the boundary of the CREC. With regard to the 20 sites identified on the Crystal River property, 18 were prehistoric, one was prehistoric and historic, and one was unspecified. None of these sites has been evaluated by the State Historic Preservation Office (SHPO) for eligibility for listing in the National Register. Siting of the two proposed units at the Crystal River site has the potential to affect resources through visual impacts from buildings and transmission lines. If any of the 20 properties is subsequently listed in the National Register, the visual impacts from the proposed project may result in significant alterations to the visual landscape within the geographic area of interest.

Building Impacts

To accommodate building two new nuclear generating units on the Crystal River site, PEF would need to clear land for the main power plant site as described in Section 9.3.2.1. If the Crystal River site were chosen for the proposed project, identification of cultural resources would be accomplished through additional cultural resource surveys and consultation with the SHPO, Tribes, and interested parties. The results would be used in the site-planning process to avoid cultural resources impacts. If significant cultural resources were identified by these surveys, the review team assumes that PEF would use the same protective measures used at the LNP site, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could potentially destabilize important attributes of historic and cultural resources.

Section 9.3.2.1 describes the transmission-line corridors. While there are no existing transmission lines connecting directly to the Crystal River site, transmission-line corridors that connect to the CREC may be used to construct transmission lines for the Crystal River site (PEF 2009b). However, a new transmission-line corridor would be built to serve the Crystal River site. If the Crystal River site were chosen for the proposed project, the review team assumes that PEF would conduct its transmission line-related cultural resource surveys and procedures in a manner similar to that for the LNP site including Florida State site-certification conditions. In addition, the review team assumes the State of Florida's Conditions of Certification regarding transmission-line siting and building activities would also apply, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could potentially destabilize important attributes of historic and cultural resources.

Operations Impacts

Impacts on historic and cultural resources from operation of two new nuclear generating units at the Crystal River site would include those associated with the operation of new units and maintenance of transmission lines. The review team assumes that the same procedures currently used by PEF, including the State of Florida's Conditions of Certification (FDEP 2011b), would be used for onsite and offsite maintenance activities. Consequently, the incremental effects of the maintenance of transmission-line corridors and operation of the two new units and associated impacts on the cultural resources would be negligible for the physical and visual APEs.

Cumulative Impacts

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include rural, agricultural, and industrial development and activities associated with these land-disturbing activities such as road development. Table 9-6 lists past, present, and reasonably foreseeable projects and other actions that may contribute to cumulative impacts on historic and cultural resources in the geographic area of interest. Projects from Table 9-6 that may fall within the geographic area of interest for cultural resources include operation of CREC Units 1–5, uprate and license renewal at CREC Unit 3, Crystal River Mariculture Center, other aquaculture facilities, and future urbanization.

Long linear projects such as new or expanded roads and pipelines may intersect the proposed transmission-line corridors. Because cultural resources can likely be avoided by long linear projects, the impacts on cultural resources would be minimal. Future projects associated with the CREC would not result in increased significance of the current physical or visual alterations of cultural resources when considered in addition to past and present activities. If building associated with such activities results in significant alterations (both physical alteration and visual intrusion) of cultural resources in the transmission-line corridors, then cumulative impacts on cultural resources would be greater.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the Crystal River site would be SMALL. This impact-level determination reflects the fact that the cultural resources on the Crystal River site have been evaluated for license renewal (NRC 2011b). If the Crystal River site were to be developed, then cultural resource surveys and evaluations would need to be conducted and PEF would assess and resolve adverse effects of the undertaking. Adverse effects could result in greater cumulative impacts.

9.3.2.8 Air Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affect air quality, including the shutdown of two coal-fired units, and other Federal and non-Federal projects listed in Table 9-6. The geographic area of interest for the Crystal River site is Citrus County, which is in the West Central Florida Intrastate Air Quality Control Region (40 CFR 81.96).

The emissions related to building and operating a nuclear plant at the Crystal River site would be similar to those at the LNP site. The air quality status for Citrus County as set forth in 40 CFR 81.310 reflects the effects of past and present emissions from all pollutant sources in the region. Citrus County is classified as being in attainment for all NAAQSs.

The atmospheric emissions related to building and operating a nuclear plant at the LNP site in Levy County, Florida, are described in Chapters 4.7.1 and 5.7.1. Emissions of criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of criteria pollutant emissions at the LNP site were evaluated and also determined to have a SMALL impact.

Cumulative Impacts

Reflecting on the projects listed in Table 9-6, the most significant with regard to air quality within Citrus County are the operations of Units 1–5 at the CREC. Four of these units are fossil-fuel plants. Assuming a timely completion and startup of LNP Units 1 and 2, PEF has agreed to shut down coal-fired CREC Units 1 and 2 by December 31, 2020 (FDEP 2011b). In the period while the fossil-fuel plants are in operation, their effluents are typically released through stacks with significant vertical velocity. Other industrial projects listed in Table 9-6 would have *de minimis* impacts. Given that these projects would be subject to institutional controls, it is unlikely that the air quality in the region would degrade to the extent that the region would be declared to be in nonattainment for any of the NAAQSs.

The air quality impact of the Crystal River site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects, including the aforementioned units at CREC, that would have emissions during site development that would, in combination with emissions from the Crystal River site, result in a degradation of air quality in the region.

Releases from the operation of two new units at the Crystal River site would be intermittent and made at low altitudes with little or no vertical velocity. The air quality impacts of the CREC are included in the baseline air quality status. The cumulative impacts from emissions of effluents from the Crystal River site and the aforementioned sources would be noticeable until at least 2020. After the new nuclear units go into service, operations of fossil-fueled Units 1 and 2 at CREC would likely be discontinued, and the emissions from the Crystal River site and aforementioned sources would be less noticeable.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.6.2. The impacts of the emissions are not sensitive to the location of the source. Consequently, the discussion in Section 7.6 is applicable to a nuclear power plant located at the Crystal River site. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable. The review team further concludes that the cumulative impacts would be noticeable with or without the GHG emissions of the project at the Crystal River site or the potential shutdown of fossil-fueled Units 1 and 2 at CREC.

Cumulative impacts on air quality resources are estimated based on the information provided by PEF and the review team's independent evaluation. Other past, present, and reasonably foreseeable future activities exist in the geographic area of interest (local for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutant air quality from emissions from the Crystal River site, other projects, and the CREC could be noticeable, principally as a result of the contribution of the fossil-fuel units at CREC. The national and worldwide cumulative impacts of GHG emissions are noticeable with or without the GHG emissions from the Crystal River site. The review team concludes that cumulative impacts from construction, preconstruction, and operations, as well as other past, present, and reasonably foreseeable future actions on air quality resources in the geographic area of interest would be SMALL to MODERATE for criteria pollutants (assuming the shutdown of the two coal units occurs) and MODERATE for GHG emissions. The incremental contribution of impacts on air quality resources from building and operating two new nuclear units at the Crystal River site would be insignificant for both criteria pollutants and GHG emissions.

9.3.2.9 Nonradiological Health

The following impact analysis includes impacts from building activities and operations for the Crystal River site. The analysis also considers other past, present, and reasonably foreseeable future actions that could affect nonradiological health, including the other Federal and non-Federal projects listed in Table 9-6. The building activities that have the potential to affect the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and the transport of construction materials and personnel to and from the site. The operation-related activities that have the potential to affect the health of members of the public and workers include exposure to etiological agents, noise, EMFs, and impacts from the transport of workers to and from the site.

The nonradiological health impacts for the Crystal River alternative site would be similar to the impacts evaluated for the LNP site. For the same reasons discussed in Section 7.7, most of the nonradiological health impacts for building and operation (e.g., air emissions, noise, occupational injuries) would be limited to areas within approximately 2 mi from the site. Occupational injuries would occur only within the boundaries of the Crystal River site, and there would thus be no potential for cumulative impacts with other projects. Impacts of air and particulate pollutants released during building activities, and noise from construction and operation have likewise been assessed as minimal for the offsite receptors nearest to the Crystal River site.

For nonradiological health impacts associated with transmission lines, the geographic area of interest would be the transmission-line corridor. As was the case for operation at the LNP site, thermal discharge from two new units built at the Crystal River site would be discharged into the CREC outfall.

Building Impacts

Nonradiological health impacts on construction workers and members of the public from building two new nuclear units at the Crystal River site would be similar to those evaluated in Section 4.8 for the LNP site. The impacts include noise, vehicle exhaust, dust, occupational injuries, and transportation accidents, injuries, and fatalities. Applicable Federal and State regulations on air quality and noise would be complied with during the site-preparation and building phase. A detailed noise study has not been performed for the Crystal River site, but it is likely that noise impacts from building, except for rare, high-noise activities such as pile-driving, would comply with the Citrus County noise limit for industrial and agricultural areas of 75 dBA (Citrus County 2010). The incidence of construction worker accidents would be the same as the incidence of accidents estimated for the LNP site.

Analyses in Section 9.3.2.5 indicated that the traffic impacts in the vicinity of the Crystal River site would be minor and would not require mitigation. Interactions between the traffic destined for the Crystal River nuclear power plant project and the other power-generating plants are likely to increase the nonradiological health effects from traffic accidents in the vicinity of the Crystal River site. The additional injuries and fatalities from traffic accidents involving transportation of materials and personnel for building of a new nuclear power plant at the Crystal River site would be similar to those evaluated in Section 4.8.3 for the LNP site. Noise impacts from construction at the Crystal River site would be similar to those predicted for construction at the LNP site, although detailed noise modeling has not been performed. Noise levels would again be limited to comply with applicable Occupational Safety and Health Administration (OSHA) and local regulations.

The cumulative impacts of building two new units at the Crystal River site would, for the most part, be the same as for building activities at the LNP site, because the bulk of the current and future projects are too distant from the Crystal River site for any interactions to occur. The exception is the Holcim Mine, which is approximately 1 mi from the Crystal River site. Potential combined noise and particulate air emission impacts from quarry operations and nuclear plant construction activities might occur. The Crystal River Mariculture Center is also located adjacent to the Crystal River site, but combined nonradiological health impacts are unlikely to occur, given that the Mariculture center is already in operation and is unlikely to be a significant source of noise or air pollutant emissions. Combined impacts of building activities with other present and future projects in the area would be unlikely. The review team has concluded that cumulative nonradiological health impacts associated with building activities at the Crystal River site and all current and foreseeable future projects would be minimal.

Operational Impacts

Occupational injuries and nonradiological health impacts on members of the public from operation of two new nuclear units at the Crystal River site would be similar to those evaluated in Section 5.8 for the LNP site. Occupational health impacts on workers (e.g., falls, electric shock or exposure to other hazards) at the Crystal River site are expected to be the same as those evaluated for workers at two new units at the LNP site. Exposure of the public to waterborne etiological agents at the Crystal River site would be limited by the current physical and administrative controls around the thermal discharge of the existing facility, and the exposures would be similar to those discussed in Section 5.8.1. The operation of the new units at the Crystal River site would not likely lead to an increase in waterborne diseases in the vicinity. Noise and EMF exposure would be monitored and controlled in accordance with applicable OSHA regulations. Noise impacts would be similar to those predicted for operations at the LNP site, although no detailed noise modeling has been performed for the Crystal River site. Effects of EMF on human health would be controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria and adherence to the standards for transmission systems regulated by the FDEP. Traffic impacts during facility operation would be less than the impacts during building (minor).

Current and future energy projects with the potential for combined impacts include the ongoing operation of the CREC; these activities include the license renewal and uprate of CREC nuclear Unit 3 and the retirement of two older coal-fired generation plants at CREC when LNP Units 1 and 2 come online. The review team has concluded that the cumulative nonradiological human health impact would be minimal for operation at the Crystal River site. The increase risk to humans from exposure to etiological agents as a result of two additional nuclear closed-cycle units at the Crystal River site would be insignificant. Facility operations at Crystal River are unlikely to have any combined health impacts with other nearby projects (Crystal River Quarry and Crystal River Mariculture Center), and the other projects identified in Table 9-6 are too far away from the Crystal River site for cumulative impacts to be a concern. Thus, the cumulative nonradiological health impacts of these operations and the facility operations at the Crystal River alternative site would also be minimal.

The review team is also aware of the potential climate changes that could affect human health; recent analyses of these issues (GCRP 2009) have been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature and a decrease in precipitation, which may alter the presence of microorganisms and parasites in surface water. While the overall impacts of climate change may not be insignificant (Section 7.7), the effect of, or contribution to, these effects from operation at the Crystal River site is likely to be minor. The review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change in the incidence of waterborne diseases.

Summary

Based on the information provided by PEF and the review team's independent evaluation, the review team expects that nonradiological health impacts from building and operation of two new units at the Crystal River alternative site would be similar to the impacts predicted for the LNP site. While past, present, and future activities in the geographic area of interest could affect nonradiological health in ways similar to the building and operation of two units at the Crystal River site, the impacts would be localized and managed through adherence to existing regulatory requirements. The review team concludes, therefore, that cumulative impacts of nonradiological health associated with building activities and operations at the Crystal River site would be SMALL.

9.3.2.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts from building activities and operation for two additional nuclear units at the Crystal River site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects listed in Table 9-6. As described in Table 9-6, the CREC consists of five power-generating plants operated by PEF, four fossil-fuel plants and one nuclear plant, CREC Unit 3. The geographic area of interest is the area within a 50-mi radius of the Crystal River site. Other than CREC Unit 3, there are no major facilities that result in regulated exposures to the public or biota within 50 mi of the Crystal River site. However, there are likely to be hospitals and industrial facilities with 50 mi of the Crystal River site that use radioactive materials.

The radiological impacts of building and operating the proposed two AP1000 reactors at the Crystal River site include direct radiation and liquid and gaseous radioactive effluents. Releases of radioactive materials and all pathways of exposure would produce low doses to people and biota offsite, well below regulatory limits. The impacts are expected to be similar to those estimated for the LNP. The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Crystal River site. This conclusion is based on the radiological monitoring program conducted for the currently operating CREC Unit 3.

Based on the information provided by PEF and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 units and other past, present, and reasonably foreseeable projects and actions in the geographic area of interest around the Crystal River site would be SMALL.

9.3.2.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from operations for two additional nuclear units at the Crystal River site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including the other Federal and non-Federal projects and the projects listed in Table 9-6. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Crystal River site. As described in Section 9.3.2, the Crystal River site is adjacent to an existing power plant site; there is currently one nuclear facility on the adjacent site. There are no proposed reactors that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Crystal River site.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of design basis accidents (DBAs) at the LNP site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorological conditions of the Crystal River and LNP sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Crystal River site would be minimal.

Because the meteorology, population distribution, and land use for the Crystal River site are similar to the LNP site, risks from a severe accident for an AP1000 reactor located at the Crystal River site are expected to be similar to those analyzed for the LNP site. The risks for the LNP site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For the existing plant within the geographic area of interest, namely CREC Unit 3, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR Part 51, Appendix B, Table B-1). If the NRC approves the requested 20 percent power uprate at CREC Unit 3 its approval will be based, in part, on the NRC staff's determination that the risk implications of the planned 20 percent power uprate are acceptable. Therefore, the impact would continue to be SMALL. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Crystal River site would be SMALL.

9.3.3 Dixie Site

This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Dixie alternative site (hereafter Dixie site) in northern Florida. The site is located in a rural area of Dixie County northwest of the Suwannee River. The Suwannee River would be the source for water for plant cooling and other plant uses, and construction of a new water-storage reservoir would be required. Dixie is a greenfield site not currently owned by PEF (PEF 2009b). Conceptual routes of the transmission lines necessary to connect the Dixie site to the electrical grid are located in Taylor, Lafayette, Suwannee, Columbia, Gilchrist, Dixie, Levy, Citrus, Marion, Sumter, Lake, Pasco, Pinellas, Hillsborough, and Hernando counties (CH2M HILL 2010).

The following sections include a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action, if implemented at the Dixie site, and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction and operations and impacts of preconstruction activities. Also included in the assessment are past, present, and reasonably foreseeable future Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Dixie site. Other actions and projects considered in this cumulative analysis are described in Table 9-13.

Table 9-13. Past, Present, and Reasonably Foreseeable Future Projects and Other Actions Considered in the Cumulative Analysis of the Dixie Site

Project Name	Summary of Project	Location	Status
Energy Projects			
Operation and Decommissioning of CREC Units 1–5	The CREC consists of five power-generating plants operated by PEF – four fossil-fuel plants and one nuclear plant. The fossil-fuel plants began operations in 1966, 1969, 1982, and 1984. The nuclear plant began operations in 1977.	Within 50 mi of the Dixie site in northern Citrus County	Operational. The nuclear plant (Unit 3) is shut down due to damage to the containment. The State of Florida Siting Board's Conditions of Certification for LNP would require PEF to discontinue the operations of the two fossil-fuel units by December 31, 2020, assuming licensing, construction, and commencement of operation of LNP occurs in a timely manner (PEF 2011e; DOE/EIA 2010b; FDEP 2011b).
Renewal of the operating license for the CREC nuclear Unit 3	Extension of operations of CREC Unit 3 for an additional 20-year period beyond the end of the current license term, which is valid through midnight on December 3, 2016.	Within 50 mi of the Dixie site in northern Citrus County	Proposed. If granted, the license renewal would provide PEF the authority to continue operations through 2036. The draft Supplemental EIS for the license was issued on May 26, 2011 (NRC 2011b).
Uprate at CREC Unit 3	CREC Unit 3 has requested an uprate to increase the maximum power level at which the nuclear power plant may operate. The project would also include construction of a new helper cooling tower.	Within 50 mi of the Dixie site in northern Citrus County	Proposed. The application submitted to the State of Florida was approved in August 2008. USACE issued a public notice on May 25, 2010 (USACE, 2010b). An application was submitted to NRC in 2011 (PEF 2011f).
Florida Gas Transmission Company, LLC (FGT) Phase VIII Expansion Project	Construct natural-gas pipelines, new compressor, meter, regulator stations, and other appurtenant facilities	Various counties in Alabama and Florida, including Levy, Citrus, and Hernando	Placed in service on April 1, 2011 (FERC 2009b; Panhandle Energy 2011).

Table 9-13. (contd)

Project Name	Summary of Project	Location	Status
Parks and Conservation Areas			
Parks, forests, and reserves	Several parks, recreation, and conservation areas are located within the 50-mi region. Examples of such areas include Goethe State Forest, Cedar Keys National Wildlife Refuge; Cummer Sanctuary, Crystal River National Wildlife Refuge, Lower Suwannee National Wildlife Refuge; Crystal River Preserve State Park, Manatee Springs State Park, Yellow Jacket Conservation Area, Fowlers Bluff Conservation Area, Lower Coastal Creeks Conservation Area, and Steinhatchee Wildlife Management Area	Throughout region	Currently managed by various local, State, and Federal agencies and organizations. Development likely limited in these areas.
Other Actions/Projects			
Commercial forest management	Managed forests for timber production.	Throughout region	Operational
Commercial dairies	Several dairies are located within the 50-mi region, including the Levy County Dairy, Alliance, and Piedmont Dairies, Hill Top Dairy, Aurora Dairy, Dairy Production Systems, and Oak Grove Dairy, Inc.	Throughout region	Operational
Minor water dischargers and wastewater-treatment plants	NPDES-permitted dischargers in Fanning Springs, Trenton, Blitchville, Bell, Chiefland, Cedar Key, Suwannee, and other locations.	Throughout region	Operational
Concrete companies	Two ready-mixed concrete suppliers.	Within 10 mi	Operational (EPA 2010e, f)
Bryan Farms	Animal aquaculture	Within 10 mi	Operational (EPA 2010h)

Table 9-13. (contd)

Project Name	Summary of Project	Location	Status
Crystal River Mariculture Center	Multi-species marine hatchery adjacent to the CREC	Within 50 mi	Operational (FFWCC 2011)
Kaiser Agricultural Chemicals	RCRA site on Suwannee River in Branford, Florida	Within 40 mi	Operational (EPA 2010i)
Other Actions/Projects			
Various hospitals and industrial facilities that use radioactive materials	Medical and other industrial isotopes	Within 50 mi	Operational in nearby cities and towns
Future urbanization	Construction of housing units and associated commercial buildings; roads, 22-mi expansion of SR-26 from US-19 to CR-26A and other activities such as widening, bridges, and railroads; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents.	Throughout region	Construction would occur in the future, as described in State and local land-use planning documents (FDOT 2010a, 2011; Dixie County 2006).

The geographic area of interest for cumulative impacts considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Dixie site. An accident at a nuclear plant within 100 mi of the Dixie site could increase this risk. The CREC is within 50 mi of the Dixie site and is included in Table 9-13. Other nuclear plants in Florida, Alabama, and Georgia that are more than 100 mi from the Dixie site are not included in the cumulative impact analysis.

9.3.3.1 Land Use and Transmission Lines

The following analysis includes impacts from building and operating two nuclear units at the Dixie site, along with the necessary transmission lines to connect them to the electrical grid. The analysis also considers other past, present, and reasonably foreseeable future actions that affect land use, including the other Federal and non-Federal projects listed in Table 9-13. For this analysis, the geographic area of interest for considering cumulative impacts is the area within a 20-mi radius of the Dixie site and within the transmission-line corridors. The review team determined that the 20-mi radius would represent the smallest area that would be directly affected because it includes the primary communities (such as Trenton, Chiefland, and Fanning Springs) that would be affected by the proposed project if it were located at the Dixie site. The review team is aware that PEF has made minor revisions (PEF 2011a; CH2M HILL 2010) to the proposed site layout and associated offsite facilities in coordination with USACE to minimize impacts on wetlands. These minor changes did not change the land-use impact determinations since the DEIS, therefore the following evaluation was completed with original information provided by PEF and was not updated.

Historically, Dixie County was known for commercial fishing, agriculture, and timber operations. Existing land uses in the vicinity of the Dixie site include agriculture, forestry, and low-density residential development. Several subdivisions are located along the Suwannee River. The area around the site is relatively flat, but prone to flooding (PEF 2009b). The Dixie site is subject to the Coastal Zone Management Act because the site is located within one of the designated Florida coastal zone counties. Manatee Springs State Park, Yellow Jacket Conservation Area, Fowlers Bluff Conservation Area, Lower Coastal Creeks Conservation Area, and Steinhatchee Wildlife Management Area lie within the region.

Zoning changes would likely be needed to accommodate construction and operation of a nuclear power plant at the Dixie site. Like the LNP site, the footprint of new power-generating units would be approximately 627 ac, with about 150 ac of additional land needed for temporary facilities and laydown yards. In addition, PEF indicates that a 1291-ac reservoir would be needed at the Dixie site to provide cooling water during periods of low flow of the Suwannee River (PEF 2009a; CH2M HILL 2009). Construction of these facilities would result in a permanent land-use change from the existing land uses described in the previous paragraph to a transportation, communications, and utilities land-use category.

Additional land-use impacts include possible additional growth and land conversions to accommodate new workers and services. Because the workforce would be dispersed over larger geographic areas in the labor supply region, the impacts from land conversion for residential and commercial buildings induced by new workers relocating to the local area can be absorbed into the wider region. Therefore, the review team concludes that such impacts would be minimal.

There are no existing transmission lines or transmission-line corridors in the geographic area of interest around the Dixie site. New transmission lines would need to be constructed to connect the site to existing transmission lines. The transmission lines would run through counties designated under the Florida Coastal Management Program. Any expansion of these transmission-line corridors would require review under the procedures established under the Florida Coastal Management Program. Procedures for siting new transmission lines in Florida are discussed in Section 4.1.2. The review team assumes that the Conditions of Certification issued to PEF by the FDEP would apply at all of the alternative sites.

The review team estimated the linear run of the expected transmission-line corridors by referring to PEF Figure 3.3.3-9 (PEF 2009a), which depicts the potential routing of corridors needed to connect the Dixie units to the grid. That figure suggests that 340 mi of transmission-line corridor would be needed. For purposes of land-use impact analysis, the review team made the assumption that 10 ac/mi would be disturbed, based on the LNP case where 1790 ac are expected to be disturbed over the 180 mi of corridor, as discussed in Section 4.1.2. The review team concludes that this assumption is not unreasonable because siting in Florida is a relatively rigorous process (Site Certification Application process), and the applicant would be bound by permit conditions resulting from that process, which would require it to use existing corridors to the extent practicable. The review team expects that the Site Certification Application (SCA) process would be consistently applied anywhere transmission lines are proposed in Florida. Therefore, the review team concludes that about 3400 ac of land would be disturbed to construct the transmission-line corridors for the Dixie site. Similar to the case at the LNP site, the review team concludes that land-use impacts from developing about 340 mi of new transmission-line corridor to connect new units at the Dixie site would be noticeable, but not destabilizing, and additional mitigation beyond the measures and conditions identified would not be warranted.

Cumulative Impacts

Future urbanization in the review area could contribute to additional decreases in open areas, forests, and wetlands and generally result in some increased residential and industrialized areas. Currently, the area around the Dixie site consists of farmland, forests, and low-density rural residential land uses, but local land-use planning documents describe potential future construction of residential and commercial buildings. Increased urbanization, especially long linear projects such as new or expanded roads or pipelines, would also contribute to the loss of open or forested areas and increase fragmentation of habitats along or near the transmission lines. Due to the extent of new transmission lines that would be built, the review team expects that the corridors would have a noticeable impact on the local area. These projects would have limited impacts on land use because a small incremental amount of land would be converted to a new land use, and it would be adjacent to the current roads or pipelines. Development would likely be limited in the nearby parks and recreational areas. Therefore, the incremental impacts associated with increased urbanization would be minimal.

Global climate change could increase temperature and reduce precipitation, which could result in reduced crop yields and livestock productivity (GCRP 2009), which, in turn, could change portions of agricultural and ranching land uses in the geographic area of interest. In addition, global climate change could increase sea level and storm surges in the geographic area of interest (GCRP 2009), thereby changing land use through inundation and loss of coastal wetlands and other low-lying areas. However, existing State and national forests, parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by sea-level rise. Because other projects identified in Table 9-13 that are within the geographic area of interest would be consistent with applicable land-use plans and control policies and would occur in dispersed locations, the review team considers their contribution to the cumulative land-use impacts to be relatively minor and manageable.

In the State of Florida's Conditions of Certification (FDEP 2011b), CREC Unit 1 and 2, two coal-fired plants, would stop operating by December 31, 2020, as long as PEF completes the licensing process, construction activities, and commences commercial operation of LNP Units 1 and 2 within a timely manner. If the Dixie site were selected, the review team expects the same condition would apply. If CREC Units 1 and 2 are shut down, land use at the units likely would remain industrial. Depending on economic conditions, PEF sells 60 to 95 percent of the coal plant ash to cement and building materials manufacturers, with the remainder going to Citrus Central Landfill in Lecanto, Florida. With the closure of CREC Units 1 and 2, this source of ash no longer would be available locally. The review team expects land-use impacts associated with the shutdown of CREC Units 1 and 2 would be minimal.

Based on the information provided by PEF and the review team's own independent review, the review team concludes that the cumulative land-use impacts of building and operating two new nuclear reactor units at the Dixie site and other projects would be MODERATE. The proposed project would be a significant contributor to the MODERATE impacts because of the substantial amount of land that would be needed for the proposed power plant, reservoir, and transmission infrastructure.

9.3.3.2 Water Use and Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that could affect water use and quality, including the other Federal and non-Federal projects listed in Table 9-13. PEF has indicated that the development of this site for two nuclear units would require the building of a water reservoir on the Dixie site supplied with water from the Suwannee River (PEF 2009b). PEF has indicated that the site is located in an area considered to be low-lying and flood prone, and the construction of flood protection structures may be required (PEF 2009b).

The geographic area of interest for surface water at the Dixie site is considered to be the drainage basin of the Suwannee River upstream and downstream of the site, because the water resource in this area could be affected if the proposed project were located at the Dixie site. For groundwater, the geographic area of interest is limited to the alternative site because PEF has indicated no plans for use of groundwater to build or operate the plant (PEF 2009b).

Historical flow data for water years 1941–2008 are available for Suwannee River near Wilcox and for the Suwannee River above the Gopher River near Suwannee, Florida (USGS 2010a, b). The Suwannee River near the Wilcox streamflow gauge is upstream of the Dixie site and the

Suwannee River above the Gopher River streamflow gauge is downstream of the Dixie site. Minimum flows and levels for the Suwannee River are summarized by the Suwannee River Water Management District (SRWMD) (SRWMD 2005).

The average streamflow reported by the SRWMD is approximately 10,000 cfs based on historic data from the gauge at Wilcox (SRWMD 2005). Mean annual flow for the past 10 years in the Suwannee River above Gopher River is reported as 7440 cfs (USGS 2009). Minimum flow and level objectives are established by the SRWMD for the Suwannee River (SRWMD 2005). For the Suwannee River near the Wilcox streamflow gauge, the recommended minimum flow is 6600 cfs from May to October and 7600 cfs from November to April (PEF 2007b). These minimum flows provide an indication of the water potentially available for use in building and operating two units at the site. During the 2008 water year, these minimum flows were equaled or exceeded only during the months of March and September. SRWMD would determine the actual yield available for consumption that exceeds recommended minimum flow. Based on the available information, the review team determined that the Suwannee River occasionally does not meet the SRWMD recommendation for minimum flow for extended periods during a water year.

The Lower Suwannee River was identified as being impaired by nutrients and was included on Florida's Verified List of Impaired Waters (Hallas and Magley 2008). A USGS report on the condition of the river states, "human health and ecological concerns have arisen recently because of the large nitrogen inputs to the land surface from fertilizers, animal wastes and atmospheric deposition. This problem occurs primarily in the middle and lower Suwannee and lower Santa Fe Rivers in Florida, where spring water and diffuse upward leakage of groundwater contribute substantial loads of nitrate-N" (USGS 2004). Based on available information, the review team determined that the waters of the Lower Suwannee River are impaired because of historical activities in the basin.

Building Impacts

Because the building activities at the Dixie site would be similar to those at the LNP site, the review team determined that the amount of surface water needed for building activities at the Dixie site would be similar to the proposed amount of groundwater use for building at the LNP site. During building activities at the LNP site, the total maximum usage is projected to be 550,000 gpd (0.85 cfs) and the projected average estimated groundwater usage is 275,000 gpd (0.43 cfs) (see Table 3-2). The review team assumed that surface water from the Suwannee River would be used at the Dixie site for potable and sanitary use as well as for various building-related activities. This surface-water withdrawal rate is minor when compared to the average annual flow in the Suwannee River (10,000 cfs). However, as mentioned above, recommended minimum flows were met only during March and October of the 2008 water year. The applicant would need to obtain an approval from the SRWMD to use surface water from the river for building activities. Because the surface-water withdrawal would be minor compared to the average annual flow and because the withdrawal from the river would be temporary and limited to the building period, the review team concludes that the impact of surface-water use for building the potential units at the Dixie site would be minimal.

As stated above, the review team assumed that no groundwater would be used to build the units at the Dixie site. The review team also assumed that the impact of dewatering the excavations needed for building two units at the site would be managed through the installation of diaphragm walls and grouting as is proposed for the LNP site. Therefore, because there would be no groundwater use and the impact of dewatering would be controlled, the review team determined that there would be minimal impact on groundwater resources.

Surface-water quality would most likely be affected by surface-water runoff during site preparation and the building of the facilities. The FDEP would require PEF to develop an E&SCP and a SWPPP (PEF 2009b). The plan would identify BMPs to control the impacts of stormwater runoff. The review team anticipates that PEF would construct new detention and infiltration ponds and drainage ditches to control delivery of sediment from the disturbed area to nearby waterbodies. Sediment carried with stormwater from the disturbed area would settle in the detention ponds and the stormwater would infiltrate into the shallow aquifer. While stormwater runoff is anticipated to contain nitrogen in low concentrations (Table 3-3) it is not anticipated to contribute significantly to the nutrient concentrations in the river and implementation of BMPs should minimize impacts on the Suwannee River near the Dixie site. Therefore, during building activities, the surface-water-quality impacts near the Dixie site would be temporary and minimal.

While building new nuclear units at the Dixie site, impacts on groundwater quality may occur from leaching of spilled effluents into the subsurface. The review team assumes that the BMPs PEF has proposed for the LNP site would also be in place during building activities at the Dixie site, and therefore the review team concludes that any spills would be quickly detected and remediated. In addition, groundwater impacts would be limited to the duration of these activities, and therefore would be temporary. The review team examined the BMPs that could be implemented at such a site (FDEP 2011b). Because any spills related to building activities would be quickly remediated under BMPs, and the activities would be temporary, the review team concludes that the groundwater-quality impacts from building at the Dixie site would be minimal.

Operational Impacts

PEF determined that a cooling-water reservoir would be needed at the Dixie alternative site. The review team assumed that the cooling water system for the proposed plant, if built and operated at the Dixie alternative site, would be similar to that proposed at the LNP site; specifically, the cooling water system would use cooling towers and blowdown would be discharged to the Suwannee River. The cooling-water reservoir would provide capacity for times when adequate water from the river may not be available. PEF did not provide details of the cooling-water intake and effluent discharge locations. However, it is standard practice for power plants to design cooling-water intake and effluent discharge locations such that recirculation of discharged effluent to the intake does not occur. The reservoir was sized assuming the plant would operate on four cycles of concentration, and that the total cooling-water requirements would be 45 Mgd (31,250 gpm). The reservoir was sized so that the storage is sufficient for a 90-day supply of cooling (PEF 2009a; CH2M HILL 2009).

PEF determined that the total amount of water required to operate two units would be approximately 40,000 gpm (89 cfs). As indicated in Chapter 3, evaporative losses from cooling two units would be approximately 28,000 gpm (62 cfs). As described above, minimum flows were equaled or exceeded for only 2 months during the 2008 water year, suggesting that even with a reservoir, alternative sources of water or other water-saving strategies may be required for operation of two units at the Dixie site. Monthly mean streamflow lower than the recommended minimum flows have occurred in other recent water years, most notably in 2000 (12 of 12 months were below recommended minimum flow), 2001 (10 of 12 months), 2002 (12 of 12 months), 2004 (9 of 12 months), 2006 (9 of 12 months), 2007 (12 of 12 months), 2008 (10 of 12 months), and 2009 (9 of 12 months). The review team determined that out of 69 water years of available streamflow record at Wilcox, mean monthly streamflow at Wilcox was less than the recommended minimum at least six months during the water year in 26 water years. Of these 26 water years, mean monthly streamflow was less than the recommended minimum at least nine months during the water year for 16 water years. The review team also determined that based on established minimum flows, the discharge in the Suwannee River at Wilcox does not exceed 22 and 16 percent of the months during the periods November through April and May through October, respectively. The cooling water withdrawal needed for the proposed plant is 89 cfs, which is less than 2 percent of the smallest recommended minimum streamflow at Wilcox in the Suwannee River. Based on the minimum flow requirements for the Suwannee River and the recent extended periods when these low flows have not been met, the review team determined that the operational impact of the proposed plant at the Dixie alternative site on surface water would be noticeable but not destabilizing.

As stated above, the review team assumed that no groundwater would be used to operate the units at the Dixie site. Therefore, because there would be no groundwater use, the review team determined that there would be no impact on groundwater resources.

During the operation of the proposed plant at the Dixie site, impacts on surface-water quality could result from stormwater runoff, discharges of treated sanitary and other wastewater, and blowdown from cooling towers into the receiving waterbody. PEF did not provide the blowdown rate at the Dixie site. The review team conservatively assumed that the blowdown rate would be the same as that at the LNP site, 57,923 gpm (129 cfs). This assumption is conservative because the proposed plant at the Dixie site would use freshwater from the Suwannee River rather than more saline water at the LNP site, requiring less frequent and smaller blowdown discharge. The FDEP would require PEF to develop a SWPPP (PEF 2009b). The plan would identify measures to be used to control stormwater runoff (PEF 2009b). The blowdown would be regulated by FDEP pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by FDEP in an NPDES permit.

During the operation of new nuclear units at the Dixie site, impacts on groundwater quality could result from potential spills. Spills that might affect the quality of groundwater would be prevented or remediated by using BMPs. Because BMPs would be used to quickly remediate spills and no intentional discharge to groundwater should occur, the review team concludes that the impacts on groundwater quality from operation of two nuclear units at the Dixie site would be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operation activities, the cumulative impacts analysis considers past, present, and reasonably foreseeable future actions that affect the same water resources.

For the cumulative analysis of impacts on surface water, the geographic area of interest for the Dixie site is considered to be the drainage basin of the Suwannee River upstream and downstream of the site because this is the water resource in the river basin that could be affected by the proposed project. For groundwater, the geographic area of interest is limited to 20 mi from the Dixie site because it is sufficiently large to characterize the cumulative groundwater-use impacts. Actions that have past, present, and future potential impacts on water supply and water quality near the Dixie site include existing agriculture and existing and future urbanization in the region.

The U.S. Global Change Research Program (GCRP) has compiled the state of knowledge in climate change (GCRP 2009). This compilation has been considered in the preparation of this EIS. The projections for changes in temperature, precipitation, droughts, and increasing reliance on aquifers within the Suwannee River basin are similar to those at the LNP site. Such significant changes in climate would necessitate adaptations to both surface-water and groundwater management practices and policies that are unknown at this time.

Cumulative Water Use

The water use during operation of the two units at the Dixie site (89 cfs) would significantly exceed the amount of water use during building activities (less than 1 cfs). The amount of water needed for plant operation, 89 cfs, is less than 1 percent of the long-term average flow of the Suwannee River at the site (10,000 cfs). Extended periods when flows in the Suwannee River are below the minimum flow levels set by the SRWMD have been observed. Reasonably foreseeable future actions in the Suwannee River basin (see Table 9-13) would also use additional waters. Based on the minimum flow requirements for the Suwannee River and the recent extended periods when these low flows have not been met, the review team determined that the surface-water-use impact of the proposed plant at the Dixie site would be minor but alternative sources of water or other water-saving strategies may be needed to support operation of two units at this site because the river discharge is frequently less than the recommended minimum flow.

Other projects listed in Table 9-13 are considered in the analysis included above or would have little or no impact on surface-water use. Therefore, the review team concludes that cumulative impacts on surface-water use would be MODERATE. Building and operating the proposed plant at the Dixie site would not be a significant contributor to these water-use impacts.

As stated above, the review team assumed that no groundwater would be used to build or operate the units at the Dixie site and that groundwater impacts from dewatering would be controlled with diaphragm walls and grouting. Therefore, the review team determined that there would be minimal impact on groundwater resources.

Other projects listed in Table 9-13 are considered in this analysis or would have little or no impact on groundwater use. Therefore, the review team concludes that cumulative impacts on groundwater use would be SMALL.

Cumulative Water Quality

Point and non-point sources have affected the water quality of the Suwannee River upstream and downstream of the site. As mentioned above, the Lower Suwannee River was identified as being impaired by nutrients and was included on Florida’s Verified List of Impaired Waters. Water-quality information presented for the impacts of building and operating the new units at the Dixie site would also apply to evaluation of cumulative impacts. The State of Florida would require PEF to develop a SWPPP (PEF 2009b), which would identify measures to be used to control stormwater runoff (PEF 2009b). The blowdown would be regulated by FDEP pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by FDEP in an NPDES permit. Such permits are designed to protect water quality, and while stormwater runoff and plant discharge are anticipated to contain nitrogen in low concentrations (Table 3-3), they are not anticipated to contribute significantly to the nutrient concentrations in the river.

The lower Suwannee River appears on Florida’s list of impaired waters because of the presence of nutrients, fecal coliform, iron, and mercury in fish tissue (FDEP 2009c); therefore, the review team concluded that the cumulative impact on surface-water quality of the receiving waterbody would be MODERATE. Building and operating the proposed units at the Dixie site would not be a significant contributor to these impacts on surface-water quality because industrial and wastewater discharges from the proposed units would comply with NPDES permit limitations and any stormwater runoff from the site during operations would comply with the SWPPP (PEF 2009b).

As stated in Section 7.2.2.2, global climate change can result in a rise in sea level that may induce saltwater intrusion in the surficial and Floridan aquifers. Projected changes in the climate for the region during the life of the proposed units include an increase in average temperature and a decrease in precipitation. These changes are likely to result in changes in agriculture including crops, pests, and the associated changes in application of nutrients, pesticides, and herbicides that may reach groundwater. As a result, groundwater quality may be altered by the infiltration of chemicals. While the changes in groundwater quality that are indirectly attributable to climate change may not be insignificant, the review team did not identify anything that would alter its conclusion regarding groundwater quality impacts. The review team also concluded that with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the Dixie site would likely be minimal. Therefore, the cumulative impact on groundwater quality would be SMALL.

Other projects listed in Table 9-13 are either considered in the analysis included above or would have little or no impact on surface-water and groundwater quality.

9.3.3.3 Terrestrial and Wetland Resources

Site Description

The following impact analysis includes direct, indirect, and cumulative impacts from construction and preconstruction activities and operations on terrestrial and wetland resources. The analysis also considers past, present, and reasonably foreseeable future actions that affect those resources, including the other Federal and non-Federal projects and the projects listed in Table 9-13. For the analysis of terrestrial ecological impacts at the Dixie site, the geographic area of interest is considered to be a 20-mi-wide area centered on the Dixie site and the associated offsite and transmission-line corridors. This 20-mi radius and corridor around each proposed transmission-line is expected to encompass the locations of possible development projects potentially capable of substantially influencing terrestrial ecological resources on and close to the Dixie project site. This area includes watersheds providing direct runoff from the Dixie site to the Suwannee River and other river basins, as well as the watersheds through which the transmission lines would be routed.

The Dixie site is a greenfield site located in the Gulf Coast Flatwoods ecoregion. It is situated in a remote rural area on the Lower Suwannee River, which is classified by the FDEP as an Outstanding Florida Water. The Suwannee River is considered one of the largest and most ecologically unique blackwater river systems in the southeastern United States. Land uses in the Lower Suwannee River basin generally include agriculture, commercial forestry, and low-density residential development. Vegetation communities present on the site and in the vicinity, including offsite corridors, are typical of those found in the Gulf Coast Flatwoods ecoregion consisting of slash pine and remnant longleaf pine with bottomland oak-gum-cypress forests in low-lying areas along most rivers (USDA 2006). Predominant cover types on the site include managed pine forestland and scrub vegetation. The topography is relatively flat with only minor relief (approximately 2 ft).

The proposed associated transmission-line corridors would begin in the Gulf Coast Flatwoods ecoregion and cross the Southwestern Florida Flatwoods and Central Florida Ridges and Uplands ecoregions. Vegetation community types in the Southwestern Florida Flatwoods ecoregion include forests dominated by slash pine, longleaf pine, cabbage palm, and live oak with typical understory species of sawpalmetto, gallberry, and grasses such as bluestems and wiregrasses (USDA 2006). Vegetation community types in the Central Florida Ridges and Uplands ecoregion include sandhill vegetation such as turkey oak, bluejack oak, and longleaf pine for the dominant canopy species along with common understory species of running oak, gopher apple, and bluestem and panicum grasses (USDA 2006).

Important Species

Common wildlife, including important species, associated with the above-mentioned ecoregions that may occur on the Dixie site, associated offsite corridors, and transmission-line corridors, includes recreationally important species such as Florida white-tailed deer, bobcat, feral hog, squirrel, northern bobwhite, and mourning dove, as well as skunk, raccoon and several species of woodpecker. Various bird, reptile, and amphibian species also have the potential to reside on the Dixie site and within the associated transmission-line corridors (USDA 2006; FNAI 2009).

Federal and State-listed threatened and endangered terrestrial species occur in Dixie County and all counties crossed by the transmission-line corridors. Some of these species may at times be found on or in vicinity of the Dixie site or within associated offsite corridors and transmission-line corridors. No critical habitat for these listed species has been designated by the FWS in Dixie County; however, no field studies have been conducted on the site and in vicinity offsite corridors or the associated transmission-line corridors. Table 9-7 lists all Federally and State-listed species that could occur on the Dixie site and in the vicinity, offsite corridors, and in the counties crossed by the likely transmission-line corridors. Counties that would be crossed by the transmission-line corridors include Citrus,Dixie, Gilchrist, Lafayette, Taylor, Columbia, Suwannee, Levy, Lake, Marion, Hernando, Hillsborough, Pinellas, Pasco, and Sumter counties. PEF has stated that on-the-ground field surveys would be conducted before commencement of ground-disturbing activities on the site and in the offsite corridors and transmission-line corridors as required by the FDEP (PEF 2009b; CH2M HILL 2010; FDEP 2011b).

Building Impacts

Some impacts from building two nuclear units and supporting facilities on wildlife habitat would be unavoidable. Activities that would affect wildlife include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the areas of disturbance. Some wildlife, including important species, would perish or be displaced during land clearing for any of the above projects as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities.

Undisturbed land adjacent to the areas of disturbance could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some important species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite, eastern meadowlark, and the gopher tortoise. Birds of prey, such as red-tailed hawks would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in an herbaceous or scrub-shrub condition that could provide improved foraging habitat for waterfowl and wading birds. However, fragmentation of upland and wetland forests could adversely affect species that are dependent on large tracts of continuous forested habitat.

To accommodate the building of two nuclear units on the Dixie site, PEF would need to clear approximately 660 ac of terrestrial habitats for the nuclear facility and approximately 851 ac for associated offsite structures and corridors (excluding transmission lines), and an additional 1499 ac of land would need to be cleared and excavated to accommodate a reservoir (see Table 9-14 and Table 9-15) (CH2M HILL 2010).

Based upon FLUCFCS land-use data, approximately 22 ac of wetlands would be affected on the site during building (CH2M HILL 2010). Approximately 45 ac of wetlands would be affected in the offsite corridors excluding transmission lines (CH2M HILL 2010). Approximately 144 ac of wetlands would be affected to excavate the reservoir (CH2M HILL 2010). PEF states that the nuclear facility would be sited to avoid wetlands whenever possible and potential impacts on wetlands near building zones would be minimized through the use of established BMPs (PEF 2009b). Under Federal and State permitting requirements, PEF would be obligated to mitigate any unavoidable construction impacts on jurisdictional wetlands and listed species (FDEP 2011b).

Table 9-14. Summary of Impacts by Land-Use Class for the Dixie Alternative Site

Land-Use Class (FLUCFCS) (acreage)	Onsite	Reservoir	Offsite Corridors (Except Transmission)	Transmission Corridors[(a)]
Urban and Built Environment (percent of area)	0 (0%)	0 (0%)	96 (11%)	2458 (18%)
Agriculture	0 (0%)	0 (0%)	179 (21%)	2188 (16%)
Rangeland	0 (0%)	25 (2%)	34 (4%)	246 (2%)
Upland Forested	638 (97%)	1328 (89%)	492 (58%)	3385 (25%)
Water	0 (0%)	2 (<1%)	3 (<1%)	126 (<1%)
Wetlands	22(3%)	144 (10%)	45 (5%)	2200 (16%)
Barren Lands	0 (0%)	0 (0%)	0 (0%)	17 (<1%)
Transportation, Communication and Utilities	0 (0%)	0 (0%)	2 (<1%)	2832 (21%)

Source: CH2MHILL 2010
(a) Acreages shown in table for transmission-line corridors are total acres available, not total acres affected.

Table 9-15. Total Terrestrial Habitat Impacts on the Dixie Site

Impact Areas	Acres
Onsite Impact Areas	660
Reservoir Impact Areas	1499
Transmission-Line Corridor Areas	13452[(a)]
Offsite Impact Areas	851
Total Impact Areas	3010 (plus portion of 13,452-ac transmission corridor)[(b)]

Source: CH2M HILL 2010
(a) Acreages for transmission lines are total acres available, not total acres affected.
(b) If impacts on all lands in the transmission-line corridors reflect the 26 percent total impact estimated by PEF for wetlands (CH2M HILL 2010), those impacts would encompass approximately 26 percent of 13,452 ac, or 3498 ac. The review team therefore estimates that the total land requirements for the entire project would be 3010 ac plus 3498 ac, or 6508 ac.

New transmission system infrastructure would be needed to support a nuclear power facility at the Dixie site. There are no existing transmission lines or transmission-line corridors present on the site. PEF has assumed that new transmission lines would be collocated within existing transmission-line corridors to the extent possible to minimize potential terrestrial impacts. In addition, transmission-line corridors, towers, and access road would be situated to avoid critical or sensitive habitats and species to the extent possible. Transmission-line corridor width would vary depending on size, voltage, and whether or not existing corridors could be used. CH2M HILL2010The likely transmission-line corridors for the Dixie site consist of approximately 13,452 ac, of which approximately 2200 ac are wetlands (CH2M HILL 2010). PEF estimated that building the transmission lines would require filling approximately 6 percent of the wetlands in the corridor and clearing woody vegetation from approximately 20 percent of the wetlands in the corridor, resulting in a total impact on approximately 26 percent of the wetlands in the corridor (CH2M HILL 2010). Using these assumptions and the estimate of approximately 2200 ac of wetlands in the corridor, the review team estimates that building the transmission lines would require filling approximately 132 ac of wetlands and clearing woody vegetation from approximately 440 ac of additional wetlands, totaling approximately 572 ac of wetland impacts.

Under Federal and State permitting requirements, PEF would be obligated to mitigate any unavoidable construction impacts on jurisdictional wetlands and listed species. PEF stated that all land clearing associated with nuclear facility, offsite structures, and transmission-line creation would be conducted according to Federal, State, and local regulations, permit requirements, existing procedures, and established BMPs (PEF 2009b).

Building two new nuclear reactors at the Dixie site, including offsite corridors (excluding transmission-line corridors) and a reservoir, would result in the loss of approximately 3010 ac of terrestrial habitat (Table 9-15). Clearing land within the 13,452-ac transmission-line corridor would also result in a loss of an undetermined additional amount of forested terrestrial habitat and increase habitat fragmentation along the corridor. If impacts on all lands in the transmission-line corridors reflect the 26 percent total impact estimated by PEF for wetlands (CH2M HILL 2010), those impacts would encompass approximately 26 percent of 13,452 ac, or 3498 ac. The total estimated land impact would therefore be approximately 6508 ac. Other sources of impacts on terrestrial resources such as noise, increased risk of collision and electrocution, and displacement of wildlife would likely be temporary and result in minimal impacts on the resource. Because of the extent of unavoidable terrestrial habitat losses, building the two new units and associated facilities (including transmission lines) would noticeably alter the available terrestrial habitat on and in the landscape surrounding the Dixie site.

Operational Impacts

Impacts on terrestrial ecological resources, including important species, from operation of two new nuclear units at the Dixie site include those associated with transmission system structures, maintenance of transmission-line corridors, and operation of the cooling towers. Also, during plant operation, wildlife would be subjected to impacts from increased traffic.

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the specific location of cooling towers at the 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 nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team 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 would be minor.

Outdoor noise levels on the Dixie site are predicted to range from 90 dBA near the loudest equipment to 65 dBA in areas more distant from major noise sources (PEF 2009b). Noise modeling predicts not perceptible to slight increases in noise from plant operations at the site boundary (PEF 2009b). Except in areas immediately adjacent to major noise sources, expected noise levels would be below the 60- to 65-dBA threshold at which birds and red foxes (a surrogate for small and medium-sized mammals) are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Dixie site would not be likely to disturb wildlife beyond the site boundary. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

An evaluation of specific impacts resulting from building of transmission lines and transmission-line corridor maintenance cannot be conducted in any detail due to the lack of information, such as the specific locations of new rights of way that could result from transmission system upgrades. However, in general, impacts associated with transmission-line operation consist of bird collisions with transmission lines, EMF effects on flora and fauna, and habitat loss due to corridor maintenance. The impacts associated with transmission-line corridor maintenance activities include alteration of habitat, including but not limited to wetland and floodplain habitat, due to cutting and herbicide application.

Transmission lines and associated structures pose a potential avian collision hazard. Direct mortality resulting from birds colliding with tall structures has been observed (Erickson et al. 2005). Factors that appear to influence the rate of avian impacts with structures are diverse and related to bird behavior, structure attributes, and weather. Migratory flight during darkness by flocking birds has contributed to the largest mortality events. Tower height, location, configuration, and lighting also appear to play a role in avian mortality. Weather, such as low cloud ceilings, advancing fronts, and fog also contribute to this phenomenon. Waterfowl may be particularly vulnerable due to their low, fast flight and flocking behavior (EPRI 1993). Bird collisions with transmission lines are recognized as being of minor significance at operating nuclear power plants, including those with transmission-line corridors with variable numbers of power lines (NRC 1996). Accordingly, 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. PEF would also be required to have an Avian Protection Plan in compliance with State certification guidelines (FDEP 2011b). Consequently, the incremental number of bird collisions posed by the addition of new transmission lines for new nuclear units would be negligible.

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). At a distance of 300 ft, the magnetic fields from many lines are similar to typical background levels in most homes. Thus, 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 2003). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2003). Therefore, the incremental EMF impact posed by addition of new transmission lines for new nuclear units would be negligible.

Existing roads providing access to the proposed transmission-line corridors at the alternative sites would likely be sufficient for use in any expanded corridors; however, new roads would be required during the construction of new transmission-line corridors. Management activities (cutting and herbicide application) related to transmission-line corridors and related impacts on floodplains and wetlands in transmission-line corridors are recognized as being of minor significance at operating nuclear power plants, including those with transmission-line corridors of variable widths (NRC 1996). The review team assumes that the same vegetation and construction management of corridors currently used by PEF would be used in the establishment and maintenance of the new corridors. Under the Conditions of Certification for the State, PEF would also be required to retain existing vegetation whenever practicable and use BMPs that comply with the Florida State regulations (FDEP 2011b). Consequently, the incremental effects of the maintenance of transmission-line corridors and associated impacts on floodplains and wetlands posed by expanding existing corridors or the addition of a new transmission-line corridor for new nuclear units would be negligible.

To summarize, the potential effects of operating two new nuclear reactors at the Dixie site would be primarily associated with the maintenance of transmission-line corridors and increased traffic. In general, operational impacts on terrestrial resources would be expected to be minimal.

Cumulative Impacts

There are no past or current actions in the geographic area of interest that have influenced terrestrial resources in a way exactly similar to the building and operation of the proposed two new nuclear units at the Dixie site. However, terrestrial habitats throughout the geographic area of interest have been extensively altered by a history of forestry and agricultural practices as well as low density residential development.

Proposed future actions that could affect terrestrial resources in a way similar to development at the Dixie site would include the proposed expansion of SR-26 from US-19 in Gilchrist County to CR-26A in Alachua County (22 mi), located within 10-mi northeast of the Dixie site that would include expansion of the existing two-lane roadway to a four-lane divided highway. Transmission-line creation and/or upgrading throughout the designated geographical ROI and future urbanization would also be expected to occur. However, there are several areas within the geographical ROI that are managed for the benefit of wildlife, including but not limited to Manatee Springs State Park, Yellow Jacket Conservation Area, and Fowlers Bluff Conservation Area.

The other impact on terrestrial resources at the Dixie site would be the effect of global climate change on plants and wildlife. The impact of global climate change on terrestrial wildlife and habitat in the geographic area of interest is not precisely known. Global climate change would result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation, and increases in average temperature (GCRP 2009). Such changes in climate could alter terrestrial community composition on or near the Dixie site through changes in species diversity, abundance, and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce terrestrial habitat. Specific predictions of habitat changes in this region due to global climate change are inconclusive at this time. However, because of the regional nature of climate change, the impacts related to global climate change would be similar for all of the alternative sites.

Summary Statement

Impacts on terrestrial ecology resources are estimated based on the information provided by PEF and the review team's independent review. Past, present, and reasonably foreseeable future activities in the geographic area of interest could affect terrestrial ecology in ways similar to the building of the proposed two units at the LNP site. The Dixie site and some of the associated transmission-line corridors are natural habitats that would be substantially altered by development and maintenance activities, noticeably affecting the level and movement of terrestrial wildlife populations in the surrounding landscape. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team therefore concludes that the cumulative impacts on baseline conditions for terrestrial ecological resources would be MODERATE. This determination is based upon the extent of expected wetland loss and habitat fragmentation from ongoing and planned development projects, continued widespread manipulation of habitats for commercial forest management, and anticipated losses of habitat for important species. The incremental impacts from building and operating the Dixie project would be a significant contributor to the MODERATE cumulative impact, primarily because of a loss or modification of habitats that support wildlife, wetlands, and important species. Although incremental impacts on terrestrial resources could be noticeable near the Dixie project site, these impacts would not be expected to destabilize the overall ecology of the regional landscape.

9.3.3.4 Aquatic Resources for the Dixie Site

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The proposed Dixie County alternative site has no existing infrastructure associated with development of a nuclear power plant. This greenfield site is adjacent to the Suwannee River, which is proposed as the water source for cooling and discharge. Water flow in the Suwannee River is managed by the SRWMD and has a multi-tiered minimum-flow-level program designed to maintain the quality of the unique freshwater springs system throughout the middle and Lower Suwannee River basin. The recommended minimum flow for the Lower Suwannee River is 6600 cfs for May–October, and 7600 cfs from November–April. PEF maintains that there would be adequate flow to supply water through a closed-cycle cooling design for a two-unit plant. However, under drought conditions, the Suwannee River may not be able to provide sufficient water, and PEF acknowledges that building of a reservoir would be required to ensure consistent water supply (PEF 2009b). The geographic area of interest considered includes the Suwannee River watershed from the Gulf of Mexico up to Fanning Springs, Florida, because it and the associated transmission-line corridors are the area most likely to be affected by new nuclear units.

The Suwannee River is classified by the State of Florida as an Outstanding Florida Water system. There are several State parks that could be affected by the proposed action. Dixie County natural areas include Fanning Springs State Park and Manatee Springs State Park, both of which have freshwater habitat used by Florida manatees seeking freshwater refuge. The offshore area from the mouth of the Suwannee River is part of the Big Bend Seagrasses Aquatic Preserve, which extends from the St. Marks River in Wakulla County to the mouth of the Withlacoochee River in Levy County. The preserve includes more than 55,000 ac of uplands in Taylor and Dixie counties, referred to as the Big Bend marsh buffer (FDNR 1988).

The potential impacts on aquatic biota from building and operation of the proposed units at the Dixie site are assumed to be primarily to organisms inhabiting the Suwannee River and the immediate offshore habitat of the Gulf of Mexico.

Commercially and Recreationally Important Species

While no commercial fisheries exist for the Suwannee River, commercial fisheries allowed near the mouth of the Suwannee in the Gulf of Mexico include black mullet, red grouper, sea bass (*Centropristis* sp.), gag grouper (*Mycteroperca microlepis*), grunts, blue crab, and stone crab. Recreational species include these commercial species as well as sunfish species, catfish species, and largemouth bass (*Micropterus salmoides*) (Save our Suwannee, Inc., no date). Commercial species not previously described in Section 2.4.2 are described here.

Sea Bass (*Centropristis* sp.)

Sea bass are in the same family as groupers, and they spawn offshore from January through July. Larvae develop offshore, then move to onshore habitats and begin feeding on small fish, crustaceans, and shellfish. Sea bass associate with bottom structures such as reefs and rubble (ASMFC 2005). Landings of this species for Dixie County in 2008 exceeded 35,000 lb (FFWCC 2009a).

Non-Native and Nuisance Species

Water hyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata*) are two common invasive aquatic plant species that have been noted in the Suwannee River, but are largely under control (Hoyer et al. 2005; FDEP 2002a). These species are managed by the State of Florida and should not be affected by power plant operations.

Critical Habitats

Critical habitats for the threatened gulf sturgeon occurs on the Gulf Coast of Florida in the Suwannee River and immediate offshore area and are described further under the Federally and State-listed species subheading for gulf sturgeon (68 FR 13370). The nearshore areas off Dixie County in the Gulf of Mexico are designated by the Gulf of Mexico Fisheries Management Council as essential fish habitat Ecoregion 2, which extends from Tarpon Springs north to Pensacola Bay, Florida (GMFMC 2004). Essential fish habitat has been designated by NMFS for the nearshore Gulf of Mexico area at the mouth of the Suwannee River, upstream to Little Lake City, Florida, for species and life stages listed in Section 2.4.2, Table 2-15. There are no habitat areas of particular concern near the Dixie site.

Federally and State-Listed Species

Federally and State-listed aquatic species that may occur near the Dixie County site and along existing transmission-line corridors include the endangered Florida manatee, green sea turtle, leatherback sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, smalltooth sawfish, and the threatened gulf sturgeon and loggerhead sea turtle. Detailed species information is provided in Section 2.4.2.3.

Florida Manatee (*Trichechus manatus latirostris*)

The Florida manatee northwest Florida population, which includes Citrus and Levy counties, constitutes approximately 12 percent of the total manatee population. This subpopulation of manatees has the greatest concentration in the Crystal River area, where they are protected under the ESA, Marine Mammal Protection Act of 1972, as amended (16 USC 1361 et seq.), and the Florida Manatee Sanctuary Act of 1978. In the winter, manatees migrate to warmer waters near the coast and are known to occur in the Suwannee River in Manatee Springs State Park (FDEP 2002b) and Fanning Springs State Park (FDEP 2009d).

Sea Turtles

Four species of sea turtle are listed as Federally and State endangered, with the loggerhead sea turtle listed at both Federal and State levels as threatened. All sea turtles have certain life-history similarities in that females swim ashore to sandy beaches and deposit eggs in nesting pits that are covered to allow incubation. Juveniles hatch, struggle out of the sandy nest and make their way to their respective ocean habitats. Although there are no sandy coastline habitats in the area of the Suwannee River, juvenile and adult sea turtle life stages have been found in the offshore Gulf of Mexico area. Sea turtle sightings offshore of the Suwannee River have been documented since 1999.

Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)

The current range of the gulf sturgeon is limited to the Mississippi River east to the Suwannee River, Florida, where the Suwannee River supports the largest subpopulation of gulf sturgeon (Carr et al. 1996). Critical habitat for Florida is designated for 182 mi of the Suwannee River, 12 mi of the northern Withlacoochee River where it branches off to the north of the Suwannee River, and 211 mi^2 of estuarine/marine area of Suwannee Sound that is north of Cedar Key (68 FR 13370). Gulf sturgeon show a high homing fidelity (site-specific) spawning behavior based on gene flow between river drainages (Stabile et al. 1996). Male gulf sturgeon mature in 7 to 9 years and females in 8 to 12 (Huff 1975). Adults spend 8 to 9 months in river habitat, near springs in the Suwannee River, and move to estuarine or Gulf of Mexico waters during the coolest months to feed (FWS and GSMFC 1995). Spawning occurs in the Suwannee River when temperatures range between 17 to 22°C in late March to mid-April and the substrate is characterized as clean gravel-cobble mix over rock with strong, persistent laminar flows and eddies that created reversed or diminished bottom currents (Sulak and Clugston 1998). Young-of-the-year sturgeon disperse widely downstream of spawning habitats within the river inhabiting open sandy areas away from shorelines and vegetation (Sulak and Clugston 1998). Timing and location of spawning grounds in the Suwannee River are not well documented, but it is believed that females seek out gravel or rock bottom habitats associated with freshwater springs (FWS and GSMFC 1995). Because specific spawning locations and habitat usage by gulf sturgeon within the Suwannee River are largely unknown, the critical habitat designation includes the entire Suwannee River.

Smalltooth Sawfish (*Pristis pectinata*)

Observations of smalltooth sawfish north of Port Charlotte are rare, but three sightings along the coastal Dixie County region have been documented since 2002, notably in the mouth of the

Suwannee River (FMNH 2009). However, adverse impacts are unlikely because these fish would avoid activities occurring in these areas.

Building Impacts

Cooling-water intake and discharge structures on the Swannee River in addition to a cooling-water reservoir would be required at the Dixie County site. Installation of a new intake and discharge would result in the temporary displacement of aquatic biota within the vicinity of both structures. It is expected that these biota would return to the area after installation is complete. Sedimentation due to disturbances of the river bank and bottom during installation activities could affect local benthic populations. Impacts on aquatic organisms would be temporary and largely mitigable through the use of BMPs. However, as the Suwannee River is considered critical habitat for the gulf sturgeon, some loss of critical habitat may occur through dredging or installation activities associated with intake and discharge structures. Building impacts of a cooling-water reservoir may be significant depending on the siting of the reservoir. During the review team's site visit, observations of the proposed site via public roads indicated that there are streams present that are either perennial or seasonal. Offsite transmission-line corridors would cross two streams, and one open waterbody (CH2M HILL 2009). These aquatic resources have not been examined for diversity of aquatic biota, but nonetheless, still represent aquatic habitat that would likely be affected by the building of facilities for the site. The use of good management practices and BMPs during building activities could result in minimal impacts on the gulf sturgeon, which occurs in the vicinity of the proposed intake and discharge locations for the Dixie County site in the Suwannee River (CH2M HILL 2009). Consultation with FDEP and FWS would likely be required for in-water work associated with designated critical habitat for the gulf sturgeon and presence of manatees. PEF would comply with the Standard Manatee Conditions for In-Water Work (FDEP 2011b) for building activities in the Suwannee River to prevent impacts on manatees in the vicinity of intake and discharge installation activities. Due to the upriver location of the Dixie site, it is unlikely that there would be impacts on the smalltooth sawfish or sea turtles.

New transmission-line infrastructure would be required for a new two-unit facility. Currently no existing transmission-line corridors are located within the immediate vicinity of the Dixie greenfield site, and new corridors would need to be established. Likely transmission-line corridors identified by PEF appear to follow those identified for LNP without the need for an LNP-to-CREC corridor, and additional corridors in Taylor, Lafayette, Suwannee, Columbia, Gilchrist, and Dixie counties (CH2M HILL 2010). PEF anticipates transmission-line corridors would cross 13 streams and 140 open waterbodies and should have minimal impact on aquatic resources (CH2M HILL 2010).

Operational Impacts

Impingement and entrainment of organisms from the Suwannee River and inshore Gulf of Mexico and from a man-made reservoir would be the most likely impacts on aquatic populations that could occur from operation of two new nuclear units at the Dixie County site. Assuming a closed-cycle cooling system, a maximum through-screen intake velocity of 0.5 fps or less, and an intake flow of less than or equal to 5 percent of the mean annual flow which meets the EPA's Phase I regulations for new facilities (66 FR 65256), the anticipated impacts on aquatic populations from entrainment and impingement are expected to be minimal. Thermal discharges from operations may result in increased use of habitat by manatees near the point of discharge to the Suwannee River and decrease some habitat suitable for Gulf sturgeon. Plant outages that result in cold shock could affect manatees and other aquatic biota that become habituated to power plant thermal discharges. However, it is unlikely that both units would be shut down at the same time. Operational impacts associated with water quality and discharge cannot be determined without additional detailed analysis. However, based on the review team's experience with other facilities, the review concludes that with proper design the impacts on aquatic resources from operation of two new nuclear units at the Dixie County site would likely be minimal with FDEP NPDES compliance.

The review team also concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would also be minimal assuming that appropriate BMPs are used.

Cumulative Impacts

Cumulative impacts on aquatic resources within the Suwannee River basin include the operation of dairy farms and small businesses that discharge wastewater to the Suwannee River watershed within 10 mi of the Dixie site. These dairy operators and businesses have active NPDES permits for discharge.

Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility can present additional constraints on aquatic resources. Future activities may include shoreline development (i.e., removal of habitat), increased water needs, and increased discharge of effluents into the Suwannee River. The effects of continued dairy practices could result in additional habitat loss and/or degradation due to water use using surface waters and groundwater withdrawal, point and non-point source pollution, siltation, and bank erosion. The review team is also aware of the potential for global climate change affecting aquatic resources. The impact of global climate change on aquatic organisms and habitat in the geographic area of interest is not precisely known. Global climate change would result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation, and increases in average temperature (GCRP 2009). Such changes in climate could alter aquatic community composition on or near the Dixie site through changes in species diversity, abundance and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce aquatic habitat, but specific predictions on aquatic habitat changes in this region due to global climate change are inconclusive at this time. The level of impact resulting from these events would depend on the intensity of the perturbation and the resiliency of the aquatic communities.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by PEF, the State of Florida, and the review team's independent review. The review team concludes that the impacts from building intake and discharge structures for two new nuclear units at the Dixie site would be noticeable but not destabilizing to the critical habitat within the Suwannee River for the threatened gulf sturgeon. The review team also concludes that the aquatic impacts from operation of two new units would be minimal. Therefore, the review team concludes that the cumulative impacts of building and operating two new reactors on the Dixie site combined with other past, present, and future activities on most aquatic resources in the Suwannee River would be MODERATE. This is because of the potential for impact on gulf sturgeon and on designated critical habitat for gulf sturgeon, the loss of aquatic habitat, particularly during low flow conditions in the river due to the consumptive loss of water from closed-cycle cooling, and unspecified impacts related to the construction and operation of a cooling reservoir. Impacts related to the cooling reservoir could be minimized through proper siting and the use of BMPs during construction. The use of a cooling reservoir would partially mitigate the effects of consumptive water loss on aquatic habitat during low river flow. The incremental contribution of building and operating the two new reactors at the Dixie site to the cumulative impacts within the ROI would not likely result in destabilization of aquatic resources or populations but would significantly contribute to noticeable impacts on aquatic resources and populations.

9.3.3.5 Socioeconomics

The following impact analysis includes direct, indirect, and cumulative impacts from building activities and operations at the Dixie site, which is located in a remote rural area on the lower Suwannee River in Dixie County, Florida. The analysis considers other past, present, and reasonably foreseeable future actions that affect socioeconomics, including other Federal and non-Federal projects listed in Table 9-13 and approximately 340 mi of transmission lines. For the analysis of socioeconomic impacts at the Dixie site, the geographic area of interest is considered to be the region described by a 50-mi radius centered on the Dixie site. The review team gave special consideration to Dixie, Gilchrist, Lafayette, Alachua, and Levy counties, because that is where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of site development and operation at the Dixie site, the review team undertook a reconnaissance survey of the site using readily obtainable data from the Internet or published sources.

The Dixie site is a greenfield site in eastern Dixie County. The review team drew upon USCB 2010 data (USCB 2010a) to find the available total construction workforce within the host county, adjacent counties, and any nearby counties with a major population center within a reasonable commuting distance from the site. For the Dixie site, this included Dixie, Gilchrist, Lafayette, Taylor, Levy, Suwannee, and Alachua counties. In 2010 the total construction workforce in these counties was 6638 workers. Based on this availability, the review team assumed that 75 percent of the 3440-person workforce involved in building the two-unit plant, or 2580 workers, would migrate into the area.

The review team identified Dixie County and four counties near Dixie County (Gilchrist, Lafayette, Alachua, and Levy) as the primary EIA for the Dixie County site on the basis of expected effects of in-migrating workers and families. All of these counties, except Alachua, are rural, with populations in 2010 ranging between about 7000 people in Lafayette County to about 35,500 people in Levy County. Much of the population in Alachua County resides in the greater Gainesville metropolitan area (2010 population of approximately 125,000 people). The majority of the population in the remaining four counties resides in unincorporated settlements or rural areas. The largest incorporated communities in the four rural counties of the EIA are Williston and Chiefland in Levy County and Cross City in Dixie County; each with a population of close to 3000 people in 2008. Large portions of Dixie, Lafayette, and Levy counties are year-round or seasonal marshland or commercial forests, which are generally only sparsely populated.

The review team expects that some of the in-migrating workers would choose to reside in Alachua County because of the amenities available in the large city of Gainesville. Because Suwannee and Taylor counties offer few amenities that would encourage a longer commute, the review team expects few in-migrating workers would locate in Suwannee or Taylor County. The review team focused on effects of the building-phase workforce because the operations workforce would be smaller and, following after the larger building-related workforce cause expected smaller socioeconomic impacts. Table 9-16 provides some socioeconomic data for the five counties.

Table 9-16. Socioeconomic Data for the Dixie Site EIA

Data Category	Dixie	Gilchrist	Lafayette	Levy	Alachua	Data Source
Population						
1980	7751	5767	4035	19,870	151,369	(a)
1990	10,585	9667	5578	25,923,	181,596	(a)
2000	13,827	14,437	7022	34,450	217,955	(b)
2010	16,422	16,939	8870	40,801	247,336	(c)
Median Household Income (2009)	$30,268	$37,139	$35,689	$32,258	$38,597	(c)

Table 9-16. (contd)

Data Category	Dixie	Gilchrist	Lafayette	Levy	Alachua	Data source
Vacant Housing Units	3003	1186	748	3719	12,250	(d)
Total Housing Units	9319	7307	3328	20,123	112,766	(d)
Workforce						
Employed	1550	1834	1039	5971	85,577	(e)
Construction	50	200	43	648	4622	(e)
Total Schools	2 E-M, 1 M, 1 H	2 E-M, 2 H	1 E-M-H, 1 E-M	1 E, 1 E-M-H, 4 E-M, 3 M-H, 2 M, 2 H	2 E, 7 M, 3 E-M-H, 24 E-M, 2 M-H, 5 H	(f)
Number of Schools Failing Student-Teacher Ratio	0	0	0	0	0	(f)
Police	Sheriff Dept – 13 positions	Sheriff Dept – 9 positions	Sheriff Dept – # positions	Sheriff Dept and police depts. in Inglis, Williston, Chiefland, Cedar Key	Sheriff Dept and police depts. in Gainesville, Alachua, High Springs, Santa Fe Comm. College, and Univ of Florida	(f)(g)
Emergency Services	6 fire stations; 2 EMS stations	EMS department	County rescue 24/7; 1-4 units	EMS from the 14 fire stations; 8 paid and 183 volunteer firefighters	EMS and fire rescue departments	(h)
Population						
White	88.8	90.9	77.4	85.5	69.6	(c)
African American	8.4	5.3	15.9	9.4	20.3	(c)
Hispanic	3.1	5	12.1	7.5	8.4	(c)
Low-Income	23.7	18	24.6	21.8	23	(c)

(a) USCB 1990
(b) USCB 2000b
(c) USCB 2010b
(d) USCB 2010c
(e) USCB 2010a
(f) FDOE 2009a
(g) Dixie: Dixie Sheriff 2009; Gilchrist: Gilchrist Sheriff 2009; Lafayette: Lafayette Sheriff 2009; Levy: Section 2.5.2.6; Alachua: Alachua County Florida 2010
(g) Dixie: Dixie EM 2009; Gilchrist – Gilchrist EM 2009; Lafayette: Lafayette EM 2009; Levy: Section 2.5.2.6; Alachua: Alachua County Florida 2010
E = elementary school; M = middle school; H = high school; EMS = emergency management services

For purposes of this analysis the review team assumed there would be 645 in-migrants into Alachua County (24 percent of the in-migrants into the region) and the remaining 1935 in-migrating workers would be distributed among the four rural counties of the EIA as follows: 34 percent to Dixie County (658 workers); 14 percent to Gilchrist County (271 workers); 9 percent to Lafayette County (174 workers); and 43 percent to Levy County (832 workers). The review team further assumed that all in-migrating workers would bring families; this is unlikely but contributes to the provision of an upper bound on the population increase associated with the project. The review team used the 2.49-person average Florida family size to project the distribution of new jobs and population in the EIA due to in-migrating workers, as listed in Table 9-17.

Table 9-17. Projected Distribution of Workers and Associated Population Increase in the EIA for the Dixie Site

County	Percent Population Increase 1990–2000[(a)]	Percent Population Increase 2000–2010[(b)]	Workers In-Migrating to Build Dixie Plant	Population of In-Migrating Workers and Families	Population of Workers and Families (as a percent of 2010)
Dixie	30.6	18.8	658	1638	9.9
Gilchrist	39.3	17.3	271	675	3.9
Lafayette	25.9	26.3	174	433	4.8
Levy	32.9	18.4	832	2072	5.0
Alachua	20	13.5	645	1606	0.6

(a) Based on USCB data, as reported in PEF 2007b.
(b) USCB 2010b.

Physical and Aesthetics Impacts

With the exception of the need to construct a new access road to the Dixie site, many of the physical impacts of building and operation on workers and the public would be the same as those described for the LNP site. People who work or live around the site could be exposed to noise, fugitive dust, and gaseous emissions from building activities. Workers and personnel working onsite could be the most affected. Air-pollution emissions are expected to be controlled by applicable BMPs 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 to not exceed applicable regulations during normal operations. The impacts of station operations on air quality are expected to be minimal. As with building impacts, potential offsite receptors during operations are generally located well away from the site boundaries.

Residential and commercial areas are located away from the site boundaries, applicable air-pollution regulations would have to be met by PEF, and applicable BMPs would be put in place, including during the construction and use of the site access road. Therefore, based on information provided by PEF and the review team's independent review of reconnaissance-level information, the review team concludes that the physical impacts of building and operating the station would have minimal impact on workers and the local public around the Dixie site.

Building activities and station operations are not expected to affect any offsite buildings. Most buildings are well removed from the site boundaries. Because this is a greenfield site, there are no onsite buildings to be affected by shock and vibration from pile-driving and other related activities. No long-term physical impacts on structures, including any residences near the site boundaries, would be expected. Therefore, based on consideration of reconnaissance-level information, the review team concludes that the physical impacts of station building and operation on offsite buildings would be minor.

As the estimated 340 mi of transmission lines are put in place and the buildings and cooling towers associated with the new reactors reach their final heights and begin operating, they would add an industrial landscape that is visible to viewers, with a noticeable aesthetic impact. In places requiring the clearing of new transmission-line corridors, aesthetic impacts would be noticeable but not destabilizing, depending on the proximity of viewers and the nature of vegetation remaining between them and the corridors. Given the general characteristics of the area, there would likely be vegetative screening around the site that would potentially mitigate the aesthetic impacts at the reactor site.

Demographic Impacts

Table 9-17 lists the estimated project-related population migrating into the EIA at peak workforce levels and the population increase in each county between 1990 and 2000 and between 2000 and 2010. As seen in Table 9-17, Dixie County experienced an 18.8 percent increase in population between 2000 and 2010. Because the review team estimates that the project would add an additional 9.9 percent to the 2010 population for Dixie County during the peak building employment years (about half of the 10-year population increase), the review team determined that the project related demographic impacts for Dixie County would be noticeable but not destabilizing, and minimal in the rest of the region.

Economic Impacts

The review team determined that the impact of jobs associated with building the plant would have no noticeable effect on total employment and income in Alachua County. However, the review team determined that the impact of jobs associated with building the plant would have a noticeable beneficial effect on total employment in the four rural counties, with likely short-term noticeable effects in Dixie County during the period of peak workforce when the in-migrating workers are projected to be about 41.2 percent of the 2009 civilian workforce in the county. The direct jobs filled by local residents would add to the project's effect on employment, as would the indirect jobs created as a result of the multiplier effect, as described in Sections 4.4.3 and 5.4.3. This peak in employment would be temporary, transitioning to the lower employment effects of plant operations, when approximately 541 operations jobs (70 percent of operations jobs) are expected to be filled by in-migrating operations workers and a smaller number of local residents are expected to fill the associated indirect jobs. Consequently, the review team concludes that the proposed project would have a noticeable, beneficial, but temporary impact on employment in the four rural counties of the EIA during the years of peak building, followed by a minor, beneficial long-term impact during operations.

State and local taxes would be governed by Florida law. The review team assumed that tax revenues generated from sales and use taxes associated with the building and operation of a plant at the Dixie site would be approximately the same as those evaluated for the LNP site in Sections 4.4.3.3 and 5.4.3.3, with a similar minor impact on revenues for the EIA and the region, along with a similar delay in substantial property tax payments to Dixie County until the commencement of operations.

The review team concluded that increased property taxes from the two units following reassessment for improvements and for its use as a utility would have a substantial beneficial impact on Dixie County. The State of Florida Conditions of Certification for LNP would require PEF to discontinue the operations of two fossil-fueled units at the CREC in Citrus County by December 31, 2020, assuming licensing, construction, and operation of LNP were to occur in a timely manner (DOE/EIA 2010b; FDEP 2011b). Because of the age and size of the two units planned for closure, the review team does not expect their value to be very high, but Citrus County would still lose a small component of its property tax base, resulting in a minor but adverse tax-based economic impact on the County.

The review team found that additional property taxes on new houses built by in-migrating workers would constitute a small percentage increase in the local tax base in the EIA; thus the impact of both building and operations on residential property tax revenues would be minor.

Housing

The review team compared the 2010 figures for vacant housing in the EIA listed in Table 9-16 with the number of in-migrating workers projected for peak building years listed in Table 9-17. The housing figures do not include RV parks, campgrounds, or hotels, and thus provide a lower bound of what would be available to construction workers.

The U.S. Census Summary File 1 General Housing Profile (USCB 2010c) for each of the five counties in the EIA estimated the following:

- Dixie County – a total housing stock of 9319 units with a vacancy rate of 32.2 percent (3003 housing units were unoccupied at the time of the survey).
- Gilchrist County – a total housing stock of 7307 units with a vacancy rate of 16.23 percent (1186 housing units were unoccupied at the time of the survey).
- Lafayette County – a total housing stock of 3328 units with a vacancy rate of 22.4 percent (748 housing units were unoccupied at the time of the survey).
- Levy County – a total housing stock of 20,123 units with a vacancy rate of 18.48 percent (approximately 3719 housing units were unoccupied at the time of the survey).
- Alachua County – a total housing stock of 112,766 units with a vacancy rate of 10.86 percent (approximately 12,250 housing units were unoccupied at the time of the survey).

The review team expects that the in-migrating workforce could be absorbed into the existing housing stock in the EIA without a measureable impact. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that housing impacts of building and operating two nuclear units at the Dixie site would be minor.

Public Services

In discussions with county personnel (Dixie County 2009a, b; Gilchrist County 2009; Lafayette County 2009; Taylor County 2009), the review team learned that, while all counties welcome additional development and expect that they could manage it, some public services in the four rural counties of the EIA are currently over, at, or near capacity. Levy County is over capacity for fire-protection services. Dixie County is near or at capacity at the sheriff's department, but has plans to expand for future growth, as in the past, and the department is about to add another deputy. Dixie County is also near or at capacity in the management of roads and streets. There are no capacity issues for fire protection or emergency medical response. For general healthcare, Dixie County residents use resources in Gainesville for serious medical problems, and this practice is expected to continue. Water and wastewater are generally handled through wells and residential septic systems in Dixie County, with no capacity issues. Gilchrist County can handle present demands for police and emergency services, but might need to add a deputy and another emergency management service (EMS) station and vehicle if 200 families were to move in; capacity is adequate for healthcare, with people using primary care providers within the county and going to Gainesville or Chiefland for other needs; water and wastewater are generally provided with wells and septic systems, with no capacity issues currently. Lafayette County is not at capacity for any services presently, and would add to law enforcement, fire-protection services (all volunteer currently), and EMS as needed; the county is currently seeing development of a new prison that will bring in 150 people, which will be an exercise in responding to new growth. Demands on the planning and permitting infrastructure in these four counties may increase for a short period in response to efforts to rapidly expand housing availability.

The review team assumed that the counties and communities in the EIA for the Dixie site, like those for the LNP site, have planned to meet needs for public services based on forecast population increases that did not include the presence of a workforce associated with constructing and operating a nuclear plant. The review team based its analysis of potential impacts on public services on the level of population increase represented by in-migrant workers during peak building years added to forecasted population growth without the proposed project. In addition, the review team took into consideration that the EIA would not receive a significant increase in property tax revenues during the period of peak demand, and that Dixie County would be the only major property tax recipient once the proposed units went into operation. Consequently, the review team expects impacts on public services during peak building years would be noticeable and adverse in Dixie County, particularly on law enforcement and road management, and all of the communities near the proposed site and minor in the rest of the EIA, with the exception of Levy County, where a noticeable adverse impact on fire-protection services is expected. Once the project transitions to operations, the impacts on public services are expected to moderate, in part because of the reduction in in-migrant population and in part because the counties and communities will have expanded capacity to address peak building-phase demand. The public service providers in the four rural counties of the EIA could find it more difficult to respond effectively because the demand for service would increase rapidly and substantially, persist for several years, but then decline substantially as the project-related workforce rises and falls.

Traffic

Roads closest to the proposed Dixie site include US-19/98/27A/SR55 (US-19), SR-349, and SR-51. US-19 is a four-lane divided rural highway that crosses Dixie County from northwest to east-southeast, providing access to the metropolitan areas of Tallahassee (northwest) and Tampa (south). SR-349, extending from US-19 to the north county boundary in the northeast part of the county and SR-51, running north-south along the Steinhatchee River, are two-lane, undivided minor arterials. Dixie County has assigned a LOS standard of “B” to US-19 and “D” to the State routes and its county roads (Dixie County 2006). CR-349 extends south and southwest from the intersection of SR-349 and US-19 to the coast at Suwannee; other county roads extend northeast and southwest from US-19 farther west along the highway. Dixie County classifies the county roads as undivided minor arterials or undivided major collectors. Traffic volumes in 2008 on SR-349 ranged from 2111 to 6400; volumes on SR-51 in Taylor and Lafayette counties ranged from 309 to 3000; and volumes on US-19 ranged from 4700 to 12,200 (FDOT 2008). PEF has indicated that an access road would need to be constructed at the Dixie site.

US-19 would be the main artery carrying workers from western Dixie County and the three adjacent counties, as well as from Gainesville and Taylor counties and other places in nonadjacent counties. The review team considered the impact of building-related traffic in terms of the likelihood that it would reduce the LOS along US-19 to be lower than the assigned standard "B." The review team assumed 2281 trips daily (following LNP site analysis in Section 4.4.4.1), split 65 percent to/from the southeast and 35 percent to/from the northwest, based on the assumed distribution of in-migrating worker residence discussed in Table 9-17. At morning shift change, this would add an additional 1977 cars to the total flow on US-19, 499 incoming from northwest, 926 from southeast; and 359 outgoing to the southeast, 193 to the northwest. The highest 2008 AADT count on US-19 in Dixie County was at the eastern county line, at the bridge over the Suwannee River, with 6200 cars going northwest and 6000 cars going southeast. Morning flow of building workers would add 926 cars to those going northwest from the county line toward the plant site and 359 cars leaving the county toward the southeast. This increase of about 15 percent of current flow to the northwest could change LOS at the bridge. In addition, there are five road intersections with US-19 within 2 mi of the bridge and additional traffic on these roads feeding into US-19 might affect LOS at the intersections. While additional analysis would be needed, the review team concludes that building-related traffic during peak workforce years could have a noticeable adverse effect on segments of US-19 and at intersections with State and county roads within Dixie County, especially during the period of peak onsite workforce, but would have only a minor adverse impact elsewhere in the region.

Education

Table 9-16 provides data about schools in the four rural counties of the EIA. All schools met the State teacher-student ratio classroom requirements in 2007–2008. The review team assumed that school districts in these counties, like those for the LNP site, would address short-term gains in student population with mobile classrooms and that the preschool through 12th grade (PK–12) public schools would be funded according to the Florida equalized funding formula (FDOE 2009b). The review team assumed that students would accompany each in-migrating worker family. To calculate the number of new students moving into the EIA, the review team took the average of the ratios of students per household from counties in the LNP site listed in Table 2-35. The estimated numbers of new students in each of the counties in the EIA during peak workforce years are listed in Table 9-18.

The review team found that the impact on the four Dixie County schools would require up to 10 additional classrooms in total, an average of over 2 classrooms for each of the 4 schools (note that the affected schools cover different ranges of grades). The review team found that the addition of up to13 classrooms in Levy County, 4 classrooms in Gilchrist County, and 3 classrooms in Lafayette County would amount to an average of about 1 additional classroom per school. For Alachua County, 10 additional classrooms among 43 schools would mean less than one-quarter of the schools would require an additional classroom. These school districts would also need to be adding capacity to deal with the students associated with the increase in population that is forecast to occur even without the proposed project, as discussed previously in the section on population. The review team concluded that the impact on public schools at peak impact would be noticeable in Dixie County and minor in the other rural counties of the region.

Table 9-18. Students from In-Migrating Families at Peak Workforce Years

County	In-Migrating Worker Households	New Elementary School Students	Elementary School Rooms[(a)]	New Middle School Students	Middle School Rooms[(b)]	New High School Students	High School Rooms[(c)]
Dixie	658	104	6	53	2	60	2
Gilchrist	271	43	2	22	1	25	1
Lafayette	174	27	1	14	1	16	1
Levy	832	131	7	67	3	76	3
Alachua	645	102	6	52	2	59	2

Source: Table 4-14 and State of Florida 2002
(a) 0.158 per household; 18 students per teacher required by State law.
(b) 0.081 per household; 22 students per teacher required by State law.
(c) 0.091 per household; 25 students per teacher required by State law.
PK = preschool

Recreation

PEF notes that much of the economy of Dixie County is dependent on ecotourism by users of a national wildlife refuge (the Lower Suwannee National Wildlife Refuge), Manatee Springs State Park, the Fanning Springs State Park, and numerous other State and local parks and trails (PEF 2009b). Because the exact footprint of the site is not determined, specific impacts on specific recreational facilities from site structures and the intake and discharge structures are not known but, based on the considerations discussed for the LNP site, the review team anticipates that adverse impacts of building units at the Dixie site would have minor impacts on use of the recreational facilities from which activities would be visible or audible. The increased population in the four rural counties of the EIA may increase use of local recreational areas, which is expected to have negligible impact on either the sites or the recreational experience, given the number, geographic distribution, and variety of recreational locations available.

Summary of Socioeconomics

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. Based on information provided by PEF and its own independent evaluation, the review team finds that the socioeconomic effects of building two units at the Dixie site would be minor with the following exceptions. There would be noticeable adverse, but not destabilizing, effects on transportation, education, and public services (law enforcement and road management) in Dixie County and on fire-protection services and transportation in Levy County during the peak building employment, after which the tax effects are expected to be substantial and positive on Dixie County and minor elsewhere in the five-county local area. Closure of the operations of two fossil-fueled units at the CREC in Citrus County would result in a minor but adverse tax-based economic impact on Citrus County.

Traffic congestion is expected to have a noticeable, though intermittent and temporary, impact on US-19 near the Dixie/Levy County border. The transmission lines and corridors would have a noticeable adverse impact on aesthetics.

Cumulative Impacts

In addition to assessing the incremental socioeconomic impacts from the building and operation of two nuclear units on the Dixie site, the review team considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on the region, including other Federal and non-Federal projects. For the analysis of cumulative socioeconomic impacts at the Dixie site, the geographic area of interest is considered to be the 50-mi region centered on the Dixie site (the region) with special consideration of Alachua, Dixie, Gilchrist, Lafayette, and Levy counties because that is where the review team expects socioeconomic impacts to be the greatest (i.e., the Economic Impact Area, or EIA). Table 9-13 identifies the projects that have contributed and will continue to contribute to the demographics, economic climate, and community infrastructure of the region. Collectively these projects will contribute to an overall trend toward urbanization and generally will result in increased populations and economic activities.

Within the wider region, the residential population is concentrated around the city of Gainesville to the east, which serves as the area's economic center. Lafayette County has the smallest population of the four rural counties of the EIA (Dixie, Gilchrist, Lafayette, and Levy counties). Within the region, the planned expansion of SR-26, the proposed Tarmac King Road Limestone Mine, the potential closing of coal-fired units at CREC, and continued urbanization are the future actions identified for the region that would have the most noticeable socioeconomic effects on the four rural counties of the EIA.

The review team expects that improved road access to the regional urban center of Gainesville would contribute to and accelerate the population and economic growth in Dixie, Gilchrist, Lafayette, and northwestern Levy counties, adding to the ongoing gradual urbanization trends evident in the region. This road expansion project has not been scheduled and is not expected to be completed during the building of the proposed nuclear units.

The potential closure of coal-fired units at CREC and subsequent loss of operations jobs would moderate these growth effects. Considering this combination of ongoing and proposed projects and project terminations, the review team determined that cumulative socioeconomic effects of building new units at the Dixie site and the actions identified in Table 9-13 would not differ noticeably from the project effects analyzed above. Thus, the review team determined that cumulative socioeconomic impacts of the proposed project and other past, present, and reasonably foreseeable projects would be SMALL, with the following exceptions attributable to building and operating the Dixie site: Dixie County would experience MODERATE, but temporary and not destabilizing, effects on transportation, education, and public services (law enforcement and road management) during the peak building phase that would persist until operations commence, when these impacts would be SMALL and the tax impacts are expected to be LARGE and positive on Dixie County and minor elsewhere among the four rural counties of the EIA. Finally, the aesthetic impacts of the transmission lines and corridors are expected to be MODERATE and long-term along their viewsheds. The Dixie nuclear project would be a significant contributor to the MODERATE adverse effects on infrastructure and the LARGE beneficial tax effect identified.

9.3.3.6 Environmental Justice

The following impact analysis includes environmental justice impacts from building activities and operations as well as the cumulative impacts from other past, present, and reasonably foreseeable future actions that could have environmental justice effects, including other Federal and non-Federal actions listed in Table 9-13. For the analysis of environmental justice impacts at the Dixie site, the geographic area of interest is the region within a 50-mi radius centered on the Dixie site. The region includes the urban area of Gainesville in Alachua County and four rural counties: Dixie, Gilchrist, Lafayette, and Levy. The land use in the vicinity of the site is scattered residential, farming, and commercial forestry.

The review team determined that from an environmental justice perspective there is a potential for minority and low-income populations to experience disproportionately high and adverse impacts. The review team used the approach described in Sections 2.6, 4.5, and 5.5 to identify minority and low-income populations of interest and assess environmental justice impacts. Figure 9-2 shows the location of aggregate minority populations of interest by census block group within the region. The closest block groups with an aggregate minority population of interest are approximately 10 mi to the southeast in Levy County and 10 mi to the east in Gilchrist County. The closest African-American or Black population of interest is about 7 mi to the east in northern Levy County. The closest Hispanic population of interest is 10 mi away from the site to the southeast in Levy County. Several additional block groups with minority or ethnic populations of interest are more distant from the proposed site but still within the region. Figure 9-3 shows the distribution of block groups with low-income populations of interest within the region. The closest block group with a low-income population of interest is located

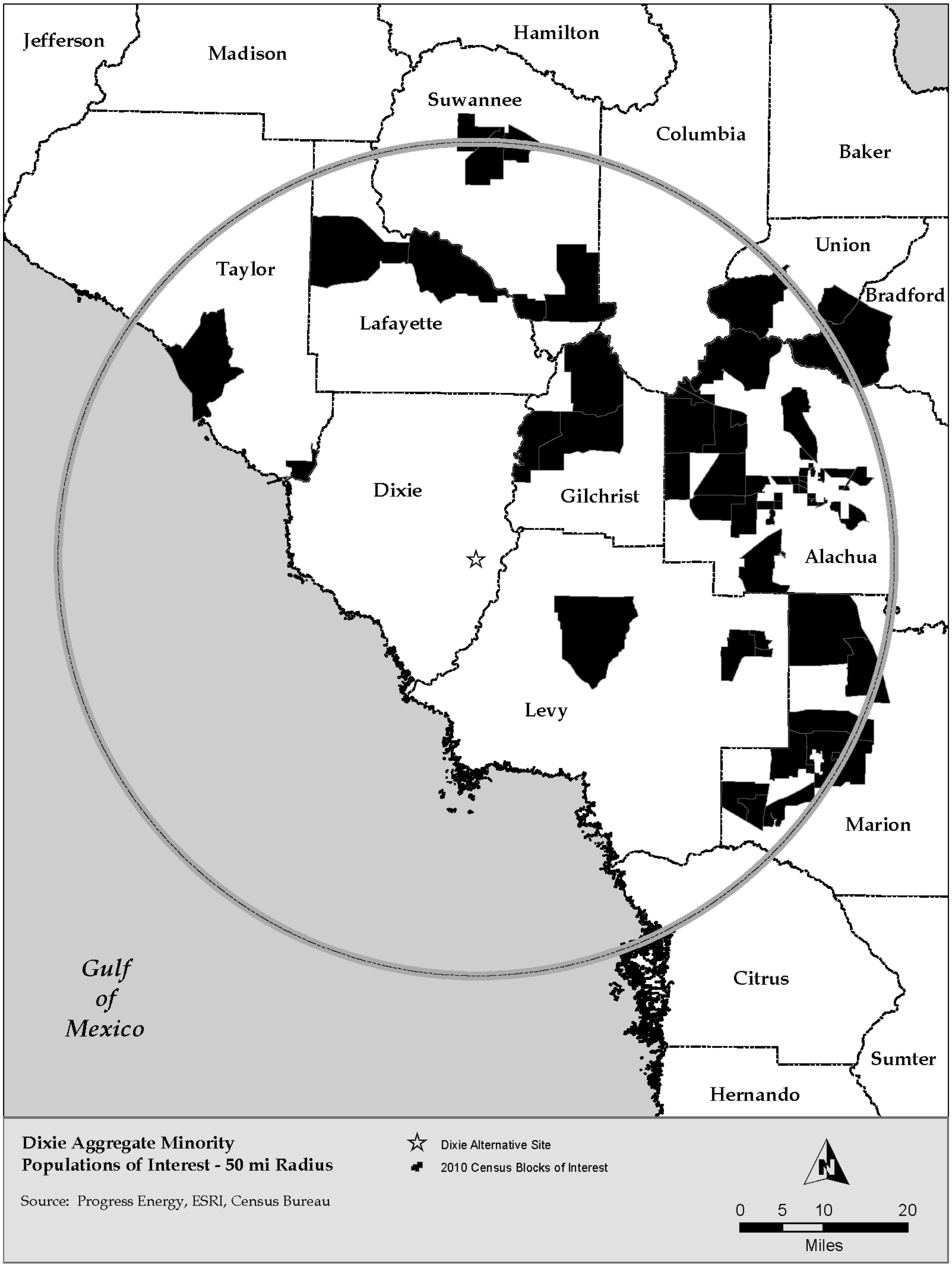

Figure 9-2. Dixie County Aggregate Minority Populations (USCB 2011)

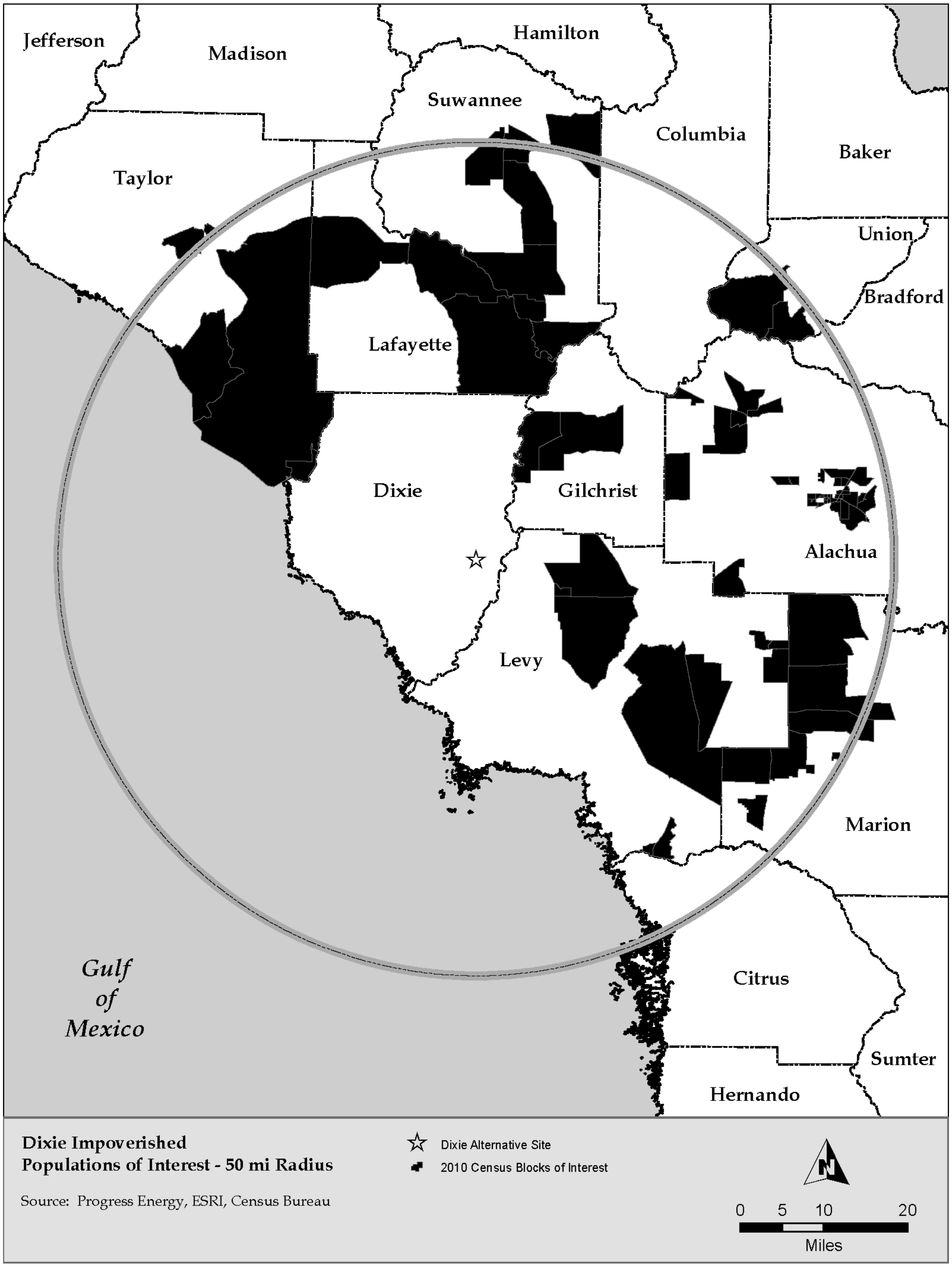

Figure 9-3. Dixie County Low-Income Populations (USCB 2011)

approximately 10 mi to the southeast of the proposed site (this is the same block group with an African-American or Black minority population of interest discussed above). Some additional block groups with low-income populations of interest are at a farther distance from the proposed site. There is some overlap in the block groups with minority and low-income populations of interest.

The review team investigated the presence of unique characteristics or practices in minority or low-income communities that could result in different socioeconomic impacts from the building and operating of the Dixie site compared to the general population. Dixie County Environmental Health Division personnel informed the review team that they are not aware of subsistence use of resources in the county, and think that they would know if such behavior were present (Dixie County 2009c). Likewise, the County Manager indicated there was no need for county residents to fish or hunt for subsistence (Dixie County 2009d). During their independent review of environmental justice impacts at the Dixie site, the review team determined that some subsistence fishing or hunting could take place outside the national wildlife refuge mentioned above, because this area of Florida is well known for its hunting, fishing, and agricultural resources and for its high levels of participation in these activities by residents and visitors alike. Such subsistence activities would possibly be affected during the building phase. The review team determined that an area south of US-19 with a low-income population parallels the Suwannee River and is north of the protected refuge (EPA 2009b). This area was not revealed by the census block group analysis but due to its proximity to the Suwannee River may rely on subsistence fishing and be affected by building or operation activities.

Physical effects from building activities (noise, fugitive dust, air emissions, traffic) would not affect any populations at the distances of the closest populations of interest because physical effects attenuate with distance, topography, and intervening foliage. None of the minority or low-income populations of interest is located within 12 mi of the site, which is primarily woodland.

In places requiring the clearing of new transmission-line corridors, aesthetic impacts would be noticeable but not destabilizing, depending on the proximity of viewers and the nature of vegetation remaining between them and the corridors. Given the general characteristics of the area, there would likely be vegetative screening around the site that would potentially mitigate the aesthetic impacts at the reactor site. The review team determined that the minority and low-income populations would not experience disproportionately high and adverse aesthetic impacts from the project.

Minority and low-income populations would experience the noticeable, but relatively short-term and localized adverse effects on public services, transportation, and education, as discussed in Section 9.3.3.5. As shown on Figure 9-2 and Figure 9-3, the closest aggregate minority, African-American or Black minority, Hispanic, and low-income populations of interest are well to the southeast of the affected commuting routes and therefore would not receive a disproportionately high and adverse traffic-related impact. For other socioeconomic categories, the review team found no evidence of unique characteristics or practices among minority or low-income populations that would result in disproportionately high and adverse impacts when compared to the general public.

The operation of the proposed nuclear power plant at the Dixie site would have no physical impact on minority or low-income populations because of their distance from the site. The review team found no evidence of unique characteristics or practices among minority or low-income populations that would result in their receiving disproportionately high and adverse impacts to demographics, economics, community services and infrastructure, or transportation.

Because the review team found no disproportionate adverse impacts on minority or low-income populations from building and operating the Dixie project, the review team concludes that environmental justice impacts would be minor.

Cumulative Impacts

The review team did not identify any environmental pathways by which disproportionately high and adverse impacts could affect minority or low-income populations or communities. Therefore the review team concludes that the environmental justice impacts on minority and low-income populations associated with the building and operation of two new units at Dixie in combination with the other projects and activities identified in Table 9-13 would range from minor to noticeable as discussed above, in proportion to the effects on majority populations, and would not be disproportionately high and adverse for the minority and low-income populations. Therefore, the review team concluded that the environmental justice impacts would be SMALL.

9.3.3.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the Dixie site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect historic and cultural resources, including the other Federal and non-Federal projects listed in Table 9-13. For the analysis of cultural impacts at the Dixie site, the geographic area of interest is considered to be the APE for this site. This includes the direct effects APE, defined as the area physically affected by the site-development and operation activities at the site and transmission lines. The indirect effects APE is defined as the area visually affected and includes an additional 0.5-mi radius APE around the transmission-line corridors and a 1-mi radius APE around the cooling towers.

Reconnaissance activities in a cultural resource review have particular meaning. Typically, the activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing this EIS, the review team relied upon reconnaissance-level information to perform its alternative sites evaluation in accordance with ESRP 9.3 (NRC 2000).

Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the Dixie site, the following information was used:

- PEF ER (2009b)
- National Register of Historic Places database (NPS 2010)
- Florida Historical Markers Program (FDOS 2010)
- NRC Alternative Sites Visit October 14–17, 2008 (NRC 2009).

Historically, the Dixie site and vicinity were largely undisturbed and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, the area has been disturbed by low-impact development, including agriculture, commercial forestry, and low-density residential development (PEF 2009b). In its ER, PEF states that potentially significant cultural resources are located within Dixie County and that cultural resource investigations would be required before siting a new reactor at this location. PEF also states that consultation with the SHPO would occur if any significant historic, cultural, or archaeological resources are identified and that appropriate mitigation measures would be put in place before construction and operation (PEF 2009b).

A search of the National Register revealed two sites listed in the Dixie County, including the City of Hawkinsville shipwreck and the Garden Patch Archaeological Site (NPS 2010). A search of the Florida Historical Markers Program revealed seven historical markers listed in Dixie County, including Old Town – one of the largest Native-American villages in Florida – and Fort Duval (FDOS 2010).

Building Impacts

To accommodate building two new nuclear generating units on the Dixie site, PEF would need to clear land for the main power plant site as described in Section 9.3.3.1 of this EIS. If the Dixie site were chosen for the proposed project, identification of cultural resources would be accomplished through cultural resource surveys and consultation with the SHPO, Tribes, and interested parties. The results would be used in the site-planning process to avoid cultural resources impacts. If significant cultural resources were identified by these surveys, the review team assumes that PEF would develop protective measures in a manner similar to that for the LNP site, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could potentially destabilize important attributes of historic and cultural resources.

There are no existing transmission-line corridors connecting to the Dixie site. Section 9.3.3.1 describes the proposed transmission-line corridors associated with this site. Visual impacts from transmission lines may result in significant alterations of the visual landscape within the geographic area of interest. If the Dixie site were chosen for the proposed project, the review team assumes that PEF would conduct its transmission-line-related cultural resource surveys and procedures in a manner similar to that for the LNP site described in Section 4.6. In addition, the review team assumes the State of Florida's Conditions of Certification regarding transmission-line siting and building activities would apply, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could potentially destabilize important attributes of historic and cultural resources.

Operations Impacts

Impacts on historic and cultural resources from the operation of two new nuclear generating units at the Dixie site would include those associated with the operation of new units and maintenance of transmission lines. The review team assumes that the same procedures currently used by PEF, including the State of Florida's Conditions of Certification, would be used for onsite and offsite maintenance activities. Consequently, the incremental effects of the maintenance of transmission-line corridors and operation of the two new units and associated impacts on the cultural resources would be negligible for the physical and visual APEs.

Cumulative Impacts

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include rural development and agricultural development and activities associated with these land-disturbing activities such as road development. Table 9-13 lists past, present, and reasonably foreseeable projects and other actions that may contribute to cumulative impacts on historic and cultural resources in the geographic area of interest. Projects from Table 9-13 that may fall within the geographic area of interest for cultural resources include future urbanization, such as new or expanded roads.

Long linear projects such as new or expanded roads may intersect the proposed transmission-line corridors. Because cultural resources can likely be avoided by long linear projects, impacts on cultural resources would be minimal. If building associated with such activities results in significant alterations (both physical alteration and visual intrusion) of cultural resources in the transmission-line corridors, then cumulative impacts on cultural resources would be greater.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the Dixie site and other projects would be SMALL. This impact-level determination reflects no known cultural resources that could be affected; however, if the Dixie site were to be developed then cultural resource surveys and evaluations would need to be conducted and PEF would assess and resolve adverse effects of the undertaking. Adverse effects could result in greater cumulative impacts.

9.3.3.8 Air Quality

The following impact analysis includes impacts from building activities and operations.

The analysis also considers other past, present, and reasonably foreseeable future actions that affect air quality, including the shutdown of two coal-fired units at CREC, and other Federal and non-Federal projects listed in Table 9-13. The geographic area of interest for the Dixie site is Dixie County, which is in the Jacksonville (Florida)-Brunswick (Georgia) Interstate Air Quality Control Region (40 CFR 81.91).

The emissions related to building and operating a nuclear plant at the Dixie site would be similar to those at the LNP site. The air quality status for Dixie County as set forth in 40 CFR 81.310 reflects the effects of past and present emissions from all pollutant sources in the region. Dixie County is classified as being in attainment for all NAAQSs.

The atmospheric emission related to building and operating a nuclear plant at the LNP site in Levy County, Florida, are described in Chapters 4 and 5. Emissions of criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of criteria pollutant emissions at the LNP site were evaluated and also determined to have a SMALL impact.

Cumulative Impacts

Reflecting on the projects listed in Table 9-13, all industrial projects listed in the table would have *de minimis* impacts. The impact of closing two coal-fired units at CREC on criteria pollutants at the Dixie site are not considered because the CREC is located outside of the geographic area of interest for this site. Given the small amount of emissions from the projects, it is unlikely that the air quality in the region would degrade to the extent that the region would be declared to be in nonattainment for any of the NAAQSs.

The air quality impact of the Dixie site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects, including the aforementioned sources, that would have emissions during site development that would, in combination with emissions from the Dixie site, result in a degradation of air quality in the region.

Releases from the operation of two new units at the Dixie site would be intermittent and made at low altitudes with little or no vertical velocity. The air quality impacts of current emissions near the Dixie site are included in the baseline air quality status. The cumulative impacts from emissions of effluents from the Dixie site and other sources would not be noticeable.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.6. The impacts of the emissions are not sensitive to the location of the source. Consequently, the discussion in Section 7.6.2 is applicable to a nuclear power plant located at the Dixie site. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable. The review team further concludes that the cumulative impacts would be noticeable, with or without the GHG emissions of the project at the Dixie site or the potential shutdown of the fossil-fuel units at CREC.

Cumulative impacts on air quality resources are estimated based on the information provided by PEF and the review team's independent evaluation. Other past, present, and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions from the Dixie site and other projects would not be noticeable. The national and worldwide cumulative impacts of GHG emissions are noticeable, with or without the GHG emissions from the Dixie site. The review team concludes that cumulative impacts from construction, preconstruction, and operations, and other past, present, and reasonably foreseeable future actions on air quality resources in the geographic area of interest would be SMALL for criteria pollutants and MODERATE for GHG emissions. The incremental contribution of impacts on air quality resources from building and operating two new units at the Dixie site would be insignificant for both criteria pollutants and GHG emissions.

9.3.3.9 Nonradiological Health

The following analysis assesses impacts from building activities and operations for the Dixie site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect nonradiological health, including the other Federal and non-Federal projects listed in Table 9-13. Impacts from building activities that have the potential to affect the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and increased traffic associated with the transport of construction materials and personnel to and from the site. The operation-related activities that have the potential to affect the health of members of the public and workers include exposure to etiological agents, noise, EMFs, and impacts from the transport of workers to and from the site.

Most of the nonradiological health impacts of building and operation (e.g., air emissions, noise, occupational injuries) would be limited to areas within approximately 2 mi from the site, which applies to the analysis for the Dixie site. Occupational injuries would occur only within the boundaries of the site, and noise from construction and operation has likewise been assessed as minimal for offsite receptors beyond a 2-mi radius. For nonradiological health impacts associated with transmission lines, the geographic area of interest would be the transmission-line corridor. If the facility were built and operated at the Dixie alternative site, the Suwannee River would serve as the source and discharge receptor of cooling water. In addition, a reservoir would need to be built to assure an adequate cooling-water supply.

Building Impacts

Nonradiological health impacts on construction workers and members of the public from building two new nuclear units at the Dixie site would be similar to those evaluated in Section 4.8 for the LNP site. The impacts include noise, construction vehicle exhaust, dust, occupational injuries, and transportation accidents, injuries, and fatalities. A detailed noise study has not been performed for the Dixie site, but it is likely that noise from building at the site, except for rare, high-noise activities such as pile-driving, would comply with State and local noise ordinances and that the overall noise impact associated with building would be minimal. Fugitive dust and vehicle emissions during building would be controlled by good management practices and compliance with Federal, State, and local air quality regulations. The incidence of construction worker accidents would be the same as that for the LNP site, the only difference being potential injuries associated with cooling-water reservoir construction.

Analyses described in Section 9.3.3.5 indicate that the traffic impacts in the vicinity of the Dixie site would be noticeable during peak building activities and could be mitigated by implementation of a suitable traffic-management plan. Owing to the rural nature of the Dixie site, there is little potential for cumulative traffic impacts with other projects, and additional injuries and fatalities from traffic accidents involving transportation of materials and personnel for building of a new nuclear power plant at the Dixie site would be similar to those estimated in Section 4.8.3 for building at the LNP site.

Because all of the past, present, or potential future construction projects identified in Table 9-13 are relatively distant (greater than 10 mi) from the Dixie site, it does not appear that combined nonradiological health impacts from construction at the Dixie site and other projects would occur. Cumulative impacts of building at the Dixie site would therefore be minimal.

Operational Impacts

Noise, air emissions, and occupational injuries from the operation of two new nuclear units at the Dixie site would be similar to those evaluated in Section 5.8 for the LNP site. Occupational health impacts on workers (e.g., falls, electric shock or exposure to other hazards) at the Dixie site would be the same as those evaluated for workers at two new units operating at the LNP site. The cooling-system discharge from the facility could encourage the growth of etiologic organisms in the Suwannee River. Etiological agent growth could be reduced by the use of biocides in the cooling systems, thermal discharge would be restricted by NPDES permit limitations, and exposure to impaired water would be limited by controls on access to the discharge zone (fencing, signage, and other security measures). However, because discharge may amount to a significant proportion of minimum flows in the river, and because the Suwannee River is already impaired due to contamination with nitrates and other pollutants (Hallas and Magley 2008; USGS 2004), the effect of blowdown discharge to the river could have a noticeable effect on the growth of etiological agents. Exposure to etiological agents in the cooling-water reservoir would not pose an additional health risk as long as access to the reservoir is limited by virtue of its being within the controlled and fenced site boundaries.

Noise and EMF exposure from operations would be monitored and controlled in accordance with applicable OSHA regulations. Although no detailed noise modeling has been performed for the Dixie site, it is likely that noise impacts would be similar to those predicted for operations at the LNP site. The effects of EMF on human health in the transmission-line corridors would be controlled and minimized by conformance with NESC criteria and adherence to the standards for transmission systems regulated by the FDEP. Nonradiological impacts of traffic associated with the operations workforce would be less than the impacts during building (minimal).

A number of the projects and activities identified in Table 9-13 (commercial farms and dairies, minor permitted municipal discharges) might also affect water quality in the Suwannee River, which has been identified as being impaired by nutrients and was included on Florida's Verified List of Impaired Waters (Hallas and Magley 2008). The impairment is due to nitrate contamination from fertilizers, animal wastes, and atmospheric deposition (USGS 2004). Releases from the two new nuclear units at the Dixie site (which would be limited by NPDES permits) would have little impact on nitrate levels in the river. Although, as noted above, blowdown discharge may result in increased water temperature that could facilitate the growth of etiological agents.

The review team is also aware of the potential climate changes that could affect human health; recent analyses of these issues (GCRP 2009) have been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature and a decrease in precipitation, which may alter the presence of microorganisms and parasites in surface water. While the overall impacts of climate change may not be insignificant (see Section 7.7), the effect of, or contribution to, climate change impacts by the operation of two new units at the Dixie site is likely to be minor. In its analysis of climate change impacts the review team did not identify additional data that would alter its conclusion regarding the presence of etiological agents or change in the incidence of waterborne diseases associated with operation of a nuclear facility at the Dixie site.

Summary

The assessment of impacts on nonradiological health from building and operation of the two new units at the Dixie alternative site is based on the information provided by PEF and the review team's independent evaluation. The review team concludes that nonradiological health impacts on workers and the public resulting from building two new units and associated transmission lines at the Dixie alternative site would be minimal. The review team also expects that the nonradiological health impacts to workers and the public from the operation of two new nuclear units at the Dixie site would be minimal, except for potential growth of etiological agents in the Suwannee River from the influence of the cooling-system blowdown discharges during droughts or low-flow periods. These effects could be reduced if the blowdown were discharged to the cooling reservoir, rather than directly to the river. Exposure to etiological agents could be increased if access to the cooling reservoir is not limited by physical and administrative controls. Based on these findings, the review team concludes that cumulative impacts on nonradiological health from related past, present, and future actions in the geographic area of interest and building and operations of two nuclear units at the Dixie alternative site risks would be SMALL to MODERATE. The severity of impacts would depend on the design characteristics of the facility, which have not been fully defined. If exposure to water heated by thermal discharge is not limited by administrative or physical controls, the contribution from building and operations at the Dixie site could be a significant contributor to the nonradiological health impacts.

9.3.3.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts from building activities and operation for two nuclear units at the Dixie site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects listed in Table 9-13. As described in Section 9.3.3, the Dixie site is a greenfield site. The geographic area of interest is the area within the 50-mi radius of the Dixie site. The CREC Unit 3 nuclear power plant is located within 50 mi from the Dixie site. There are no other major facilities that result in regulated exposures to the public or biota within 50 mi of the Dixie site. However, there are likely to be hospitals and industrial facilities with 50 mi of the Dixie site that use radioactive materials.

The radiological impacts of building and operating two AP1000 units at the Dixie site include direct radiation and liquid and gaseous radioactive effluents. These pathways produce low doses to people and biota offsite, well below regulatory limits. The impacts are expected to be similar to those estimated for the LNP site. The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Dixie site. This conclusion is based on the radiological monitoring programs conducted around currently operating nuclear power plants.

The radiological impacts of the existing CREC Unit 3 also include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around the CREC site.

Based on the information provided by PEF and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 units and other past, present, and reasonably foreseeable projects and actions in the geographic area of interest around the Dixie site would be SMALL.

9.3.3.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the Dixie site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including the other Federal and non-Federal projects listed in Table 9-13. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Dixie site. As described in Section 9.3.3, the Dixie site is a greenfield site within 50 mi of the existing CREC power plant site; there is one nuclear facility at the CREC site. There are no proposed reactors that have the potential to increase the probability-weighted consequences from a severe accident at any location within 50 mi of the Dixie site.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the LNP site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet the NRC safety criteria. The AP1000 design is independent of site conditions and the meteorological conditions of the Dixie and LNP sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Dixie site would be minimal.

Assuming the meteorology, population distribution, and land use for the Dixie site are similar to the LNP site, risks from a severe accident for an AP1000 reactor located at the Dixie site are expected to be similar to those analyzed for the LNP site. These risks for the LNP site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For the existing plant within the geographic area of interest, namely CREC Unit 3, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR Part 51, Appendix B, Table B-1). If the NRC approves the requested 20 percent power uprates at CREC Unit 3, its approval will be based, in part, on the NRC staff's determination that the risk implications of the planned 20 percent power uprate are acceptable. Therefore, the impact would continue to be SMALL. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Dixie site would be SMALL.

9.3.4 Highlands Site

This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Highlands alternative site (hereafter Highlands site) in central Florida. The site is located in a rural area in Highlands and Glades counties southwest of the Kissimmee River. The Kissimmee River would be the source for water for plant cooling and other plant uses, and construction of a new water-storage reservoir would likely be required. Highlands is a greenfield site not currently owned by PEF (PEF 2009b). Conceptual routes of the transmission lines necessary to connect the Highlands site to the electrical grid are located in Osceola, Polk, Hardee, Highlands, and Glades counties.

The following sections include a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if implemented at the Highlands site and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction and operations and impacts of preconstruction activities. Also included in the assessment are past, present, and reasonably foreseeable future Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Highlands site. Other actions and projects considered in this cumulative analysis are described in Table 9-19.

Table 9-19. Past, Present, and Reasonably Foreseeable Future Projects and Other Actions Considered in the Cumulative Analysis of the Highlands Site

Project Name	Summary of Project	Location	Status
Energy Projects			
Operation and decommissioning of St. Lucie Plant Units 1 and 2	Two 839-MW(e) combustion engineering reactors	Within 50 mi	Operational (NRC 2010b). In 2003, the operating licenses were renewed for an additional 20 years, or to 2036 for Unit 1 and 2043 for Unit 2.
Uprate at St. Lucie Plant Units 1 and 2	St. Lucie Units 1 and 2 are planning to request power uprates, or increases in the maximum power level at which each nuclear power plant may operate.	Within 50 mi	Proposed. Application for Unit 1 submitted in 2010, Application for Unit 2 submitted in 2011. (NRC 2011c)
Florida Gas Transmission Company, LLC (FGT) Phase VIII Expansion Project	Construction and expansion of natural-gas pipelines, new compressor, meter, regulator stations, and other appurtenant facilities	Various counties in Alabama and Florida, including Highlands County. Route passes within 5 mi of the Highlands site and collocated with U.S. Highway 70.	Placed in service on April 1, 2011 (FERC 2009b; Panhandle Energy 2011).
Other Actions/Projects			
Mining Projects			
Daniel Shell Pit	Excavation pit.	Within 20 mi	Operational (EPA 2010j)

Table 9-19. (contd)

Project Name	Summary of Project	Location	Status
Parks, Forests and Reserves			
Commercial forest management	Managed forests for timber production.	Throughout region	Operational
Parks, forests, and reserves	Several parks, recreation, and conservation areas are located within the 50-mi region. Examples of such areas include Kissimmee Prairie Preserve State Park, and Paradise Run.	Throughout region	Currently managed by various local, State, and Federal agencies and organizations. Development likely limited in these areas.
Everglades Restoration	Multi-agency Comprehensive Plan for multiple restoration projects	Central and Southern Florida	Multiple projects underway (CERP 2010).
Lake Okeechobee Regulation	USACE management of Okeechobee Lake levels.	Lake Okeechobee and estuaries	Revised regulation schedule implemented in 2008 (USACE 2010c)
Brighton Reservation	35,280-ac reservation managed by Seminole Indian Tribe	Within 20 mi	Operational (Seminole Tribe of Florida 2010)
Taylor Creek Nubbins Slough Conservation Area	A reservoir-assisted stormwater-treatment area as part of the Comprehensive Everglades Restoration Plan	Within 40 mi	Operational. Managed by South Florida Water Management District (FDEP 2010b; SFWMD 2010a)
Lake Okeechobee Water Retention/Phosphorus Removal	Critical restoration consists of two components, the Isolated Wetlands Restoration and two constructed treatment wetlands known as Stormwater Treatment Areas	Within 40 mi	Operational. Managed by SFWMD and USACE (FDEP 2010c)
Minor water dischargers	NPDES permitted dischargers including in the town of Okeechobee, Kissimmee Oaks Ranch, Butler Oaks Farm, B-4 Dairy, and other locations	Throughout region	Operational
Other Actions/Projects			
Various hospitals and industrial facilities that use radioactive materials	Medical isotopes	Within 50 mi	Operational in nearby cities and towns
Future urbanization	Construction of housing units and associated commercial buildings; roads (such as the proposed widening of SR-70 and SR-710), bridges, and railroads; construction	Throughout region	Construction would occur in the future, as described in State and local land-use planning documents (FDOT 2010b, c)

Table 9-19. (contd)

Project Name	Summary of Project	Location	Status
	of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents		

The geographic area of interest for cumulative impacts considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Highlands site. An accident at a nuclear plant within 100 mi of the Highlands site could increase this risk. The St. Lucie Nuclear Plant is within 50 mi of the Highlands site and is included in Table 9-19. Other nuclear plants in Florida, Alabama, and Georgia are more than 100 mi from the Highlands site and are therefore not included in the cumulative impact analysis.

9.3.4.1 Land Use and Transmission Lines

The following analysis includes impacts from building and operating two nuclear units at the Highlands site, along with the necessary transmission lines to connect them to the grid. The analysis also considers other past, present, and reasonably foreseeable future actions that affect land use, including the other Federal and non-Federal projects listed in Table 9-19. For this analysis, the geographic area of interest for considering cumulative impacts is the area within a 25-mi radius of the Highlands site and the transmission-line corridors. The review team determined that a 25-mi radius would represent the smallest area that would be directly affected because it includes the primary communities (such as Okeechobee, Lake Placid, Parker Island, and Placid Lakes) that would be affected by the proposed project if it were located at the Highlands site. The review team is aware that PEF has made minor revisions (PEF 2011a; CH2M HILL 2010) to the proposed site layout and associated offsite facilities in coordination with USACE to minimize impacts on wetlands. These minor changes did not change the land-use impact determinations since the DEIS, therefore the following evaluation was completed with original information provided by PEF and was not updated.

The Highlands site is located in two Florida counties – Highlands County and Glades County. Historically, both Highlands and Glades counties were known for agriculture. Existing land use in the geographic area of interest is mostly agriculture, including both citrus orchards and cattle ranches. The area is relatively flat, but has the potential for flooding (PEF 2009b). The Highlands site is not subject to the Coastal Zone Management Act because the site is not located within one of the designated Florida coastal zone counties. There are many parks and conservation areas in the region, as well as a Seminole Indian reservation.

Zoning changes would be needed to accommodate building and operation of a nuclear power plant at the Highlands site. Like the LNP site, the footprint of new power-generating units would be approximately 627 ac, with about 150 ac of additional land needed for temporary facilities and laydown yards. In addition, PEF indicates that a 1291-ac reservoir would be needed at the Highlands site to provide cooling water during periods of low flow of the Kissimmee River (PEF 2009a; CH2M HILL 2010). Construction of these facilities would result in a permanent land-use change from agriculture to a transportation, communications, and utilities land-use category. Additional land-use impacts include possible additional growth and land conversions to accommodate new workers and services. Because the workforce would be dispersed over larger geographic areas in the labor supply region, the impacts from land conversion for residential and commercial buildings induced by new workers relocating to the local area can be absorbed into the wider region. Therefore, the review team concludes that such impacts would be minimal.

There are no existing transmission lines or transmission-line corridors in the geographic area of interest around the Highlands site. New transmission lines would need to be constructed to connect the site to existing transmission lines. The transmission lines would run through counties designated under the Florida Coastal Management Program. Any expansion of these transmission-line corridors would require review under the procedures established under the Florida Coastal Management Program. Procedures for siting new transmission lines in Florida are discussed in Section 4.1.2. The review team assumes that the Conditions of Certification issued to PEF by the FDEP would apply at all of the alternative sites.

The review team estimated the linear run of the expected transmission-line corridors by referring to PEF Figure 3.2.3-12 (PEF 2009a), which depicts the potential routing of corridors needed to connect the Highland units to the grid. The figure suggests that 200 mi of transmission-line corridor would be needed. For purposes of land-use impact analysis, the review team made the assumption that 10 ac/mi would be disturbed, based on the LNP case where 1790 ac are expected to be disturbed over the 180 mi of corridor, as discussed in Section 4.1.2. The review team concludes that this assumption is reasonable because siting in Florida is a relatively rigorous process (Site Certification Application process), and the applicant would be bound by permit conditions resulting from that process, which would force it to use existing corridors to the extent practicable. The review team expects the SCA process would be consistently applied anywhere transmission lines are proposed in Florida. Therefore, the review team concludes that about 2000 ac of land would be disturbed to construct the transmission-line corridors for the Highlands site. Similar to the case at the LNP site, the review team concludes that land-use impacts from developing about 200 mi of new transmission-line corridors to connect new units at the Highlands site would be noticeable, but not destabilizing, and additional mitigation beyond the measures and conditions identified would not be warranted.

Cumulative Impacts

Future urbanization could contribute to additional decreases in open areas, forests, and wetlands and generally result in some increased residential and industrialized areas. However growth would likely be limited since the Highlands County Commissioners voted to pursue a

"Rural Land Stewardship" program to maintain the rural character of the county (FDCA 2007). Increased urbanization, especially long linear projects such as new or expanded roads or pipelines, would also contribute to the loss of open or forested areas and increase fragmentation of habitats along or near the transmission lines. Due to the extent of new transmission lines that would be built, the review team expects that the corridors would have a noticeable impact on the local area. Florida Gas Transmission Company recently completed expansion of its LNG pipeline in the vicinity, passing near the Highlands site and collocated with U.S. Highway 70. This project has limited impacts on land use because a small incremental amount of land was converted to a new land use and it is adjacent to the current road. Development would likely be limited in the nearby parks and conservation areas and the Seminole Indian reservation. Therefore, the incremental impacts associated with increased urbanization would be minimal.

Global climate change could increase temperature and reduce precipitation, which could result in reduced crop yields and livestock productivity (GCRP 2009), which, in turn, may change portions of agricultural and ranching land uses in the geographic area of interest. In addition, global climate change could increase sea level and storm surges in the geographic area of interest (GCRP 2009), thereby changing land use through inundation and loss of coastal wetlands and other low-lying areas. However, existing State and national forests, parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by sea-level rise. Because other projects identified in Table 9-19 that are within the geographic area of interest would be consistent with applicable land-use plans and control policies and would occur in dispersed locations, the review team considers their contribution to the cumulative land-use impacts to be relatively minor and manageable.

In the State of Florida's Conditions of Certification (FDEP 2011b), CREC Unit 1 and 2, two coal-fired plants, would stop operating by December 31, 2020, as long as PEF completes the licensing process, construction activities, and commences commercial operation of LNP Units 1 and 2 within a timely manner. If the Highlands site were selected, the review team expects the same condition would apply. If CREC Units 1 and 2 are shut down, land use at the units likely would remain industrial. Depending on economic conditions, PEF sells 60 to 95 percent of the coal plant ash to cement and building materials manufacturers, with the remainder going to Citrus Central Landfill in Lecanto, Florida. With the closure of CREC Units 1 and 2, this source of ash no longer would be available locally. The review team expects land-use impacts associated with the shutdown of Units 1 and 2 would be minimal.

Based on the information provided by PEF and the review team's in independent review, the review team concludes that the land-use impacts of building and operating two new nuclear reactor units at the Highlands site and other projects would be MODERATE. The proposed project would be a significant contributor to the MODERATE impacts due to the substantial amount of land that would be needed for the proposed power plant, reservoir, and transmission infrastructure.

9.3.4.2 Water Use and Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affect water use and quality, including the other Federal and non-Federal projects listed in Table 9-19. The Highlands site is located in rural Highlands County in Florida near the Kissimmee River. PEF has indicated that the development of this site for two nuclear units would require the building of a water reservoir on the Highlands site supplied with water from the Kissimmee River (PEF 2009b).

The geographic area of interest for the Highlands site is considered to be the drainage basin of the Kissimmee River upstream and downstream of the site because this is the resource that would be affected if the proposed project were located at the Highlands site. For groundwater, the ROI is limited to the alternative site because PEF has indicated no plans for use of groundwater to build and operate the plant (CH2M HILL 2010).

PEF indicates that the primary source of water for the site would be the Kissimmee River. Groundwater is considered an unavailable or unreliable resource for large quantities of cooling water at all of the alternative sites; in addition, permitting large groundwater withdrawals for industrial use is generally inconsistent with State policy (CH2M HILL 2010). This analysis therefore assumes that groundwater would not be used during building or operation of the two units at this site and that all water needs would be met with surface water from the Kissimmee River.

Surface water is available at the site from the Kissimmee River. Historical flow data for October 1948 through September 1951, and October 1962 through September 1964, are available for the Kissimmee River near Fort Basinger, Florida (USGS 2010c, d). The USGS has recently begun to measure flow again at this site and data from May 2009 to the present are available on its website. Mean annual flow for the historic record ranged from 566 cfs in 1963 to 2878 cfs in 1949 with the lowest monthly flow reported as 276.8 cfs in January 1963.

Building Impacts

The review team assumes that the surface-water use for building activities at the Highlands site would be identical to the proposed groundwater use for the LNP site. During building, the total maximum usage is projected to be 550,000 gpd (0.85 cfs) and the projected average estimated maximum groundwater usage 275,000 gpd (0.43 cfs) (see Table 3-2). This assumes that surface water would be used at the Highlands site for potable and sanitary use as well as various building related activities. This surface-water withdrawal rate is less than the potential operation withdrawal. This surface-water withdrawal rate is inconsequential when compared to the historic average monthly flow in the Kissimmee River, being less than 1 percent of the discharge for even the lowest month reported (January 1963). The review team concludes that the impact of surface-water use for building the potential units at the Highlands site would be minimal because withdrawal is small compared to the average monthly flow and withdrawal from the river would be temporary and limited to the building period.

As stated above, the review team assumed that no groundwater would be used to build the units at the Highlands site. The review team also assumes that the impact of dewatering the excavations needed for building two units at the site would be managed through the installation of diaphragm walls and grouting as is proposed for the LNP site. Therefore, because there would be no groundwater use and the impact of dewatering would be controlled, the review team determined that there would be little or no impact on groundwater resources.

Surface-water quality would most likely be affected by surface-water runoff during site preparation and the building of the facilities. FDEP would require PEF to develop an E&SCP and a SWPPP (PEF 2009b). These plans would be developed before initiation of site-disturbance activities and would identify measures to be used during site-preparation activities to mitigate erosion and control stormwater runoff (PEF 2009b).

The plans would identify BMPs to control the impacts of stormwater runoff. The review team anticipates that PEF would construct new detention/infiltration ponds and drainage ditches to control delivery of sediment from the disturbed area to onsite waterbodies. Sediment carried with stormwater from the disturbed area would settle in the detention ponds and the stormwater would infiltrate into the shallow aquifer. Implementation of BMPs should minimize impacts on surface-water bodies near the Highlands site. Therefore, the surface-water-quality impacts near the Highlands site would be temporary and minimal.

While building new nuclear units at the Highlands site, groundwater quality may be affected by leaching of spilled effluents into the subsurface. The review team assumes that the BMPs PEF has proposed for the LNP site would be in place during building activities and therefore the review team concludes that any spills would be quickly detected and remediated. In addition, groundwater impacts would be limited to the duration of these activities, and therefore, would be temporary. The review team reviewed the general BMPs that could be expected to be required at such a site (FDEP 2011b). Because any spills related to building activities would be quickly remediated under BMPs, and the activities would be temporary, the review team concludes that the groundwater-quality impacts from building at the Highlands site would be minimal.

Operational Impacts

The Highlands site was identified by PEF as needing a cooling-water storage reservoir to meet plant cooling needs during periods of low flow. The review team assumed that the cooling-water system for the proposed units, if they were to be built and operated at the Highlands alternative site, would be similar to that proposed at the LNP site; specifically, the cooling water system would use cooling towers and blowdown would be discharged to the Kissimmee River. The cooling-water reservoir would provide capacity for times when adequate water from the river may not be available. PEF did not provide details of the cooling-water intake and effluent discharge locations. However, it is standard practice for power plants to design cooling-water intake and effluent discharge locations such that recirculation of discharged effluent to the intake does not occur. The reservoir was sized assuming the plant would operate on four cycles of concentration. The total cooling-water requirements would be 45 Mgd (31,250 gpm) and storage of a 90-day supply of water would be needed. In determining the acreage needed to achieve this amount of storage, PEF assumed the reservoir would have an effective depth of 10 ft. PEF indicates that the resulting reservoir size would be 1291 ac (PEF 2009a; CH2M HILL 2010).

PEF indicates that the water needed to operate two units would be approximately 40,000 gpm or 89 cfs. As indicated in Chapter 3, evaporative losses from cooling two units would be approximately 28,000 gpm (62 cfs). A withdrawal of 89 cfs represents 16 percent of the mean annual flow of the Kissimmee River during the year with the lowest flow on record and 32 percent of the flow during the month with the lowest mean monthly discharge. Consumptive use of 62 cfs represents 11 percent of the lowest mean annual flow and 22 percent of the lowest mean monthly flow. Based on the indication that the water needed to operate two units at the Highlands site would represent a significant portion of the flow in the river, the review team determined that the operational surface-water-use impact of potential the plant at the Highlands site would be noticeable but not destabilizing.

As stated above, the review team assumed that no groundwater would be used to operate the units at the Highlands site. Therefore, because there would be no groundwater use, the review team determined that there would be no impact on groundwater resources during operations.

During the operation of two new nuclear units at the Highlands site, impacts on surface-water quality could result from stormwater runoff, discharges of treated sanitary and other wastewater and blowdown from cooling towers into the receiving waterbody. PEF did not provide the blowdown rate at the Highlands site. The review team conservatively assumed that the blowdown rate would be the same as that at the LNP site, 57,923 gpm (129 cfs). This assumption is conservative because the proposed plant at the Highlands site would use freshwater from the Kissimmee River rather than more saline water at the LNP site, requiring less frequent and smaller blowdown discharge. FDEP would require PEF to develop a SWPPP (PEF 2009b). These plans would identify measures to be used to control stormwater runoff (PEF 2009b). The blowdown would be regulated by FDEP pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by FDEP in a NPDES permit.

During the operation of the two units at the Highlands site, impacts on groundwater quality could result from potential spills. Spills that might affect the quality of groundwater would be prevented and mitigated by BMPs. Because BMPs would be used to mitigate spills and no intentional discharge to groundwater should occur, the review team concludes that the groundwater-quality impacts from operation of two nuclear units at the Highlands site would be minimal.

In a comment regarding the draft EIS, the SFWMD stated the following: "Although withdrawals are proposed from the Kissimmee River, the project site is located within the Indian River basin, which is a Restricted Allocation Area, pursuant to Section 3.2.1 of the SFWMD's Water Use Basis of Review". Within this basin, no additional surface water will be allocated from SFWMD-controlled surface-water bodies over and above existing allocations. In addition, there is a Water Rights Compact between the SFWMD and the Seminole Tribe of Florida for the Brighton Indian Reservation, located 2 mi south of the project site, whereby the Seminole Tribe is entitled to 15 percent of the surface water within the Indian Prairie basin. Therefore, the availability of water from this basin is limited (SFWMD 2010).

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that affect the same water resources.

For the cumulative analysis of impacts on surface water, the geographic area of interest for the Highlands site is considered to be the drainage basin of the Kissimmee River upstream and downstream of the site because this is the resource that would be affected by the proposed project. For groundwater, the ROI is limited to the alternative site because PEF has indicated no plans for use of groundwater to build and operate the plant. Actions that have past, present, and future potential impacts on water supply and water quality near the Highlands site include existing agriculture and existing and future urbanization in the region.

The GCRP has compiled the state of knowledge in climate change. This compilation has been considered in the preparation of this EIS. The projections for changes in temperature, precipitation, droughts, and increasing reliance on aquifers within the Kissimmee basin are similar to those at other alternative sites in Florida. Such significant changes in climate would result in adaptations to both surface-water and groundwater management practices and policies that are unknown at this time.

Cumulative Water Use

Surface-water use during the building and operation of two units at the Highlands site would be dominated by water use for operations. PEF indicates that a reservoir would be needed to provide cooling water during periods of low flow. A withdrawal of 89 cfs represents 16 percent of the mean annual flow during the year with the lowest flow on record and 32 percent of the flow during the month with the lowest mean monthly discharge. Consumptive use of 62 cfs represents 11 percent of the lowest mean annual flow and 22 percent of the lowest mean monthly flow. Based on the indication that the water needed to operate two units at the Highlands site would represent a significant portion of the flow in the river, the review team determined that the operational surface-water-use impact of the proposed plant at the Highlands site would be noticeable.

The impacts of the other projects listed in Table 9-19 are considered in the analysis included above or would have little or no impact on surface-water use. The projects believed to have little impact are excluded from the analysis either because they are too distant from the Highlands site, use relatively little or no surface water, or have little or no discharge to surface water. Some projects (for example park and forest management) are ongoing, and changes in their operations that would have large impacts on surface-water use appear unlikely.

Therefore, the review team concludes that cumulative impacts on surface-water use would be MODERATE. Building and operating the proposed plant at the Highlands site would be a significant contributor to these water-use impacts.

As stated above, the review team assumed that no groundwater would be used to build or operate the units at the Highlands site and that groundwater impacts from dewatering would be controlled with diaphragm walls and grouting. Therefore, the review team determined that the Highlands site by itself would have minimal impact on groundwater resources.

The impacts of the other projects listed in Table 9-19 are considered elsewhere in this analysis or else would have little or no impact on groundwater use. The projects believed to have little impact are excluded from the analysis either because they are too distant from the Highlands site, or use relatively little or no groundwater. Some projects (for example park and forest management) are ongoing, and changes in their operations that would have large impacts on groundwater use appear unlikely. Therefore, the review team concludes that cumulative impacts on groundwater use would be SMALL.

Cumulative Water Quality

Point and non-point sources have affected the water quality of the Kissimmee River upstream and downstream of the site. Water-quality information presented above for the impacts of building and operating the proposed new units at the Highlands site would also apply to evaluation of cumulative impacts. The Kissimmee River appears on Florida's list of impaired waters because of the presence of nutrients, fecal coliform, depressed dissolved oxygen, copper, un-ionized ammonia, and mercury in fish tissue (FDEP 2010d); therefore, the review team concluded that the cumulative impact on surface-water quality of the receiving waterbody would be MODERATE. As mentioned above, the State of Florida requires an applicant to develop a SWPPP (PEF 2009b). The plan would identify measures to be used to control stormwater runoff (PEF 2009b). The blowdown would be regulated by EPA pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by FDEP in a NPDES permit. Such permits are designed to protect water quality. Therefore, the review team concluded that building and operating the proposed units at the Highlands site would not be a significant contributor to these impacts on surface-water quality, because industrial and wastewater discharges from the proposed units would comply with NPDES permit limitations and any stormwater runoff from the site during operations would comply with the SWPPP (PEF 2009b).

The review team also concludes that with the implementation of BMPs, the impacts of groundwater quality from building and operating two new nuclear units at the Highlands site would likely be minimal. Therefore, the cumulative impact on groundwater quality would be SMALL. The impacts of other projects listed in Table 9-19 are either considered in the analysis included above or would have little or no impact on surface-water and groundwater quality.

9.3.4.3 Terrestrial and Wetland Resources

Site Description

The following impact analysis includes direct, indirect, and cumulative impacts from construction and preconstruction activities and operations on terrestrial and wetland resources. The analysis also considers past, present, and reasonably foreseeable future actions that affect those resources, including the other Federal and non-Federal projects and those projects listed in Table 9-19. For the analysis of terrestrial ecological impacts at the Highlands site, the geographic area of interest is considered to be a 20 mi-wide area centered on the Highlands site and the associated offsite and transmission-line corridors. This 20-mi radius is expected to encompass the locations of possible development projects potentially capable of substantially influencing terrestrial ecological resources on and close to the Highlands project site. This area includes watersheds providing direct runoff from the Highlands site to the lower Kissimmee River basin and the northern portion of Lake Okeechobee, as well as the Lake Whales Ridge district and the watersheds through which the transmission lines would be routed.

The Highlands site is a greenfield site located in the Eastern Florida Flatwoods ecoregion in a remote rural area near the Kissimmee River (EPA 2010g). Land use on the site and in the vicinity is predominantly agricultural, with significant farming operations and citrus groves present. Habitats present on the site are typical of the Eastern Florida Flatwoods ecoregion and include freshwater marshes and wet prairies with some mixed wetland hardwoods. Freshwater marsh vegetation communities from a range of hydroperiods include species such as arrowhead (*Sagittaria* spp.) and pickerelweed (*Pontederia lanceolata*), combinations of saw grass (*Cladium* spp.), cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), maidencane (*Panicum hemitomon)*, beakrush (*Rhynchospora spp*), spikerush (*Eleocharis* spp.), bladderwort (*Utricularia* spp.), white water lily (*Nymphaea odorata*), floating hearts (*Nymphoides aquatica*), and yellow cow lily (spatterdock, *Nuphar luteum*). Wet prairie vegetation communities include sparse short saw grass (*Cladium jamaicense*), beak rush (*Rhynchospora* spp*.)*, black sedge (*Schoenus nigricans*), wire grass (*Aristida stricta*), and dwarf cypress (*Taxodium* spp.). Mixed wetland hardwood communities in this part of Florida can include species such as oaks (*Quercus virginiana, Q. falcata*, and *Q. alba*) beech (*Fagus grandifolia*), hickory (*Carya* spp.) and needle-leaved evergreens, such as loblolly pine and spruce pine (*Pinus glabra*) (FWS 2007).

The proposed associated transmission-line corridors would begin in the Eastern Florida Flatwoods ecoregion and cross the Central Florida Ridges and Uplands and Southwestern Florida Flatwoods ecoregions. Vegetation community types in the Central Florida Ridges and Uplands ecoregion include sand hill vegetation such as turkey oak, bluejack oak, and longleaf pine forests with common understory species of running oak, gopher apple, and bluestem and panicum grasses (USDA 2006). One of the proposed transmission-line corridors passes directly through the Lake Whales Ridge district, that contains some of the largest tracts of sandhill communities left in Florida, which provides habitat for many endemic plant species. Vegetation community types in the Southwestern Florida Flatwoods ecoregion include forests dominated by slash pine, longleaf pine, cabbage palm, and live oak with typical understory species of saw palmetto, gallberry, and grasses such as bluestems and wiregrasses (USDA 2006).

Important Species

Common wildlife, including important species, associated with the above-mentioned ecoregions that may occur on the Highlands site and associated transmission-line corridors include recreationally important species such as Florida white-tailed deer, bobcat, feral hog, squirrel, northern bobwhite, and mourning dove, as well as skunk, raccoon, and several species of woodpecker. Various bird, reptile, and amphibian species also have the potential to reside on the Highlands site and associated transmission-line corridors (USDA 2006; FNAI 2009).

No site-specific surveys have been conducted for threatened and endangered species on the site and in the vicinity, offsite corridors or the associated transmission-line corridors. Table 9-7 lists all Federally and State-listed species that could occur on the Highlands site and vicinity, within offsite corridors, and in the counties crossed by the transmission-line corridors. Some of these species may at times be found on or in the vicinity of the Highlands site and associated offsite corridors. Counties crossed by the likely transmission-line corridors for the Highlands site include Hardee, Highlands, Glades, Osceola, and Polk counties. PEF has stated that on-the-ground field surveys would be conducted before commencement of ground-disturbing activities on the site and in the offsite corridors and transmission-line corridors as required by the FDEP (PEF 2009b; CH2M HILL2010; FDEP 2011b).

Building Impacts

Impacts from building two nuclear units and supporting facilities on wildlife habitat would be unavoidable. Activities that would affect wildlife include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the areas of disturbance. Some wildlife, including important species, would perish or be displaced during land clearing for the above activities as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities. Undisturbed land adjacent to areas of disturbance could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite, eastern meadowlark, and the gopher tortoise. Birds of prey, such as red-tailed hawks would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in an herbaceous or scrub-shrub condition that could provide improved foraging habitat for waterfowl and wading birds. However, fragmentation of forests could adversely affect species that are dependent on large tracts of continuous forested habitat.

To accommodate the building of two nuclear units on the Highlands site, PEF would need to clear approximately 660 ac of terrestrial habitats for the nuclear facility and approximately 515 ac for associated offsite structures and corridors (excluding transmission lines), and an additional 1494 ac of land would need to be cleared and excavated to accommodate a reservoir (see Table 9-20 and Table 9-21) (CH2M HILL 2010).

Table 9-20. Summary of Impacts by Land-Use Class for the Highlands Site

Land-Use Class (FLUCFCS) (acreage)	Onsite	Reservoir	Offsite Corridors (Except Transmission)	Transmission Corridors[(a)]
Urban and Built Environment (% of area)	0 (0%)	0 (0%)	19 (4%)	1782 (26%)
Agriculture	640 (97%)	1252 (84%)	435 (84%)	3084 (46%)
Rangeland	0 (0%)	0 (0%)	7 (1%)	430 (6%)
Upland Forested	0 (0%)	0 (0%)	10 (2%)	346 (5%)
Water	0 (0%)	0 (0%)	9 (2%)	29 (<1%)
Wetlands	20 (3%)	242 (16%)	23 (4%)	606 (9%)
Barren Lands	0 (0%)	0 (0%)	12 (2%)	4 (<1%)
Transportation, Communication and Utilities	0 (0%)	0 (0%)	0 (0%)	444 (7%)

Source: CH2M HILL 2010
(a) Acreages for transmission lines are total acres available, not acres affected.

Table 9-21. Total Terrestrial Habitat Impacts for the Highlands Site

Impact Areas	Acres
Onsite Impact Areas	660
Reservoir Impact Areas	1494
Transmission-Line Corridor Areas	6725[(a)]
Offsite Impact Areas	515
Total Impact Areas	2669 (plus portion of 6725-ac transmission-line corridor)

Source: CH2M HILL 2010
(a) Transmission-line acreage is total acres available in the transmission-line corridor, not acres affected.
(b) If impacts on all lands in the transmission-line corridors reflect the 26 percent total impact estimated by PEF for wetlands (CH2M HILL 2010), those impacts would encompass approximately 26 percent of 6725 ac, or 1748 ac. The review team therefore estimates that the total land requirements for the entire project would be 2669 ac plus 1748 ac, or 4417 ac.

Based upon FLUCFCS land-use data, approximately 20 ac of wetlands would be affected on the site during building (CH2M HILL 2010). Approximately 23 ac of wetlands would be affected in the offsite corridors, excluding transmission lines (CH2M HILL 2010). Approximately 242 ac of wetlands would be affected to accommodate the reservoir (CH2M HILL 2010). PEF states that the nuclear facility would be sited to avoid wetlands whenever possible, and potential impacts on wetlands near building zones would be minimized through the use of established BMPs (PEF 2009b). Under Federal and State permitting requirements, PEF would be obligated to mitigate any unavoidable construction impacts on jurisdictional wetlands and listed species (FDEP 2011b).

New transmission system infrastructure would be needed to support a nuclear power facility at the Highlands site. There are no existing transmission lines or transmission-line corridors present on the site. PEF has assumed that transmission lines would be collocated within existing transmission-line corridors to the extent possible, thereby minimizing potential terrestrial impacts. In addition, transmission-line corridors, towers, and access road would be situated to avoid critical or sensitive habitats and species to the extent possible. Transmission-line corridor width would be dependent on the size, voltage, and whether existing corridors could be used(CH2M HILL 2010).

The likely transmission-line corridors for the Highlands site would consist of approximately 6725 ac, of which approximately 606 ac would be wetlands (CH2M HILL 2010). PEF estimated that building the transmission lines would require filling approximately 6 percent of the wetlands in the corridor and clearing woody vegetation from approximately 20 percent of the wetlands in the corridor, resulting in a total impact on approximately 26 percent of the wetlands in the corridor (CH2M HILL 2010). Using these assumptions and the estimate of approximately 606 ac of wetlands in the corridor, the review team estimates that building the transmission lines would require filling approximately 36 ac of wetlands and clearing woody vegetation from approximately 121 ac of additional wetlands, totaling approximately 158 ac of wetland impacts.

Under Federal and State permitting requirements, PEF would be obligated to mitigate any unavoidable construction impacts on jurisdictional wetlands and listed species. PEF stated that all land clearing associated with the nuclear facility, offsite structures, and transmission-line creation would be conducted according to Federal, State, and local regulations, permit requirements, existing procedures, and established BMPs (PEF 2009b; FDEP 2011b).

Building two new nuclear reactors at the Highlands site, including offsite corridors (except transmission corridors) and a reservoir would result in a loss of approximately 2669 ac of terrestrial habitat. Clearing land within the 6725-ac transmission-line corridor would also result in a loss of an undetermined additional amount of forested terrestrial habitat and increase habitat fragmentation along the corridor. If impacts on all lands in the transmission-line corridors reflect the 26 percent total impact estimated by PEF for wetlands (CH2M HILL 2010), those impacts would encompass approximately 26 percent of 6725 ac, or 1748 ac. The total estimated land impact would therefore be approximately 4417 ac. Other sources of impacts on terrestrial resources such as noise, increased risk of collision and electrocution, and displacement of wildlife would likely be temporary and result in minimal impacts on the resource. Because of the extent of unavoidable terrestrial habitat loss, building the two new units and associated offsite facilities, including transmission lines, would noticeably alter the available terrestrial habitat in the landscape surrounding the Highlands site.

Operational Impacts

Impacts on terrestrial ecological resources, including important species, from operation of two new nuclear units at the Highlands site include those associated with transmission system structures, maintenance of transmission-line corridors, and operation of the cooling towers. Also, during plant operation, wildlife would be subjected to impacts from increased traffic.

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the specific location of cooling towers at the 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 nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team 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 would be minor.

Outdoor noise levels on the Highlands site are predicted to range from 90 dBA near the loudest equipment to 65 dBA in areas more distant from major noise sources (PEF 2009b). Noise modeling predicts not perceptible to slight increases in noise from plant operations at the site boundary (PEF 2009b). Except in areas immediately adjacent to major noise sources, expected noise levels would be below the 60- to 65-dBA threshold at which birds and red foxes (a surrogate for small and medium-sized mammals) are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Highlands site would not be likely to disturb wildlife beyond the site boundary. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

An evaluation of specific impacts resulting from building of transmission lines and transmission-line corridor maintenance cannot be conducted in any detail due to the lack of information, such as the specific locations of new rights-of-way that could result from transmission system upgrades. However, in general, impacts associated with transmission-line operation consist of bird collisions with transmission lines, EMF effects on flora and fauna, and habitat loss due to corridor maintenance. The impacts associated with transmission-line corridor maintenance activities include alteration of habitat, including but not limited to wetland and floodplain habitat, due to cutting and herbicide application.

Transmission lines and associated structures pose a potential avian collision hazard. Direct mortality resulting from birds colliding with tall structures has been observed (Erickson et al. 2005). Factors that appear to influence the rate of avian impacts with structures are diverse and related to bird behavior, structure attributes, and weather. Migratory flight during darkness by flocking birds has contributed to the largest mortality events. Tower height, location, configuration, and lighting also appear to play a role in avian mortality. Weather, such as low cloud ceilings, advancing fronts, and fog also contribute to this phenomenon. Waterfowl may be particularly vulnerable due to their low, fast flight and flocking behavior (EPRI 1993). Bird collisions with transmission lines are recognized as being of minor significance at operating nuclear power plants, including those with transmission-line corridors with variable numbers of power lines (NRC 1996). Accordingly, 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. PEF would also be required to have an Avian Protection Plan in compliance with State certification guidelines (FDEP 2011b). Consequently, the incremental number of bird collisions posed by the addition of new transmission lines for new nuclear units would be negligible.

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). At a distance of 300 ft, the magnetic fields from many lines are similar to typical background levels in most homes. Thus, 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 2003).

These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2003). Therefore, the incremental EMF impact posed by the addition of new transmission lines for new nuclear units would be negligible.

Existing roads providing access to the existing transmission-line corridors would likely be sufficient for use in any expanded corridors; however, new roads would be required during the development of new transmission-line corridors. Management activities (cutting and herbicide application) related to transmission-line corridors and related impacts on floodplains and wetlands in transmission-line corridors are recognized as being of minor significance at operating nuclear power plants, including those with transmission-line corridors of variable widths (NRC 1996). The review team assumes that the same vegetation and construction management of corridors currently used by PEF would be used in the establishment and maintenance of the new corridors. Under the Conditions of Certification for the State, PEF would also be required to retain existing vegetation whenever practicable and use BMPs that comply with the Florida State regulations (FDEP 2011b). Consequently, the incremental effects of the maintenance of transmission-line corridors and associated impacts on floodplains and wetlands posed by expanding existing corridors or the addition of a new transmission-line corridor for new nuclear units would be negligible.

To summarize, the potential effects of operating two new nuclear reactors at the Highlands site would be primarily associated with the maintenance of transmission-line corridors and increased traffic. Operational impacts on terrestrial resources would be expected to be minimal.

Cumulative Impacts

There are no past or current actions in the geographic area of interest that have influenced terrestrial resources in a way similar to the building and operation of the proposed two new nuclear units at the Highlands site. However, terrestrial habitats throughout the geographic area of interest have been extensively altered by a history of forestry and agricultural practices as well as low density residential development.

Proposed reasonably foreseeable future actions that would affect terrestrial resources in a way similar to development at the Highlands site would include transmission-corridor creation and/or upgrading throughout the designated geographical area of interest, and future urbanization would also be expected to occur. However, there is an area within the geographical area of interest that is managed for the benefit of wildlife – the Brighton Indian Reservation, located near the Highlands site.

The other impact on terrestrial resources at the Highlands site would be the effect of global climate change on plants and wildlife. The impact of global climate change on terrestrial wildlife and habitat in the geographic area of interest is not precisely known. Global climate change would result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation and increases in average temperature (GCRP 2009). Such changes in climate could alter terrestrial community composition on or near the Highlands site through changes in species diversity, abundance and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce terrestrial habitat. Specific predictions of habitat changes in this region due to global climate change are inconclusive at this time. However, because of the regional nature of climate change, the impacts related to global climate change would be similar for all of the alternative sites.

Summary Statement

Impacts on terrestrial ecology resources are estimated based in the information provided by PEF and the review team's independent review. Past, present, and future activities in the geographic area of interest could affect terrestrial ecology in ways similar to the building of the proposed two units at the LNP site. The Highlands site is predominantly agricultural land and citrus groves, but, a large portion of the associated transmission-line corridors would cross natural habitats that would be substantially altered by development and maintenance activities noticeably affecting the level and movement of terrestrial wildlife populations in the surrounding landscape. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team therefore concludes that the cumulative impacts on baseline conditions for terrestrial ecological resources would be MODERATE. This determination is based upon the extent of expected wetland loss and habitat fragmentation from ongoing and planned development projects, continued widespread manipulation of habitats for commercial agricultural management, and anticipated losses of habitat for important species. The incremental impacts from building and operating the Highlands project would be a significant contributor to the MODERATE cumulative impact, primarily because of a loss or modification of habitats that support wildlife, wetlands, and important species. Although incremental impacts on terrestrial resources could be noticeable near the Highlands project site, these impacts would not be expected to destabilize the overall ecology of the regional landscape.

9.3.4.4 Aquatic Resources for the Highlands Site

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The proposed Highlands site has no existing infrastructure associated with development of a nuclear power plant. This greenfield site is adjacent to the Kissimmee River, which would be the water source for cooling and discharge. Water flow in the Kissimmee River is managed by the South Florida Water Management District (SFWMD). PEF maintains that because the Kissimmee River is being restored to its original river bed, the building of a reservoir would be required to ensure consistent water supply (PEF 2009b). The geographic area of interest includes the lower Kissimmee River basin from Chandler Slough south and including the northern portions of Lake Okeechobee as the area most likely to be affected by new nuclear units, as well as associated transmission-line corridors.

The Kissimmee River provides almost one-half of the inflow to Lake Okeechobee. The previously channelized river is currently under restoration, which is required for successful restoration of the Everglades as part of the Lake Okeechobee watershed. Originally feeding floodplain wetlands, the Kissimmee River was channelized for flood control to discharge excess water to Lake Okeechobee. Currently, the canal is being filled in specific areas to improve flow velocities and divert water flow to the original floodplains (Audubon of Florida 2005).

There are no sanctuaries or preserves that could be affected by locating the proposed units at the Highland site. The nearest managed area is the North Fork St. Lucie aquatic preserve east of Highlands County in St. Lucie and Martin counties; the preserve protects 5000 ac of surface-water area on the St. Lucie River.

Commercially Important Species

While there is no commercial fishing in the Kissimmee River, Lake Okeechobee supports a small commercial fishery for catfish and black mullet. White catfish (*Ameiurus catus*), yellow bullhead (*A. natalis*), brown bullhead (*A. nebulosus*), and channel catfish (*Ictalurus punctatus*) have been documented in Lake Okeechobee. Spawning ranges from spring to mid-summer, and these primarily nocturnal fish feed on benthic invertebrates and other fish (Rohde et al. 1994).

Recreationally Important Species

The Kissimmee River and Lake Okeechobee support a diverse recreational freshwater fishery. Largemouth bass and black crappie (*Pomoxis nigromaculatus*) represent the most popular, although some saltwater species are routinely caught near the Franklin and St. Lucie locks on Lake Okeechobee (FFWCC 2009b).

Non-Native and Nuisance Species

Water hyacinth, water lettuce *(Pistia stratiotes*), alligatorweed *(Alternanthera philoxeroides)*, and hydrilla are common invasive aquatic plant species that have been noted in the Kissimmee River basin and Lake Okeechobee that are controlled by the Kissimmee River restoration, and Lake Okeechobee restoration efforts in cooperation with FDEP/Florida Fish and Wildlife Conservation Commission's Invasive Plant Management Program (FDEP 2008). Torpedograss (Panicum repens) and melaleuca (*Melaleuca quinquenervia*) are also spreading rapidly in the marsh areas of Lake Okeechobee due to drought conditions and the lowering of the lake level. Exotic animals that have been introduced into Lake Okeechobee include tilapia (*Tilapia aurea)*, Asiatic clam (*Corbicula fluminea*), and water flea (*Daphnia lumholtzii*) (SFWMD 2000). Power plant operations are not expected to have an impact on the presence or spread of these species.

Critical Habitats

No critical habitat has been designated by the FWS or National Oceanic and Atmospheric Administration in the vicinity of the Highlands site.

Federally and State-Listed Species

There are no Federally and/or State-listed aquatic species that may occur near the Highlands site. Federally and/or State-listed species may occur along transmission-line corridors, but their occurrence cannot be determined at this time because specific details regarding placement of transmission infrastructure are not available.

Based on the assumption that BMPs would be in use during building, site, vicinity, and transmission preparation, building and operation activities are not expected to result in impacts on Federally or State-listed species.

Building Impacts

New cooling-water intake and discharge structures in addition to a cooling-water reservoir would be required at the Highlands site. Preparation of a reservoir with intake and discharge structures would not result in impacts on aquatic resources from building activities. However, installation of a makeup-water intake structure on the Kissimmee River for fill water and a separate discharge to the Kissimmee River to receive discharge would result in the temporary displacement of aquatic biota within the vicinity of both structures on the Kissimmee River. It is expected that these biota would return to the area after installation is complete. Sedimentation due to disturbances of the river bank and bottom during installation could affect local benthic populations. However, the impacts on aquatic organisms would be temporary and largely mitigable through the use of BMPs. The impacts of building a cooling-water reservoir may be significant depending on the siting of the reservoir. During the review team's site visit, observations of the proposed site via public roads indicated the presence of streams that are either perennial or seasonal. Offsite corridor preparations would cross 10 streams and 2 open waterbodies (CH2M HILL 2009). These aquatic resources have not been examined for diversity of aquatic biota, but nonetheless still represent aquatic habitat that would likely be affected by the building of facilities for the site. The use of BMPs during building activities could minimize impacts on aquatic biota located in water resources within the site building areas.

New transmission-line infrastructure would be required for a new two-unit facility. There are currently no existing transmission-line corridors in the immediate vicinity of the Highlands site and new corridors would need to be established. Transmission corridors appear to follow routes in Osceola, Polk, Hardee, Highlands, and Glades counties (CH2M HILL 2010). PEF anticipates transmission-line corridors would cross 4 streams and 37 open waterbodies and should have minimal impact on aquatic resources (CH2M HILL 2010).

Operational Impacts

Impingement and entrainment of organisms from the Kissimmee River and from a constructed reservoir would be the most likely impacts on aquatic populations that could occur from operation of two new nuclear units at the Highlands site.

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 0.5 fps at the cooling-water intake, and (3) an intake flow of less than or equal to 5 percent of the mean annual flow, then anticipated impacts on aquatic populations from entrainment and impingement are expected to be minimal. However, as discussed in Section 9.3.4.2, the withdrawal of water from the Kissimmee River needed to operate two new units would be 16 percent of the mean annual flow during the year with the lowest flow on record. During low-flow conditions, impingement and entrainment impacts may be noticeable. Operational impacts associated with water quality and discharge cannot be determined without additional detailed analysis. However, based on the review team's experience with other facilities, the review team concludes that with proper design the impacts on aquatic resources due to the blowdown discharge from operation of two new nuclear units at the Highlands site would likely be minimal with FDEP NPDES compliance.

The review team also concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would also be minimal assuming that appropriate BMPs are used.

Cumulative Impacts

Cumulative impacts on aquatic resources within the Kissimmee River basin include the restoration activities associated with removing anthropogenic channelization and restoration to historic river flow, and Lake Okeechobee and Everglades restoration activities managed by USACE and SFWMD. All restoration activities are planned to increase the productivity and biodiversity within the Kissimmee-Okeechobee-Everglades ecosystems (SFWMD 2008). Restoration activities such as backfilling and channel carving to reconnect hydrological resources are managed through use of BMPs to minimize erosion and sedimentation (USACE 1996). Early restoration improvements have already demonstrated successful establishment of pre-channelized conditions and communities characteristic of free-flowing riverine habitats (SFWMD 2008).

Other impacts include operation of dairy farms, agriculture, and small businesses that discharge wastewater to the Kissimmee River basin within the geographic area of interest for the Highlands site. These dairy operators and businesses have active NPDES permits for discharge.

Anthropogenic activities, such as residential or industrial development near the vicinity of a nuclear facility, can present additional constraints on aquatic resources. Future activities may include shoreline development (i.e., removal of habitat), increased water needs, and increased discharge of effluents into the Kissimmee River. The effects of continued dairy practices and agriculture could result in additional habitat loss and/or degradation due to water use using surface waters and groundwater withdrawal, point and non-point source pollution, siltation, and bank erosion. The review team is also aware of the potential for global climate change to affect aquatic resources. The impact of global climate change on aquatic organisms and habitat in the geographic area of interest is not precisely known. Global climate change would result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation, and increases in average temperature (GCRP 2009). Such changes in climate could alter aquatic community composition on or near the Highlands site through changes in species diversity, abundance, and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce aquatic habitat, but specific predictions of aquatic habitat changes in this region due to global climate change are inconclusive at this time. The level of impact resulting from these events would depend on the intensity of the perturbation and the resiliency of the aquatic communities.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by PEF, the State of Florida, and the review team's independent review. Properly siting associated transmission lines, avoiding habitat for protected species, minimizing interactions with waterbodies and watercourses along the corridors, and the use of BMPs during intake and discharge installation, transmission-line corridor preparation, and tower placement would minimize building and operation impacts. There would be impacts associated with the loss of aquatic habitat, particularly during low flow conditions in the river, due to the consumptive loss of water from closed-cycle cooling. There also would be unspecified impacts related to the construction and operation of a cooling reservoir, however, these could be minimized through proper siting and the use of BMPs during construction. The use of a cooling reservoir would partially mitigate the effects of consumptive water loss on aquatic habitat during low river flow. The review team concludes that the cumulative impacts of building and operating two new reactors on the Highlands site combined with other past, present, and future activities on most aquatic resources in the Kissimmee River basin and Lake Okeechobee would be SMALL.

9.3.4.5 Socioeconomics

The following impact analysis includes direct, indirect, and cumulative impacts from building activities and operations at the Highlands site, which is located southwest of the Kissimmee River in a rural area of Highlands County, Florida. The analysis considers other past, present, and reasonably foreseeable future actions that affect socioeconomics, including other Federal and non-Federal projects listed in Table 9-19. For the analysis of socioeconomic impacts at the

Highlands site, the geographic area of interest is the region within a 50-mi radius of the Highlands site (the region). In evaluating the socioeconomic impacts of site development and operation at the Highlands site, the review team undertook a reconnaissance survey of the site using readily obtainable data from the Internet or published sources.

The Highlands site is a greenfield site in central Florida. The review team drew upon USCB data (USCB 2010a) to find the available total construction workforce within the host county, adjacent counties, and nearby counties with a major population center within a reasonable commuting distance from the site. For the Highlands site, this included Highlands, Hardee, De Soto, Glades, Okeechobee, Polk, Martin, St. Lucie, and Palm Beach counties. Because Polk, St. Lucie, Martin, and Palm Beach counties constitute a substantial population within the 50-mi region where construction workers are expected to reside, the review team assumed that up to 80 percent of the 3440-person workforce involved in building the two-unit plant, or 2752 workers, would be drawn from existing residents of the region, and that 20 percent, or 688 workers, would be in-migrants to the area. This 20 percent would include special trades needed for nuclear power plant production that may not be available in the region.

For the purposes of this analysis the review team assumed that about one-quarter or 172 of the in-migrating workers would be distributed about evenly among Polk, St. Lucie, Martin, or Palm Beach counties, because they offer more urban amenities than the EIA. The review team assumed that the other 516 in-migrating workers would be distributed among Highlands County (55 percent) and the immediately adjacent Glades (9 percent), De Soto (14 percent), Hardee (8 percent), and Okeechobee counties (14 percent), according to available housing. The review team considered this five-county area as the local area where most socioeconomic impacts would be expected to be the greatest (i.e., the Economic Impact Area or EIA). The review team focused on effects of the workforce involved in building the two-unit plant because the operations workforce would be smaller, with expected smaller socioeconomic impacts. Table 9-22 provides some socioeconomic data for the EIA.

The review team assumed that all in-migrating workers would bring families; this is unlikely but provides an upper bound to the population increase associated with the project. The review team used the 2.49 average Florida family size to project the distribution of new jobs and population in the EIA due to in-migrating workers listed in Table 9-23.

Physical and Aesthetics Impacts

The physical impacts on workers and the public of building and operating a two-unit plant at the Highlands site would be very similar to those described for the LNP site. People who work or live around the site could be exposed to noise, fugitive dust, and gaseous emissions from building activities. Workers and personnel working onsite could be the most affected. Air-pollution emissions are expected to be controlled by applicable BMPs and Federal, State, and local regulations. During plant operations, standby diesel generators used for auxiliary power

Table 9-22. Socioeconomic Data for the Highlands Site EIA

Data Category	Highlands	Glades	De Soto	Hardee	Okeechobee	Data Source
Population						
1980	47,526	5992	19,039	20,357	20,264	(a)
1990	68,432	7591	23,865	19,499	29,627	(b)
2000	87,366	10,576	32,209	26,938	35,910	(b)
2010	98,786	12,884	34,862	27,731	39,996	(c)
Median Household Income (2009)	$33,401	$34,920	$33,791	$33,728	$35,349	(c)
Vacant Housing Units 2010	12,782	2446	3145	1477	4496	(d)
Total Housing Units	55,386	6979	14,590	9722	18,509	(d)
Workforce						
Employed	21,945	1030	6714	5577	9706	(e)
Construction	1061	106	282	190	603	(e)
Total Schools	1E, 4 M, 7 E-M, 3 H	2 E-M, 2 M-H	1 E, 1 M, 3 E-M, 1 H 1 M-H,	0 E, 2 M, 5 E-M, 1 H	1 E, 1 M, 4 E-M, 2 H, 1 E-M-H	(f)
Number of Schools Failing Student-Teacher Ratio	0	0	0	1	0	(f)

Table 9-22. (contd)

Data Category	Highlands	Glades	De Soto	Hardee	Okeechobee	Data Source
Police	Sheriff Dept – 341 full-time and 18 part-time employees;	Sheriff Dept – 60+ employees; currently expanding; patrol division with 19 members	Sheriff Dept	Sheriff Dept –patrol division of 4 squads	Sheriff Dept – 44 deputies	(g)
Emergency Services	EMS department, details not available	EMS and fire departments, details not available	Emergency operations center with 5 staff; 3 fire stations	EMS department and emergency ops center, details NA	EMS department and emergency operations center, details not available	(h)
Population						
White	81.0	71.0	66.2	72.2	77.5	(c)
African American	9.4	12.3	12.7	7.0	8.0	(c)
Hispanic	17.4	21.1	29.9	42.9	23.9	(c)
Low-Income	19.9	21.5	25.6	28.4	22.3	(c)

(a) USCB 1990
(b) USCB 2000b
(c) USCB 2010b
(d) USCB 2010c, d
(e) USCB 2010a
(f) FDOE 2009a
(g) Highlands Sheriff 2009; Glades Sheriff 2009; De Soto Sheriff 2009; Hardee Sheriff 2009; Okeechobee Sheriff 2009
(h) Highlands EM 2009; Glades EM 2009; De Soto EM 2009; Hardee EM 2009; Okeechobee EM 2009
E = elementary school; M = middle school; H = high school; EMS = emergency management services

Table 9-23. Projected Distribution of Workers and Associated Population Increase in the EIA

County	Percent Population Increase 1990-2000[a]	Percent Population Increase 2000–2010[b]	Workers In-Migrating to Build Dixie Plant	Population of In-Migrating Workers and Families	Population of Workers and Families as a Percent of 2010 Population + In-Migrants
Highlands	27.7	13.0	284	707	0.70
Glades	39.3	21.8	46	115	0.89
De Soto	35.0	8.2	72	179	0.50
Hardee	38.2	2.9	41	102	0.37
Okeechobee	21.2	11.4	72	179	0.44

(a) Based on USCB data, as reported in PEF 2007b
(b) USCB 2010b

would have air-pollution emissions. These generators would see limited use for only short periods of time. Applicable Federal, State, and local air-pollution requirements would apply to all fuel-burning engines. At the site boundary, the annual average exposure from gaseous emission sources is anticipated to not exceed applicable regulations during normal operations. The impacts of plant operations on air quality are expected to be minimal. As with building impacts, potential offsite receptors of operations noise and emissions are generally located well away from the site boundaries.

The Highlands site is in a rural, agricultural area. Residential and commercial areas are located away from the site boundaries, applicable air-pollution regulations would have to be met by PEF, and applicable BMPs would be put in place during the construction and use of the site access road. Therefore, based on information provided by PEF and the review team's independent review of reconnaissance-level information, the review team concludes that the physical impacts of building and operating the two units at the Highlands site would be minimal on workers and the local public around the site.

Building activities and plant operations are not expected to affect any offsite buildings. Most buildings are well removed from the site boundaries. Because this is a greenfield site, there are no onsite buildings to be affected by shock and vibration from pile-driving and other related activities. No long-term physical impacts on structures, including any residences near the site boundaries, would be expected. Therefore, based on consideration of reconnaissance-level information, the review team concludes that the physical impacts of building and operating a two-unit nuclear plant on offsite buildings would be minor.

PEF reports that a reservoir may need to be created for water supply. Because its size and footprint are unknown, the review team cannot predict whether such a reservoir would affect aesthetics in the vicinity of the plant. However, there would likely be vegetative screening around the reservoir that would potentially mitigate the aesthetic impacts.

As the transmission lines to connect the site to the distribution grid are put in place and the buildings and cooling towers associated with the new reactors reach their final heights and begin operating, they would add a visible industrial landscape, with a noticeable aesthetic impact. In places requiring the clearing of new transmission-line corridors, aesthetic impacts would be noticeable but not destabilizing, depending on the proximity of viewers and the nature of vegetation remaining between them and the corridors. Given the general characteristics of the area, there would likely be vegetative screening around the site that would potentially mitigate the aesthetic impacts at the reactor site.

Demographic Impacts

Table 9-23 lists the estimated project-related population migrating into the EIA at peak workforce levels and the population increase in each county between 1990 and 2000 and between 2000 and 2010. As seen in the table, each county saw a greater population increase between 1990 and 2000 than between 2000 and 2010. The proposed project would increase the population in the EIA by less than 1 percent over 2010 populations. Consequently, the review team found that the in-migrating population associated with building two new nuclear generating units would have a minor demographic impact in the entire 50-mi region.

Economic Impacts

The review team determined that the impact of jobs associated with building the two units would have a minor effect on total employment in the EIA, with in-migrating workers projected at 1 percent or less of the 2010 civilian workforce in any county. The impact of approximately 541 new operations jobs (70 percent of operations workforce) within a 1-hour commute of the site would be minor on employment levels in the EIA. Due to the smaller economy of the Highlands EIA compared to the Levy EIA, and the smaller number of in-migrating workers at the period of peak workforce, the review team concludes that the expected number of indirect jobs and income created by building and operating the two-unit plant at the Highlands site due to the multiplier effect would be no greater than that estimated for the LNP site and that the combined direct and indirect economic effects would cause only a slight increase the counties' economies.

State and local taxes would be governed by Florida law. The review team assumed that tax revenues generated from sales and use taxes associated with building and operation of the proposed project at the Highlands site would be similar to those evaluated for the LNP site in Sections 4.4.3. and 5.4.3., with a minor impact on revenues in the EIA and region. The review team concluded that increased property taxes from a facility at the Highlands site during operations would have a substantial beneficial impact on Highlands County, but minimal impacts on the other counties in the EIA and region. The State of Florida Conditions of

Certification for LNP would require PEF to discontinue the operations of two fossil-fueled units at the CREC in Citrus County by December 31, 2020, assuming licensing, construction, and operation of LNP were to occur in a timely manner (DOE/EIA 2010b; FDEP 2011b). Because of the age and size of the two units planned for closure, the review team does not expect their value to be very high, but Citrus County would still lose a small component of its property tax base, resulting in a minor but adverse tax-based economic impact on the County.

The review team found that additional property taxes on new houses built by in-migrating workers would constitute a small percentage increase in the local tax base in the EIA. Therefore, the review team determined that the impact of both the building and operation of the proposed project on residential property tax revenues would be minor and beneficial everywhere in the region, with the exception of Highlands County, where property tax impacts would be substantial and beneficial.

Housing

The review team compared the 2010 figures for vacant housing in the EIA listed in Table 9-22 with the number of in-migrating workers projected for peak workforce years listed in Table 9-23. Table 9-22 housing figures do not include RV parks, campgrounds, or hotels, and thus provide a lower bound of what would be available to house workers. In the EIA, less than 3 percent of the vacant housing present in 2010 would be needed to house in-migrating workers, assuming that each worker occupied a separate housing unit.

The U.S. Census Housing Profile (USCB 2010c) for the EIA estimated the following:

- Highlands County – a total housing stock of 55,386 units with a vacancy rate of 23 percent (approximately 12,782 housing units were unoccupied at the time of the survey).
- Glades County – a total housing stock of 6979 units with a vacancy rate of 35 percent (approximately 2446 housing units were unoccupied at the time of the survey).
- De Soto County – a total housing stock of 14,590 units with a vacancy rate of 21 percent (approximately 3145 housing units were unoccupied at the time of the survey).
- Hardee County – a total housing stock of 9722 units with a vacancy rate of 17 percent (approximately 1654 housing units were unoccupied at the time of the survey).
- Okeechobee County – a total housing stock of 18,509 units with a vacancy rate of 24 percent (approximately 4496 housing units were unoccupied at the time of the survey).

The review team expects that the in-migrating workforce could be absorbed into the existing housing stock in the EIA and the region without a measureable impact. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that housing impacts of building and operating two nuclear units at the Highlands site would be minor.

Public Services

The review team assumed that the Highlands EIA, like the LNP EIA, have planned to meet needs for public services based on forecast population increases that did not include the presence of a workforce associated with constructing and operating a two-unit nuclear plant. The review team based its analysis of potential impacts on public services on the level of population increase represented by in-migrating workers and their families during peak workforce years, an estimated increase less than 1 percent over populations for 2010, as shown in Table 9-23. Using this approach, the review team expects that impacts of the proposed project on county public services during peak workforce years would be minor in the entire 50-mi region.

Traffic

Main roads in Highlands County include US-27, a multi-lane north-south road with LOS standard of “C”; SR-70, a two-lane east-west road across the southern third of the county with LOS standard of “C”; and SR-64, a two-lane road that extends west from US-27 into Hardee County in the northwest of the county with LOS standard of “C.” These roads form part of the Strategic Intermodal System, for which the FDOT sets the standards (FDOT 2009a). SR-66/US-98, a two-lane east-west road across the northern third of the county, is not part of the Strategic Intermodal System and Highlands County has not set standards for this route. Where US-98 turns north to join US-27 when it meets SR-66, it is subject to the LOS standard of “C” as part of the Strategic Intermodal System. For this analysis, the review team assigned the east-west SR-66/US 98 a LOS standard of “C,” consistent with other two-lane U.S. highways and State roads in the county.

One-way annual (2008) AADT counts for US-27 ranged from 14,500 to 17,000 around the intersection with SR-64; 10,500 in both directions around the intersection with SR-66/US-98; and 4500 to 4200 around the intersection with SR-70. One-way AADT counts for SR-70 ranged from 2100 to 1700 around the intersection with US-27; and 2100 to 2000 in the eastern side of the county. One-way AADT counts for SR-66 west of US-27 ranged from 2900 through 3100. One-way AADT counts for SR-64 west of US-27 ranged from 5200 to 5100 (FDOT 2008).

The review team determined that US-27, SR-70, SR-64, and SR-66/US-98 would be the main routes used by workers commuting to the plant site, with SR-70 linking to the site access road. The review team considered the impact of the traffic associated with the peak workforce and building-related activities in terms of likelihood that it would change the LOS along SR-70 to be lower than the assigned standard “C.” The review team assumed 2281 trips daily (following LNP site transportation analysis in Section 4.4.4.1), split 65 percent to/from the east and 35 percent to/from the west, based on the split of in-migrating worker residence discussed previously, combined with the split of commuters from Polk, Martin, St. Lucie, and Palm Beach counties. At morning shift change, this would add 1977 cars to the total flow on SR-70, 924 incoming from the east, 498 from the west; and 357 outgoing to the east, 193 to the west. The incoming traffic from the east would increase the flow by almost 50 percent over the 2008 AADT for SR-70 in the east side of the county, but, according to FDOT's generalized planning standards (FDOT 2009b), this total flow would not reduce the LOS below "C." While more analysis would be required, once specific proposals for turn lanes, signals, and other modifications were made, the review team identified the potential that a noticeable, intermittent impact would be observed at the intersection of SR-70 with the site access road, analogous to that predicted for the LNP site. Given the lower number of commuters during operations, the review team believes the traffic-related impacts during operations would be minor.

Education

Table 9-22 provides data about schools in the EIA. All schools met the State teacher-student ratio classroom requirements in 2007–2008 with the exception of one school in Hardee County. The review team assumed that school districts in the EIA, like those for the LNP site, would address short-term gains in student population with mobile classrooms and that the PK-12 public schools would be funded according to the Florida equalized funding formula (FDOE 2009b). The review team assumed that students would accompany each in-migrating worker family. To calculate the number of new students moving into the EIA, the review team took the average of the ratios of students per household from counties in the LNP site listed in Table 2-35. The estimated numbers of new students in each of the counties of the EIA during peak workforce years are listed in Table 9-24.

Table 9-24. Students from In-Migrating Families at Peak Workforce Years

County	In-Migrating Worker Households	New Elementary School students	Elementary School Rooms[(a)]	New Middle School Students	Middle School Rooms[(b)]	New High School Students	High School Rooms[(c)]
Highlands	284	45	2	23	1	26	1
Glades	46	7	0	4	0	4	0
De Soto	72	11	1	6	0	6	0
Hardee	41	6	0	3	0	4	0
Okeechobee	72	11	1	6	0	6	0

Source: Table 4-14; State of Florida 2002
(a) 0.158 per household; 18 students per teacher required by State law.
(b) 0.081 per household; 22 students per teacher required by State law.
(c) 0.091 per household; 25 students per teacher required by State law.
PK = preschool

The review team found that the addition of up to four classrooms in Highlands County and one classroom in De Soto and Okeechobee counties would amount to less than one additional classroom per school, which would constitute a minor impact. Glades and Hardee counties would not need additional classrooms to accommodate project-related students and still meet applicable student/teacher ratios. Therefore, the review team determined the expected impact of construction and operations of a Highland nuclear site would be minor.

Recreation

The economy in the Highlands EIA draws on its natural resources, including many lakes and parks. Because the exact footprint of the site is not determined, specific impacts on specific recreational facilities from site structures and the intake and discharge structures are not known. However, based on the considerations discussed for the LNP site, the review team anticipates that adverse impacts of building units at the Highlands site would have minor impacts on use of the recreational facilities from which activities would be visible or audible. Given the general characteristics of the area, there would likely be vegetative screening around the site that would potentially mitigate the aesthetic impacts. The increased population in the EIA may increase use of local recreational areas, which is expected to have negligible impact on either the sites or the recreational experience, given the number, geographic distribution, and variety of recreational locations available.

Summary of Socioeconomics

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, based on information provided by PEF and its own independent evaluation, the review team finds that the socioeconomic impacts of building two units at the Highlands site would be minor with several exceptions: (1) there would be noticeable adverse, but not destabilizing, effects on traffic in Highlands County near the site during construction and minor effects during operations; (2) the tax impacts on Highlands County would be substantial and positive, while closure of the operations of two fossil-fueled units at the CREC in Citrus County would result in a minor but adverse tax-based economic impact on Citrus County; and (3) the aesthetic impact of transmission lines would be noticeable.

Cumulative Impacts

In addition to assessing the incremental socioeconomic impacts from the building and operation of two nuclear units on the Highlands site, the cumulative impact assessment considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects. For the analysis of cumulative socioeconomic impacts at the Highlands site, the geographic area of interest is the region within a 50-mi radius centered on the Highlands site (the region) with special consideration of Highlands, De Soto, Glades, Hardee, and Okeechobee counties, because that is where the review team expects socioeconomic impacts to be the greatest (Economic Impact Area, EIA). Table 9-19 identifies the projects that have contributed and will continue to contribute to the demographics, economic climate, and community infrastructure of the region. Collectively these projects will contribute to a long-term and overall trend toward urbanization and its associated increase in population and economic activities.

The Highlands site is a greenfield site in a rural area. The EIA is within commuting distance of Tampa/St. Petersburg. Sebring and Avon Park in Highlands County are each communities of about 10,000 people, but the EIA is predominately rural. Within the region, the Avon Park Air Force Range and active residential, retirement, and recreational developments along with planned improvements to the areas transportation infrastructure are expected to result in continued urbanization that would have noticeable socioeconomic effects on the economy and residents of the EIA. The review team determined that cumulative socioeconomic effects of building new units at the Highlands site and the actions identified in Table 9-19 would not differ noticeably from the project effects analyzed above. Thus, the review team determined that the cumulative socioeconomic effects of the proposed project and other past, present, and reasonably foreseeable projects would be SMALL, with the following exceptions attributable to building and operating the Highlands site. Highlands County would experience MODERATE but short-term and spatially limited impacts on roads/traffic that would reduce to SMALL during operations, and LARGE beneficial impacts on tax receipts after the plant begins operations. The review team anticipates MODERATE long-term impacts on aesthetics along the transmission lines and corridors. Building nuclear units at the Highland site would be a significant contributor to the MODERATE impacts on roads/traffic. Building and operating nuclear units at the Highland site would be a significant contributor to MODERATE impacts on aesthetics along the transmission lines and corridors.

9.3.4.6 Environmental Justice

The review team used the approach to identify minority and low-income populations of interest described in Section 2.6. Figure 9-4 and Figure 9-5 show the location of block groups with minority and low-income populations within the region. As seen in these figures, a number of block groups that meet the criteria for minority populations of interest are in the region, including areas to the northwest, south, and east of the Highlands site, and much of the southeastern quadrant of the region. The closest aggregate minority, African-American or Black minority, or Hispanic populations of interest are within 3 mi to the west of the Highlands site. There are fewer block groups with low-income populations of interest in the region, most of which also represent minority or ethnic populations of interest. There is a large area with low-income populations of interest to the southeast of the site, with isolated pockets elsewhere. The closest low-income populations of interest are 10 to 12 mi northeast of the Highlands site. The 35,280-ac Brighton Reservation, managed by the Seminole Indian Tribe, is located southeast of the Highlands site within the region. The 2000 census indicates that 566 people, predominately Native Americans, live on the reservation (USCB 2000b).

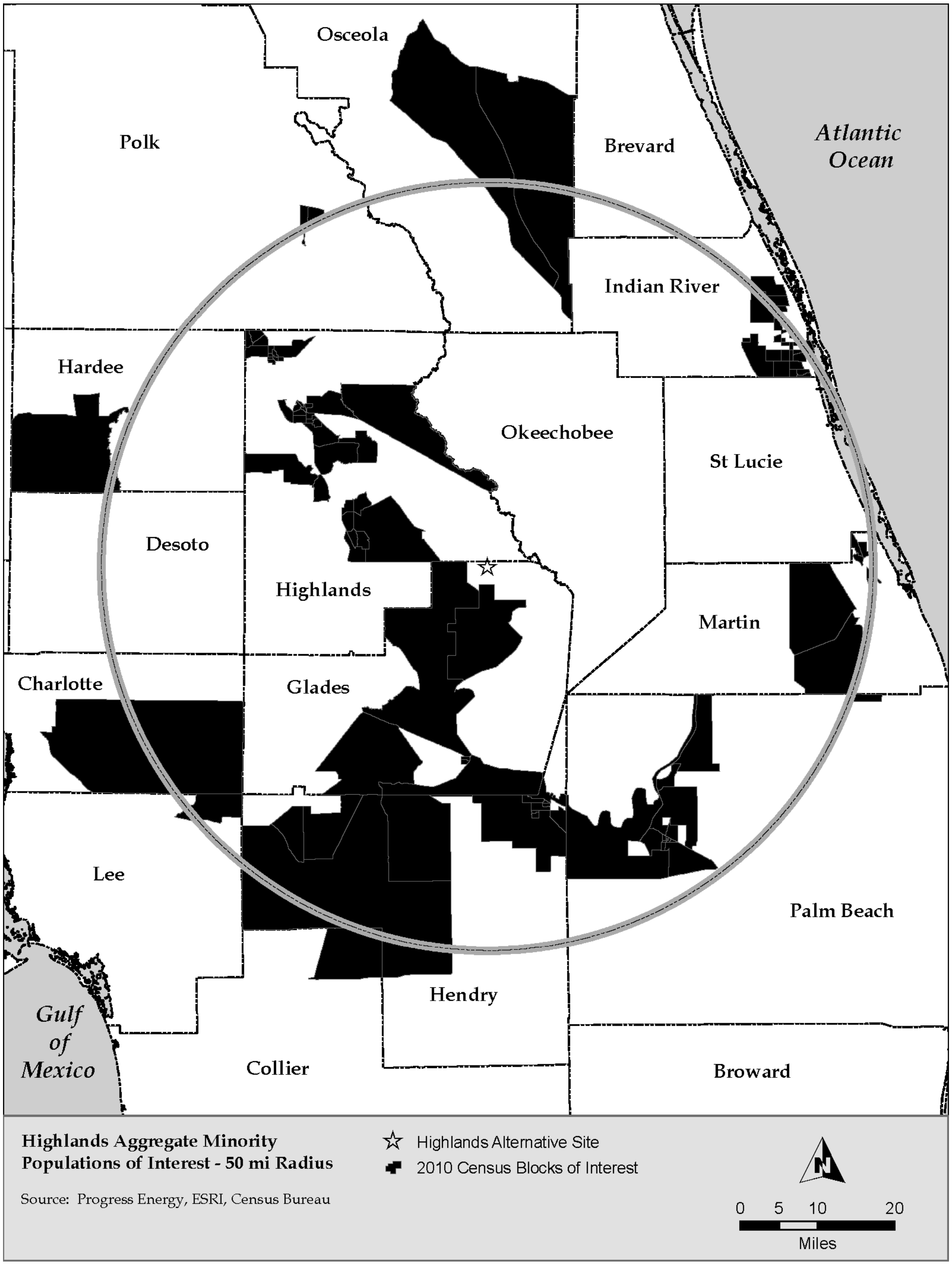

Figure 9-4. Highlands Site Aggregate Minority Populations (USCB 2011)

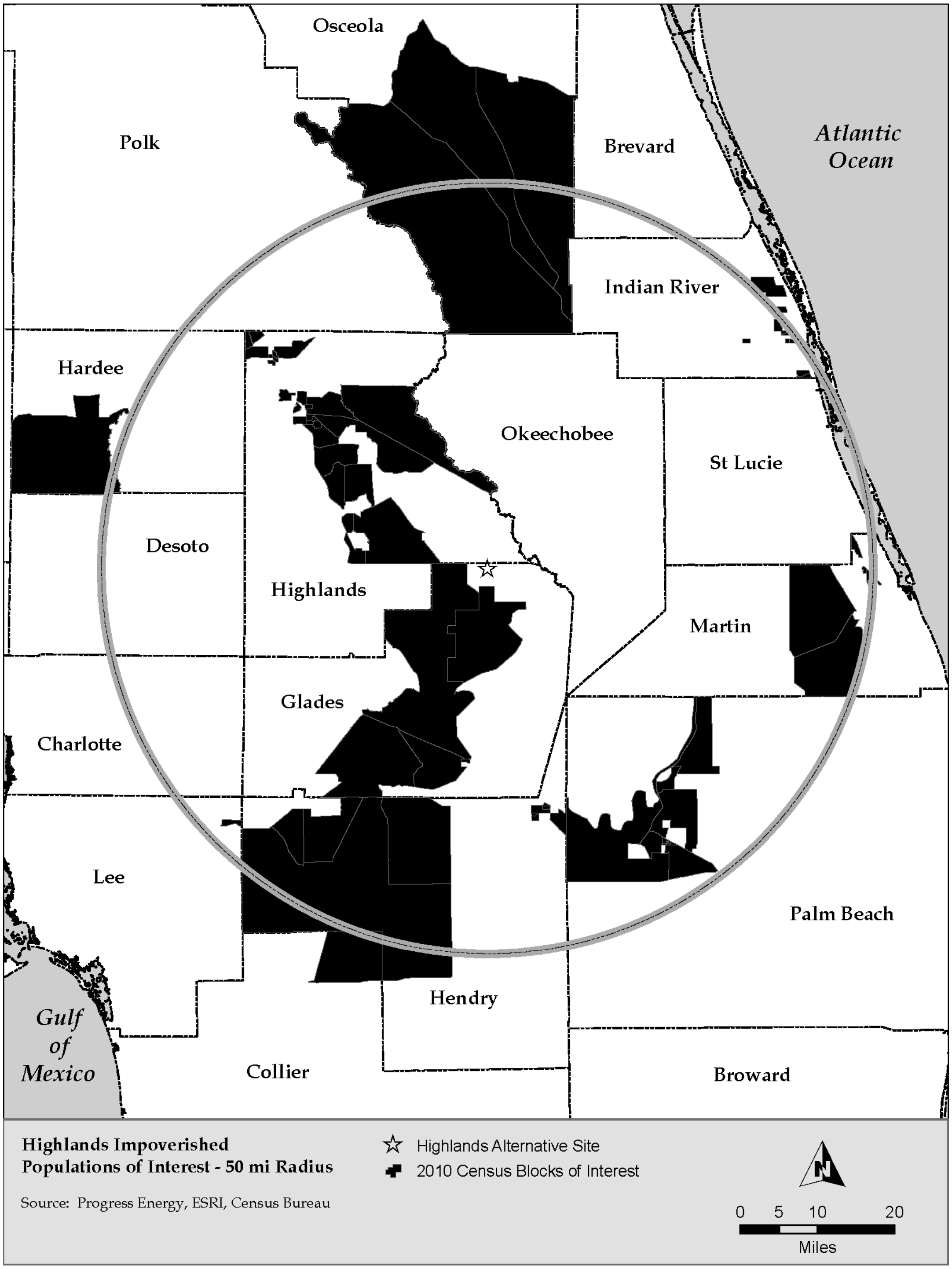

Figure 9-5. Highlands Site Low-Income Populations (USCB 2011)

The review team performed a reconnaissance-level investigation for the presence of unique characteristics or practices in minority or low-income communities that could result in different socioeconomic impacts for the Highlands site compared to the general population. The review team found two potential sources of environmental justice impacts arising from unique characteristics and practices: proximity to transmission-line corridors and subsistence fishing.

The review team identified several minority census block groups within 3 to 6 mi to the south of the Highlands site but determined none of these communities resided near a road that could be considered a potential commuting route for construction or operations workers. A conceptual transmission-line route proposed by PEF for the Highlands site could impose disproportionately high and adverse physical impacts on contiguous populations of interest during transmission-line construction. Therefore the review team concludes there is a potential for a noticeable disproportionately high and adverse impact from transmission-line construction.

Highlands County Environmental Health Division and Community Services Division personnel were unable to provide information about subsistence activities in the county, but the Community Services Division noted that hunting is popular in the county. Personnel from the County Natural Resources Department said that perhaps 1 percent of the county population may engage in subsistence fishing. On average 100 to 150 people per day may rely on fishing for their protein source. They noted that 12 percent of the county population receives food stamps (Highlands County 2009). The review team assumes that subsistence fishing activities might be affected during portions of the building phase, perhaps requiring that fishermen use different locations. In the absence of specific information about effects on local lakes and streams that are used for subsistence fishing, the review team concludes that there may be disproportionately high and adverse effects on minority and low-income populations that engage in subsistence fishing, possibly extending to the Native-American residents of the Brighton Reservation in Glade County.

The review team concludes that the physical effects of building activities (noise, fugitive dust, air emissions, traffic) would not impose disproportionately high and adversely affects on minority or low-income populations because the effects would be attenuated by distance and intervening foliage such that even the closest population of interest would not experience adverse effects. Therefore, the review team determined the physical environmental justice impacts from building and operations would be minor.

The review team concluded that environmental justice impacts could be noticeable on subsistence fishing populations and short-term and noticeable on minority communities along the proposed transmission-line corridor.

Cumulative Impacts

The review team determined the building and operation of a proposed nuclear power plant at the Highlands site would be unlikely to have a disproportionately high adverse impact on minority or low-income populations due to economic impacts, or impacts on community infrastructure; but could have a disproportionately high and adverse impact on minority or low-income populations living near transmission-line corridors (aesthetics) or engaged in subsistence activities. The cumulative impact assessment considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative environmental justice impacts in the region, including other Federal and non-Federal projects. The review team did not find any activity listed on Table 9-19 that would have a cumulative environmental justice effect when placed in context with the hypothetical Highlands project. The review team concluded that, in addition to building and operating two new nuclear units at the Highlands site, the inclusion of other past, present, and reasonably foreseeable future projects would add only a minor impact on minorities or low-income populations. Therefore, the cumulative environmental justice impacts could be MODERATE, with the building and operating of two nuclear units at the Highlands site a significant contributor to the impact.

9.3.4.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the Highlands site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect historic and cultural resources, including the other Federal and non-Federal projects listed in Table 9-19. For the analysis of cultural impacts at the Highlands site, the geographic area of interest is considered to be the APE that would be defined for this site. This includes the direct effects APE, defined as the area physically affected by the site-development and operation activities at the site and transmission lines. The indirect effects APE is defined as the area visually affected and includes an additional 0.5-mi radius APE around the transmission-line corridors and a 1-mi-radius APE around the cooling towers.

Reconnaissance activities in a cultural resource review have particular meaning. Typically, the activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing this EIS, the review team relies upon reconnaissance-level information to perform its alternative site evaluation in accordance with ESRP 9.3 (NRC 2000). Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the Highlands site, the following information was used:

- PEF ER (2009b)
- National Register of Historic Places database (NPS 2010)
- Florida Historical Markers Program (FDOS 2010)

- NRC Alternative Sites Visit October 14–17, 2008 (NRC 2009).

Historically, the Highlands site and vicinity were largely undisturbed and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, the area has been disturbed by mostly agricultural development (PEF 2009b). As described in Section 9.3.4.6, the Brighton Indian Reservation is located within the region but not within the geographical area of interest. In its ER, PEF states that an initial database search for potentially significant cultural resources in Highlands County did not identify any NRHP-listed sites in the vicinity of the Highlands site and that a cultural and archaeological resources investigation would be required before siting a new reactor at this location. PEF also states that consultation with the SHPO would occur if any significant historic, cultural, or archaeological resources are identified and that appropriate mitigation measures would be put in place before building and operation.

A search of the NRHP database completed by the review team revealed 14 sites listed in Highlands County, including the Haines Elizabeth House and the Sebring Downtown Historic District (NPS 2010), and three Historic Properties listed in Glades County, including Moore Haven Downtown Historic District, Moore Haven Residential Historic District, and Red Barn. A search of the Florida State Historical Markers Program completed by the review team revealed one historical marker in Highlands County – Fort Basinger built in 1837 during the Seminole Wars (FDOS 2010). In addition, a cultural resources inventory completed for an EIS for the Florida Gas Transmission Company, LLC Phase VIII Expansion Project has identified five archaeological sites and nine historic structures in a stretch of expansion area called Greenfield 3. This area crosses four counties, including Highlands, and runs along the border of Glades and Highlands counties. Five of the nine historic structures are considered “potentially eligible” with Florida SHPO concurrence.

Building Impacts

To accommodate building two new nuclear generating units on the Highlands site, PEF would need to clear land for the main power plant site as described in Section 9.3.4.1 of this EIS. If the Highlands site were chosen for the proposed project, identification of cultural resources would be accomplished through cultural resource surveys and consultation with the SHPO, Tribes, and interested parties. The results would be used in the site-planning process to avoid cultural resources impacts. If significant cultural resources were identified by these surveys, the review team assumes that PEF would develop protective measures in a manner similar to those for the LNP site, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could destabilize important attributes of historic and cultural resources.

There are no existing transmission-line corridors connecting to the Highlands site. Section 9.3.4.1 describes the proposed transmission-line corridors associated with this site.

Visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest. If the Highlands site were chosen for the proposed project, the review team assumes that PEF would conduct its transmission-line-related cultural resource surveys and procedures in a manner similar to that for the LNP site described in Section 4.6. In addition, the review team assumes the State of Florida's Conditions of Certification regarding transmission-line siting and building activities would apply, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could destabilize important attributes of historic and cultural resources.

Operations Impacts

Impacts on historic and cultural resources from the operation of two new nuclear generating units at the Highlands site would include those associated with the operation of new units and maintenance of transmission lines. The review team assumes that the same procedures currently used by PEF, including the State of Florida's Conditions of Certification, would be used for onsite and offsite maintenance activities. Consequently, the incremental effects of the maintenance of transmission-line corridors and operation of the two new units and associated impacts on the cultural resources would be negligible for the physical and visual APEs.

Cumulative Impacts

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include rural development and agricultural development and activities associated with these land-disturbing activities such as road development. Table 9-19 lists past, present, and reasonably foreseeable projects and other actions that may contribute to cumulative impacts on historic and cultural resources in the geographic area of interest. Projects from Table 9-19 that are evaluated in the cultural resources cumulative analysis include future urbanization and the Florida Gas Transmission (FGT) Phase VIII Expansion project.

Long linear projects such as new or expanded roads or the FGT Phase VIII Expansion may intersect the proposed transmission-line corridors. Because cultural resources can likely be avoided by long linear projects, impacts on cultural resources would be minimal. If building associated with such activities results in significant alterations (both physical alteration and visual intrusion) of cultural resources in the transmission-line corridors, then cumulative impacts on cultural resources would be greater.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the Highlands site and other projects would be SMALL. This impact-level determination reflects no known cultural resources that could be affected;

however, if the Highlands site were to be developed then cultural resource surveys and evaluations would need to be conducted and PEF would assess and resolve the adverse effects of the undertaking. Adverse effects could result in greater cumulative impacts.

9.3.4.8 Air Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affected air quality, including the shutdown of two coal-fired units at CREC, and other Federal and non-Federal projects listed in Table 9-19. The geographic area of interest for the Highlands site is Highlands and Glades counties, which are in the Southwest Florida Intrastate Air Quality Control Region (40 CFR 81.97).

The emissions related to building and operating a nuclear plant at the Highlands site would be similar to those at the LNP site. The air quality status for Highlands County, as set forth in 40 CFR 81.310, reflects the effects of past and present emissions from all pollutant sources in the region. Highlands County is classified as being in attainment for all NAAQSs.

The atmospheric emissions related to building and operating a nuclear plant at the LNP site in Levy County, Florida, are described in Chapters 4 and 5. Emissions of criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of criteria pollutants at the LNP site were evaluated and also determined to have a SMALL impact.

Cumulative Impacts

Reflecting on the projects listed in Table 9-19, all industrial projects listed in the table would have *de minimis* impacts. The impact of the closing of two coal-fired units at CREC on criteria pollutants at the Highlands site are not considered because the CREC is located outside of the geographic area of interest for this site. Given the small amount of emissions from this project, it is unlikely that the air quality in the region would degrade to the extent that the region would be declared to be in nonattainment for any of the NAAQSs.

The air quality impact of the Highlands site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects, including the aforementioned sources in Table 9-19, that would have emissions during site development that would, in combination with emissions from the Highlands site, result in a degradation of air quality in the region.

Releases from the operation of two new units at the Highlands site would be intermittent and made at low altitudes with little or no vertical velocity. The air quality impacts of current emissions near the Highlands site are included in the baseline air quality status. The cumulative impacts from emissions of effluents from the Highlands site and other sources would not be noticeable.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.6. The impacts of the emissions are not sensitive to the location of the source. Consequently, the discussion in Section 7.6 is applicable to a nuclear power plant located at the Highlands site. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable. The review team further concludes that the cumulative impacts would be noticeable, with or without the GHG emissions of the project at the Highlands site or the potential shutdown of the fossil-fuel units at CREC.

Cumulative impacts on air quality resources are estimated based on the information provided by PEF and the review team's independent evaluation. Other past, present, and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions from the Highlands site and other projects would not be noticeable. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable. The review team further concludes that cumulative impacts from construction, preconstruction, and operations, and other past, present, and reasonably foreseeable future actions on air quality resources in geographic areas of interest would be SMALL for criteria pollutants and MODERATE for GHG emissions. The incremental contribution of impacts on air quality resources from building and operating two new units at the Highlands site would be insignificant for both criteria pollutants and GHG emissions.

9.3.4.9 Nonradiological Health

The following analysis assesses impacts from building activities and operations for the Highlands site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect nonradiological health, including the other Federal and non-Federal projects listed in Table 9-19. Impacts from building activities that have the potential to affect the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and the increased traffic associated with the transport of construction materials and personnel to and from the site. The operation-related activities that have the potential to affect the health of members of the public and workers includes exposure to etiological agents, noise, EMFs, and impacts from the transport of workers to and from the site.

Most of the nonradiological health impacts associated with building and operation (e.g., air emissions, noise, occupational injuries) would be limited to areas within approximately 2 mi from the site. Occupational injuries would occur only within the boundaries of the site, and noise from construction and operation has likewise been assessed as minimal for offsite receptors beyond a 2-mi radius. For nonradiological health impacts associated with transmission lines, the geographic area of interest would be the transmission-line corridor. If the facility were built and operated at the Highlands alternative site, the Kissimmee River would serve as the source and discharge receptor of cooling water. In addition, a reservoir would need to be built to assure an adequate cooling-water supply.

Building Impacts

Nonradiological health impacts on construction workers and members of the public from building two new nuclear units at the Highlands site would be similar to those evaluated in Section 4.8 for the LNP site. The impacts include noise, vehicle exhaust, dust, occupational injuries, and transportation accidents, injuries, and fatalities. A detailed noise study has not been performed for the Highlands site, but it is likely that noise impacts from building, except for rare, high-noise activities such as pile-driving, would comply with State and local noise ordinances and that the overall noise impact associated with building would be minimal. Fugitive dust and vehicle emissions during building would be controlled by good management practices and compliance with Federal, State, and local air quality regulations.

The incidence of construction worker accidents would be the same as that for the LNP site, the only difference being potential injuries associated with cooling reservoir construction.

Analyses in Section 9.3.4.5 indicated that noticeable but intermittent traffic impacts would be observed during peak building activities at the Highlands site at the intersection of SR-70 and the site access road. These impacts would be of the same magnitude as those predicted for building at the LNP site. Owing to the rural nature of the Highlands site, there is little potential for cumulative impacts with other projects, and additional injuries and fatalities from traffic accidents involving transportation of materials and personnel for building of a new nuclear power plant at the Highlands site would be similar to those estimated in Section 4.8.3 for building at LNP site.

Except for the recently completed FGT Phase VIII Expansion Project, the past, present, or potential future construction projects identified in Table 9-19 are distant (greater than 10 mi) from the Highlands site, so combined nonradiological impacts from construction at the Highlands site and other projects would not occur. Cumulative impacts of building at the Highlands alternative site would therefore be minimal.

Operational Impacts

Noise, air emissions, and occupational injuries from the operation of two new nuclear units at the Highlands site would be similar to those evaluated in Section 5.8 for the LNP site. Occupational health impacts on workers (e.g., falls, electric shock, or exposure to other hazards) at the Highlands site would be the same as those evaluated for workers at two new units operating at the LNP site. The cooling-system discharge from the facility could encourage the growth of etiologic organisms in the Kissimmee River. Etiological agent growth could be reduced by the use of biocides in the cooling systems, thermal discharge would be restricted by NPDES permit limitations, and exposure to impaired water would be limited by controls on access to the discharge zone (fencing, signage, and other security measures). However, because discharge may amount to a significant proportion of minimum flows in the Kissimmee River, and because water quality in the river has been identified as impaired due to the of presence of nutrients, fecal coliform, depressed dissolved oxygen, un-ionized ammonia, and other pollutants (FDEP 2010d), the review team has concluded that the discharge of blowdown to the river could have a noticeable effect on the growth of etiological agents. Exposure to etiological agents in the cooling-water reservoir would not pose an additional health risk as long as access to the reservoir is limited by virtue of its being within the controlled and fenced site boundaries.

Noise and EMF exposure from operations would be monitored and controlled in accordance with applicable OSHA regulations. Although no detailed noise modeling has been performed for the Highlands site, it is likely that noise impacts would be similar to those predicted for operations at the LNP site. The effects of EMF on human health in the transmission-line corridors would be controlled and minimized by conformance with NESC criteria and adherence to the standards for transmission systems regulated by the FDEP. Nonradiological impacts of traffic associated with the operations workforce would be less than the impacts during building (minimal).

A number of the projects and activities identified in Table 9-19 (stormwater discharges, minor permitted municipal discharges) might also affect water quality in the Kissimmee River near the Highlands site. However, these releases are unlikely to have significant cumulative impacts on water quality with a nuclear facility built at the Highlands site because all of the current and future projects are distant from the site. In addition, chemicals released from the nuclear facility would be limited by an NPDES permit to levels that would not adversely affect water quality, even in combination with the existing pollutant load in the Kissimmee River. As noted above, however, blowdown discharge may result in increased water temperature that could facilitate the growth of etiological agents.

The review team is also aware of the potential climate changes that could affect human health; recent analyses of these issues (GCRP 2009) have been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature and a decrease in precipitation, which may alter the presence of microorganisms and parasites in surface water. While the overall impacts of climate change may not be insignificant (see Section 7.7), the effect of, or contribution to, climate change impacts by the operation of two new units at the Highlands site is likely to be minor. In its analysis of climate change impacts, the review team did not identify any additional information that would alter its conclusion regarding the presence of etiological agents or change in the incidence of waterborne diseases associated with operation of a nuclear facility at the Highlands site.

Summary

The assessment of impacts on nonradiological health from building and operation of the two new units at the Highlands alternative site is based on the information provided by PEF and the review team's independent evaluation. The review team concludes that nonradiological health impacts on workers and the public resulting from building two new units and associated transmission lines at the Highlands site would be minimal. The review team also expects that the nonradiological health impacts to the workers and public from the operations of two new nuclear units at the Highlands site would be minimal, except for the potential growth of etiological agents in the Kissimmee River from the influence of blowdown discharges during droughts or low-flow periods. These effects could be reduced if the blowdown were discharged to the cooling reservoir, rather than directly to the river. Exposure to etiological agents could be increased if access to the cooling reservoir is not limited by physical and administrative controls. Based on these findings, the review team concludes that cumulative impacts on nonradiological health from related past, present, and future actions in the geographic area of interest and building and operation of two nuclear units at the Highlands site would be SMALL to MODERATE. The severity of impacts would depend on the design characteristics of the facility, which have not been fully defined. If exposure to water heated by thermal discharge is not limited by administrative or physical controls, the contribution from building and operations at the Highlands site could be a significant contributor to the cumulative nonradiological health impacts.

9.3.4.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts from building activities and operation for two additional nuclear units at the Highlands site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects listed in Table 9-19. As described in Section 9.3.4, the Highlands site is a greenfield site. The geographic area of interest is the area within a 50-mi radius of the Highlands site. The St. Lucie Units 1 and 2 nuclear power plants are located approximately 50 mi from the Highlands site. There are no other major facilities that result in regulated exposures to the public or biota within 50 mi of the Highlands site. However, there are likely to be hospitals and industrial facilities with 50 mi of the Highlands site that use radioactive materials.

The radiological impacts of building and operating two AP1000 units at the Highlands site would include direct radiation and liquid and gaseous radioactive effluents. The cow-milk pathway doses at this site would be higher than at the LNP site because of the proximity of dairies, but doses would still be within regulatory limits. Releases of radioactive materials and all pathways of exposure would produce low doses to people and biota offsite, well below regulatory limits. The impacts are expected to be similar to those estimated for the LNP site. The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Highlands site. This conclusion is based on the radiological monitoring programs conducted around currently operating nuclear power plants.

The radiological impacts of existing St. Lucie Units 1 and 2 also include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around the St. Lucie site.

Based on the information provided by PEF and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 units and other past, present, and reasonably foreseeable projects and actions in the geographic area of interest around the Highlands site would be SMALL.

9.3.4.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the Highlands site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including the other Federal and non-Federal projects and those projects listed in Table 9-19. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Highlands site. The Highlands site is a greenfield site about 50 mi west of the existing St. Lucie power plant site; there are two nuclear facilities at the St. Lucie site. There are no proposed reactors that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Highlands site.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the LNP site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet the NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorological conditions of the Highlands and LNP sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Highlands site would be minimal.

Assuming the meteorology, population distribution, and land use for the Highlands site are similar to the LNP site, risks from a severe accident for an AP1000 reactor located at the Highlands site are expected to be similar to those analyzed for the LNP site. These risks for the LNP site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For the existing plants within the geographic area of interest, namely St. Lucie Units 1 and 2, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR Part 51, Appendix B, Table B-1). If the NRC approves the requested power uprates at St. Lucie Units 1 and 2, its approval will be based, in part, on the NRC staff's determination that the risk implications of the planned power uprate is acceptable. Therefore, the impact would continue to be SMALL. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Highlands site would be SMALL.

9.3.5 Putnam Site

This section covers the review team's evaluation of the potential environmental impacts of siting a new two-unit nuclear power plant at the Putnam alternative site (hereafter Putnam site) in northeastern Florida. The site is located in a rural area of Putnam County west of the St. Johns River. The St. Johns River would be the source for water for plant cooling and other plant uses, and construction of a new water-storage reservoir would be required. Putnam is a greenfield site not currently owned by PEF (PEF 2009b). Conceptual routes of transmission lines necessary to connect the Putnam site to the electrical grid are located in Marion, Lake, Volusia, Seminole, Hillsborough, Polk, Pinellas, and Putnam counties (CH2M HILL 2010).

The following sections include a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if implemented at the Putnam site and other actions in the same geographic area were considered. This assessment includes the impacts of the NRC-authorized construction and operations and impacts of preconstruction activities. Also included in the assessment are past, present, and reasonably foreseeable future Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Putnam site. Other actions and projects considered in this cumulative analysis are described in Table 9-25.

The geographic area of interest for cumulative impacts considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Putnam site. An accident at a nuclear plant within 100 mi of the Putnam site could increase this risk. The Crystal River Nuclear Plant (CREC Unit 3) is within 100 mi of the Putnam site and is included in Table 9-25. Other nuclear plants in Florida, Alabama, and Georgia are more than 100 mi from the Putnam site and are therefore not included in the cumulative impact analysis.

Table 9-25. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Analysis of the Putnam Alternative Site

Project Name	Summary of Project	Location	Status
Energy Projects			
Seminole Power Plant	Two 650-MW coal-fired generation units	Within 10 mi	Operational (SEC 2010)
Putnam Steam Power Plant	Two combined-cycle gas/oil units generating a total net 494 MW	Within 10 mi	Operational (EPA 2010k)
Operation and decommissioning of CREC Units 1–5	The CREC consists of five power-generating plants operated by PEF; four fossil-fuel plants and one nuclear plant. The fossil-fuel plants began operations in 1966, 1969, 1982, and 1984. The nuclear plant began operations in 1977.	Within 100 mi of the Putnam site in northern Citrus County	Operational. The nuclear plant (Unit 3) is shut down due to damage to the containment. The State of Florida Siting Board's Conditions of Certification for LNP would require PEF to discontinue the operations of the two fossil-fuel units by December 31, 2020, assuming licensing, construction, and commencement of operation of LNP occurs in a timely manner (PEF 2011e; DOE/EIA 2010b; FDEP 2011b).
Renewal of the CREC nuclear Unit 3 operating license	Extension of operations of CREC Unit 3 for an additional 20-year period beyond the end of the current license term, which is valid through midnight December 3, 2016.	Within 100 mi of the Putnam site in northern Citrus County	Proposed. If granted, the license renewal would provide PEF the authority to continue operations through 2036. The draft Supplemental EIS for the license renewal was issued May 26, 2011 (NRC 2011b).
Uprate at CREC Unit 3	CREC Unit 3 has requested an uprate to increase the maximum power level at which the nuclear power plant may operate.	Within 100 mi of the Putnam site in northern Citrus County	Proposed. The application submitted to the State of Florida was approved in August 2008. A Federal application was submitted to the NRC in 2011 (PEF 2011f).

Table 9-25. (contd)

Project Name	Summary of Project	Location	Status
Mining Projects			
Surface mining	Excavation of sand, gravel, and other minerals, including the Grandin Sand Mine and the Keuka Sand Mine.	Throughout region	Operational and inactive
Parks and Conservation Areas			
Parks, forests, and reserves	Several parks, recreation, and conservation areas are located within the 50-mi region, for example the Ocala National Forest and the St. Johns River Blueway.	Throughout region	Currently managed by various local, State, and Federal agencies and organizations. Development likely limited in these areas (St. Johns County 2010).
Other Actions/Projects			
Minor water dischargers	NPDES-permitted dischargers including Putnam County Central Landfill, City of Palatka WWTP, E. Putnam County WW System, Hiawatha Condominiums WWTP, Georgia Pacific paper mill, and others.	Throughout region	Operational
Hard Rock Material	Concrete batch plant and ready-mixed concrete plant	Within 10 mi	Operational (EPA 2010l)
Various hospitals and industrial facilities that use radioactive materials	Medical and other industrial isotopes	Within 50 mi	Operational in nearby cities and towns
Future urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroads, such as SR-20 improvements; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents.	Throughout region	Construction would occur in the future, as described in State and local land-use planning documents (Putnam County 2006).

WW = wastewater; WWTP = wastewater-treatment plant

9.3.5.1 Land Use and Transmission Lines

The following analysis includes impacts from building and operating two nuclear units at the Putnam site, along with the necessary transmission lines to connect them to the grid. The analysis also considers other past, present, and reasonably foreseeable future actions that affect land use, including the other Federal and non-Federal projects listed in Table 9-25. For this analysis, the geographic area of interest for considering cumulative impacts is the area within a 20-mi radius of the Putnam site and the associated transmission-line corridors. The review team determined that a 20-mi radius would represent the smallest area that would be directly affected because it includes the primary communities (such as Palatka, East Palatka, and Satsuma) that would be affected by the proposed project if it were located at the Putnam site. The review team is aware that PEF has made minor revisions (PEF 2011a; CH2M HILL 2010) to the proposed site layout and associated offsite facilities in coordination with USACE to minimize impacts on wetlands. These minor changes did not change the land-use impact determinations since the DEIS, therefore the following evaluation was completed with original information provided by PEF and was not updated.

The Putnam site is located in Putnam County, Florida. Historically, the geographic area of interest was known for forestry and agriculture. Existing land uses in the area include forestry, agriculture, and low-density residential. The Putnam site is not subject to the Florida Coastal Zone Management Act because the site is not located within one of the designated Florida coastal zone counties. The Ocala National Forest and the St. Johns River Blueway are located within the 50-mi region.

Zoning changes would be needed to accommodate building and operation of a nuclear power plant at the Putnam site. Like the LNP site, the footprint of new power-generating units would be approximately 627 ac, with about 150 ac of additional land needed for temporary facilities and laydown yards. In addition, PEF indicates that a 1291-ac reservoir would be needed at the Putnam site to provide cooling water during periods of low flow of the St. Johns River (PEF 2009a; CH2M HILL 2010). Construction of these facilities would result in a permanent land-use change from agriculture and forestry to a transportation, communications, and utilities land-use category. As shown in Table 9-25, there are coal-fired and combined-cycle gas/oil power plants, sand/gravel mines, and a concrete batch plant currently operating in the geographic area of interest around the Putman site.

Additional land-use impacts include possible additional growth and land conversions to accommodate new workers and services. Because the workforce would be dispersed over larger geographic areas in the labor supply region, the impacts from land conversion for residential and commercial buildings induced by new workers relocating to the local area can be absorbed into the wider region. Therefore, the review team concludes that such impacts would be minimal.

There are no existing transmission lines or transmission-line corridors in the geographic area of interest around the Putnam site. New transmission lines would need to be constructed to connect the site to existing transmission lines. The transmission lines would run through counties designated under the Florida Coastal Management Program. Any expansion of these transmission-line corridors would require review under the procedures established under the Florida Coastal Management Program. Procedures for siting new transmission lines in Florida are discussed in Section 4.1.2. The review team assumes that the Conditions of Certification issued to PEF by the FDEP would apply at all of the alternative sites.

The review team estimated the linear run of the expected transmission-line corridors by referring to PEF Figure 3.2.3-15 (PEF 2009a), which depicts the potential routing of corridors needed to connect the Putnam units to the grid. That figure suggests that 215 mi of transmission-line corridor would be needed. For purposes of land-use impact analysis, the review team made the assumption that 10 ac/mi would be disturbed, based on the LNP case where 1790 ac are expected to be disturbed over the 180 mi of corridor, as discussed in Section 4.1.2. The review team concludes that this assumption is reasonable because siting in Florida is a relatively rigorous process (Site Certification Application process), and the applicant would be bound by permit conditions resulting from that process, which would force it to use existing corridors to the extent practicable. The review team expects the SCA process would be consistently applied anywhere transmission lines are proposed in Florida. Therefore, the review team concludes that about 2150 ac of land would be disturbed to construct the transmission-line corridors for the Putnam site. Similar to the case at the LNP site, the review team concludes that land-use impacts from developing about 215 mi of new transmission-line corridors to connect new units at the Putnam site would be noticeable, but not destabilizing, and additional mitigation beyond the measures and conditions identified would not be warranted.

Cumulative Impacts

Future urbanization could contribute to additional decreases in open areas, forests, and wetlands and generally result in some increased residential and industrialized areas. However, growth would likely be limited since the population is projected to increase by approximately 1 percent per year during the period from 2000 to 2015 (Putnam County 2006). Increased urbanization, especially long linear projects such as new or expanded roads or pipelines, would also contribute to the loss of open or forested areas and increase fragmentation of habitats along or near the transmission lines. Due to the extent of new transmission lines that would be built, the review team expects that the corridors would have a noticeable impact on the local area. Development would likely be limited in the nearby parks and conservation areas. Therefore, the incremental impacts associated with increased urbanization would be minimal.

Global climate change could increase temperature and reduce precipitation, which could result in reduced crop yields and livestock productivity (GCRP 2009), which, in turn, may change portions of agricultural and ranching land uses in the geographic area of interest. In addition, global climate change could increase sea level and storm surges in the geographic area of interest (GCRP 2009), thereby changing land use through inundation and loss of coastal wetlands and other low-lying areas. However, existing forests, parks, reserves, and managed areas would help preserve wetlands and forested areas to the extent that they are not affected by a rise in sea level. Because other projects identified in Table 9-25 that are within the geographic area of interest would be consistent with applicable land-use plans and control policies and would occur in dispersed locations, the review team considers their contribution to the cumulative land-use impacts to be relatively minor and manageable. Because detailed information concerning the routing of the possible new transmission-line corridors is not known at this time, a complete evaluation of potential land-use impacts cannot be made.

In the State of Florida's Conditions of Certification (FDEP 2011b), CREC Unit 1 and 2, two coal-fired plants, would stop operating by December 31, 2020, as long as PEF completes the licensing process, building activities, and commences commercial operation of LNP Units 1 and 2 within a timely manner. If the Putnam site were selected, the review team expects the same condition would apply. If CREC Units 1 and 2 are shut down, land use at the units likely would remain industrial. Depending on economic conditions, PEF sells 60 to 95 percent of the coal plant ash to cement and building materials manufacturers, with the remainder going to Citrus Central Landfill in Lecanto, Florida. With the closure of CREC Units 1 and 2, this source of ash no longer would be available locally. The review team expects land-use impacts associated with the closure of CREC Units 1 and 2 would be minimal.

Based on the information provided by PEF and the review team's own independent review, the review team concludes that the land-use impacts of building and operating two new nuclear reactor units at the Putnam site and other projects would be MODERATE. The proposed project would be a significant contributor to the MODERATE impact due to the substantial amount of land that would be needed for the proposed power plant, reservoir, and transmission infrastructure.

9.3.5.2 Water Use and Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affect water use and quality, including the other Federal and non-Federal projects listed in Table 9-25. The Putnam site is located in rural Putnam County in Florida near the St. Johns River. PEF has indicated that the development of this site for two nuclear units would require the building of a water reservoir on the Putnam site supplied with water from the St. Johns River (PEF 2009b).

The geographic area of interest for the Putnam site is considered to be the drainage basin of the St. Johns River upstream and downstream of the site because this is the resource that would be affected by the proposed project. For groundwater, the ROI is limited to the alternative site because PEF has indicated no plans for use of groundwater to build and operate the plant (CH2M HILL 2010).

PEF indicates that the primary source of water for the site would be the St. Johns River. Groundwater is considered an unavailable or unreliable resource for large quantities of cooling water at all of the alternative sites; in addition, permitting large groundwater withdrawals for industrial use is generally inconsistent with State policy (CH2M HILL 2010). This analysis therefore assumes that groundwater would not be used during the building or operation of the two units at this site and that all water needs would be met with surface water from the St. Johns River.

Surface water is available at the site from the St. Johns River. Historical flow data for October 1992 through the present are available for the St. Johns River at Buffalo Bluff near Satusma, Florida (USGS 2009). Mean monthly flow for the historic record ranges from 1840 cfs in May to 7445 cfs in November. Minimum monthly flows have fallen below 230 cfs at times.

Building Impacts

The review team assumes that the surface-water use for building activities at the Putnam site would be identical to the proposed groundwater use for the LNP site. During building at the LNP site the total maximum usage is projected to be 550,000 gpd (0.85 cfs) and the projected average estimated maximum groundwater usage is 275,000 gpd (0.43 cfs) (see Table 3-2). This assumes that surface water would be used at the Putnam site for potable and sanitary use as well as various building related activities. This surface-water withdrawal rate is inconsequential when compared to the historic flow in the St. Johns River. The review team concludes that the impact of surface-water use for building the potential units at the Putnam site would be minimal because withdrawal is small compared to the average monthly flow and withdrawal from the river would be temporary and limited to the building period.

As stated above, the review team assumed that no groundwater would be used to build the units at the Putnam site. The review team also assumes that the impact of dewatering the excavations needed for building two units at the site would be managed through the installation of diaphragm walls and grouting as is proposed for the LNP site. Therefore, because there would be no groundwater use and the impact of dewatering would be controlled, the review team determined that there would be little or no impact on groundwater resources.

Surface-water quality would most likely be affected by surface-water runoff during site preparation and the building of the facilities. FDEP would require PEF to develop an E&SCP and a SWPPP (PEF 2009b). These plans would be developed before initiation of site-disturbance activities and would identify measures to be used during site-preparation activities to mitigate erosion and control stormwater runoff (PEF 2009b).

The plans would identify BMPs to control the impacts of stormwater runoff. The review team anticipates that PEF would construct new detention/infiltration ponds and drainage ditches to control delivery of sediment from the disturbed area to onsite waterbodies. Sediment carried with stormwater from the disturbed area would settle in the detention ponds and the stormwater would infiltrate into the shallow aquifer. Implementation of BMPs should minimize impacts on surface-water bodies near the Putnam site. Therefore, the surface-water-quality impacts near the Putnam site would be temporary and minimal.

While building new nuclear units at the Putnam site, groundwater quality may be affected by leaching of spilled effluents into the subsurface. The review team assumes that the BMPs PEF has proposed for the LNP site would be in place during building activities, and therefore the review team concludes that any spills would be quickly detected and remediated. In addition, groundwater impacts would be limited to the duration of these activities, and therefore, would be temporary. The review team reviewed the general BMPs that could be expected to be required at such a site (FDEP 2011b). Because any spills related to building activities would be quickly remediated under BMPs and the activities would be temporary, the review team concludes that the groundwater-quality impacts from building at the Putnam site would be minimal.

Operational Impacts

The Putnam site was identified by PEF as needing a cooling-water storage reservoir to meet plant cooling needs during periods of low flow. The review team assumed that the cooling water system for the proposed units, if they were to be built and operated at the Putnam site, would be similar to that proposed at the LNP site; specifically, the cooling water system would use cooling towers and blowdown would be discharged to the St. Johns River. The cooling-water reservoir would provide capacity for times when adequate water from the river may not be available. PEF did not provide details of the cooling-water intake and effluent discharge locations. However, it is standard practice for power plants to design cooling-water intake and effluent discharge locations such that recirculation of discharged effluent to the intake does not occur. The reservoir was sized assuming that the plant would operate on four cycles of concentration, that the total cooling-water requirements would be 45 Mgd (31,250 gpm) and that storage of a 90-day supply of water would be needed. In determining the acreage needed to achieve this amount of storage PEF assumed the reservoir would have an effective depth of 10 ft. PEF indicates that the resulting reservoir size would be 1291 ac (PEF 2009a; CH2M HILL 2010).

PEF indicates that the water needed to operate two units would be approximately 40,000 gpm or 89 cfs. As indicated in Chapter 3, evaporative losses from cooling two units would be approximately 28,000 gpm (62 cfs). A withdrawal of 89 cfs represents approximately 5 percent of the lowest mean monthly flow for the period of record. Flow in individual months has been much lower, which supports the need for a water reservoir on the Putnam site supplied with water from the St. Johns River. Minimum flows have been established for the St. Johns River (Fla. Admin. Code 40c-8). Minimum flows are specified for frequent high, average, and frequent low flow conditions of the river near DeLand, approximately 75 mi upstream of the Putnam site. The minimum flow values corresponding to frequent high, average, and frequent low flow conditions are 4600, 2050, and 1100 cfs, respectively. The withdrawal of 89 cfs would be 8 percent of the minimum recommended frequent low flow in the river. Based on the indication that the water needed to operate two units at the Putnam site would be less than 5 percent of the lowest mean monthly flow and 8 percent of the minimum recommended frequent low flow, the review team determined that the operational surface-water-use impact of a potential plant at the Putnam site would be minor.

As stated above, the review team assumed that no groundwater would be used to operate the units at the Putnam site. Therefore, because there would be no groundwater use, the review team determined that there would be no impact on groundwater resources.

During the operation of two new nuclear units at the Putnam site, impacts on surface-water quality could result from stormwater runoff, discharges of treated sanitary and other wastewater, and blowdown from cooling towers into the receiving waterbody. PEF did not provide the blowdown rate at the Putnam site. The review team conservatively assumed that the blowdown rate would be the same as that at the LNP site, 57,923 gpm (129 cfs). This assumption is conservative because the proposed plant at the Putnam site would use freshwater from the St. Johns River rather than more saline water at the LNP site, requiring less frequent and smaller blowdown discharge. FDEP would require PEF to develop a SWPPP (PEF 2009b), which would identify measures to be used to control stormwater runoff (PEF 2009b). The blowdown would be regulated by FDEP pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by FDEP in a NPDES permit.

During the operation of two new nuclear units at the Putnam site, impacts on groundwater quality could result from potential spills. Spills that might affect the quality of groundwater would be prevented and mitigated by BMPs. Because BMPs would be used to mitigate spills and no intentional discharge to groundwater should occur, the review team concludes that the groundwater-quality impacts from operation of two nuclear units at the Putnam site would be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative analysis considers past, present, and reasonably foreseeable future actions that affect the same water resources.

For the cumulative analysis of impacts on surface water, the geographic area of interest for the Putnam site is considered to be the drainage basin of the St. Johns River upstream and downstream of the site because this is the resource that would be affected by the proposed project. For groundwater, the ROI is limited to the alternative site because PEF has indicated no plans for use of groundwater to build and operate the plant. Actions that have past, present, and future potential impacts on water supply and water quality near the Putnam site include the Seminole Power Plant and the Putnam Steam Power Plant (both located within 20 mi of the Putnam site), existing agriculture, and existing and future urbanization in the region.

The GCRP has compiled the state of knowledge in climate change. This compilation has been considered in the preparation of this EIS. The projections for changes in temperature, precipitation, droughts, and increasing reliance on aquifers within the St. Johns River drainage basin are similar to those at other alternative sites in Florida. Such significant changes in climate would result in adaptations to both surface-water and groundwater management practices and policies that are unknown at this time.

Cumulative Water Use

PEF indicates that the water needed to operate two units would be approximately 40,000 gpm or 89 cfs. As indicated in Chapter 3, evaporative losses from cooling two units would be approximately 28,000 gpm (62 cfs). PEF indicates that a reservoir would be needed to provide cooling water during periods of low flow. A withdrawal of 89 cfs represents approximately 5 percent of the lowest mean monthly flow for the period of record. Flow in individual months has been much lower, which supports PEF's statement that a water reservoir on the Putnam site supplied with water from the St. Johns River would be needed.

Based on the indication that the water needed to operate two units at the Putnam site would be less than 5 percent of the lowest mean monthly flow and 8 percent of the minimum recommended frequent low flow, the review team determined that the operational surface-water-use impact of a potential plant at the Putnam site would be minor.

The impacts of the other projects listed in Table 9-25 are considered in the analysis included above or would have little or no impact on surface-water use. The effects of withdrawals by large existing surface-water users (such as by the two power generating stations mentioned above, and local agricultural and municipal users) are already reflected in historical streamflow data provided by the USGS. Other projects, that would have little impact, are excluded from the analysis either because they are too distant from the Putnam site, or use relatively little or no surface water, or have little or no discharge to surface water. Some projects (for example park and forest management) are ongoing, and changes in their operations that would have large impacts on surface-water use appear unlikely. As stated above, minimum flows have been established for the St. Johns River (Fla. Admin. Code 40c-8). A withdrawal of 89 cfs would be 8 percent of the minimum recommended frequent low flow in the river. Therefore, the review team concludes that cumulative impacts on surface-water use would be MODERATE. Building and operating the proposed units at the Putnam site would not be a significant contributor to the cumulative impact on surface-water use of St. Johns River.

As stated above, the review team assumed that no groundwater would be used to build or operate the units at the Putnam site and that groundwater impacts from dewatering would be controlled with diaphragm walls and grouting. Therefore the review team determined that there would be minimal impact on groundwater resources. The impacts of the other projects listed in Table 9-25 are considered in this analysis or would have little or no impact on groundwater use. Therefore, the review team concludes that cumulative impacts on groundwater use would be SMALL.

Cumulative Water Quality

Point and non-point sources have affected the water quality of the St. Johns River upstream and downstream of the site. The FDEP, under the Federal Water Pollution Control Act (Clean Water Act) Section 305(b), prepares a statewide Water Quality Inventory. The FDEP also identifies impaired waterbodies during this process and lists them on the 303(d) List. The 303(d) List of Waters reports on streams and lakes identified as being impaired for one or more pollutants and that do not meet one or more of the water-quality standards. The lower St. Johns River appears on Florida’s list of impaired waters because of the presence of nutrients, fecal coliform, depressed dissolved oxygen, turbidity, dioxin, iron, lead, zinc, and mercury in fish tissue (FDEP 2009e); therefore, the review team concludes that the cumulative impact on surface-water quality of the receiving waterbody would be MODERATE. Water-quality information presented above for the impacts of building and operating the new units at the Putnam site would also apply to evaluation of cumulative impacts. As mentioned above, the State of Florida would require PEF to develop a SWPPP (PEF 2009b), which would identify measures to be used to control stormwater runoff (PEF 2009b). The blowdown would be regulated by EPA pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by FDEP in a NPDES permit. Such permits are designed to protect water quality. Past and present action in the region has noticeably affected surface-water quality adversely. Therefore, the review team concludes that building and operating the proposed units at the Putnam alternative site would not be a significant contributor to impacts on surface-water quality because industrial and wastewater discharges from the proposed units would comply with NPDES permit limitations and any stormwater runoff from the site during operations would comply with the SWPPP (PEF 2009b).

The review team also concludes that with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the Putnam site would likely be minimal. Therefore, the cumulative impact on groundwater quality would be SMALL. The impacts of other projects listed in Table 9-25 are either considered in the analysis included above or would have little or no impact on surface-water and groundwater quality.

9.3.5.3 Terrestrial and Wetland Resources

Site Description

The following impact analysis includes direct, indirect, and cumulative impacts from construction and preconstruction activities and operations on terrestrial and wetland resources. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including the other Federal and non-Federal projects and the projects listed in Table 9-25. For the analysis of terrestrial ecological impacts at the Putnam site, the geographic area of interest is considered to be a 20-mi-wide area centered on the Putnam site and the associated offsite and transmission-line corridors. This 20-mi radius is expected to encompass the locations of possible development projects potentially capable of substantially influencing terrestrial and wetland ecological resources on and close to the Putnam project site. This area includes watersheds providing direct runoff from the Putnam site to onsite streams and the St. John's River, as well as the watersheds through which the transmission lines would be routed.

The Putnam site is a greenfield site situated in a rural area in the Eastern Florida Flatwoods ecoregion on the lower St. Johns River, a blackwater river designated as an American Heritage River. The St. Johns River is a wide, meandering, slow-moving river system that drops less than 30 ft as it flows north from its origins in south-central Florida to the Atlantic Ocean near Jacksonville (St. Johns Riverkeeper 2009). Most of the site has been disturbed by previous mining activities, but much has been reclaimed. Land use on and in the vicinity of the Putnam site is mostly forested habitat, with a large proportion of coniferous plantations and forest regeneration areas (CH2M HILL 2010). Habitats found on the Putnam site and in the vicinity are typical of those in the Eastern Florida Flatwoods ecoregion, which include mixed wetland hardwoods, cypress swamps, hydric pine flatwoods, freshwater marshes, and some wet prairies.

The associated transmission-line corridors would begin in the Eastern Florida Flatwoods ecoregion and cross the Central Florida Ridges and Uplands and Southwestern Florida Flatwoods ecoregions. Vegetation community types in the Central Florida Ridges and Uplands ecoregion include sandhill vegetation such as turkey oak, bluejack oak, and longleaf pine for the dominant canopy species along with common understory species of running oak, gopher apple, and bluestem and panicum grasses (USDA 2006). Vegetation community types in the Southwestern Florida Flatwoods ecoregion include slash pine, longleaf pine, cabbage palm, and live oak with typical understory species of saw palmetto, and gallberry.

Important Species

Common wildlife, including important species, associated with the above-mentioned ecoregions that may occur on the Putnam site and associated transmission-line corridors includes Florida recreationally important species such as white-tailed deer, bobcat, feral hog, squirrel, northern bobwhite, and mourning dove, as well as skunk, raccoon, and several species of woodpecker. Various bird, reptile, and amphibian species also have the potential to reside on the Putnam site and associated transmission-line corridors (USDA 2006; FNAI 2009).

No site-specific surveys have been conducted for threatened and endangered species on the site and in the vicinity, offsite corridors, or the associated transmission-line corridors. Table 9-7 lists all Federally and State-listed species that could occur on the Putnam site and in the vicinity, offsite corridors, and in the counties crossed by the transmission-line corridors. Some of these species may at times be found on or in vicinity of the Putnam site and associated offsite corridors. Counties crossed by the transmission-line corridors for the Putnam site would include Hillsborough, Marion, Pinellas, Polk, Putnam, Seminole, Lake, and Volusia counties. PEF has stated that on-the-ground field surveys would be conducted before commencement of ground-disturbing activities on the site and in the offsite corridors and transmission-line corridors as required by the FDEP (PEF 2009b; CH2M HILL 2010; FDEP 2011b).

Building Impacts

Impacts from building two nuclear units and supporting facilities on wildlife habitat would be unavoidable. Activities that would affect wildlife include land clearing and grading (temporary and permanent), filling and or draining of wetlands, increased human presence, heavy equipment operation, traffic, noise, avian collisions, and fugitive dust. These activities would likely displace or destroy wildlife that inhabits the construction areas. Some wildlife, possibly including important species, would perish or be displaced during land clearing for any of the above projects as a consequence of habitat loss, fragmentation, and competition for remaining resources. Less mobile animals, such as reptiles, amphibians, and small mammals, would be at greater risk of incurring mortality than more mobile animals, such as birds, many of which would be displaced to adjacent communities.

Undisturbed land adjacent to disturbed areas could provide habitat to support displaced wildlife, but increased competition for available space and resources could affect population levels. Wildlife would also be subjected to impacts from noise and traffic, and birds could be injured if they collide with tall structures. The impact on wildlife from noise is expected to be temporary and minor. The creation of new transmission-line corridors could be beneficial for some important wildlife species, including those that inhabit early successional habitat or use edge environments, such as white-tailed deer, northern bobwhite, eastern meadowlark, and the gopher tortoise. Birds of prey, such as red-tailed hawks would likely exploit newly created hunting grounds. Forested wetlands within the corridors would be converted to and maintained in an herbaceous or scrub-shrub condition that could provide improved foraging habitat for waterfowl and wading birds. However, fragmentation of upland and wetland forests could affect species that are dependent on large tracts of continuous forested habitat.

To accommodate the building of two nuclear units on the Putnam site, PEF would need to clear approximately 660 ac of terrestrial habitats for the nuclear facility, approximately 335 ac for associated offsite structures and corridors (excluding transmission-line corridors), and an additional 1500 ac of land would need to be cleared and excavated to accommodate a reservoir (See Table 9-26 and Table 9-27) (CH2M HILL 2010).

Table 9-26. Summary of Impacts by Land-Use Class for the Putnam Alternative Site

Land-Use Class (FLUCFCS) (acreage)	Onsite	Reservoir	Offsite Corridors (Except Transmission)	Transmission Corridors[(a)]
Urban and Built Environment (% of area)	276 (42%)	268 (18%)	70 (21%)	1575 (25%)
Agriculture	0 (0%)	0 (0%)	18 (5%)	846 (14%)
Upland Nonforested	25 (4%)	12 (<1%)	8 (2%)	202 (3%)
Rangeland	274 (42%)	720 (48%)	184 (56%)	2175 (35%)
Water	0 (0%)	0 (0%)	2 (<1%)	101 (2%)
Wetlands	77 (12%)	487 (32%)	44 (13%)	716(12%)
Barren Lands	0 (0%)	0 (0%)	4 (1%)	16 (<1%)
Transportation, Communication and Utilities	8 (1%)	13 (<1%)	5 (2%)	581 (9%)

Source: CH2M HILL 2010
(a) Acreages listed for transmission-line corridors are total acres available, not total acres affected.

Table 9-27. Total Terrestrial Habitat Impacts for the Putnam Site

Impact Areas	Acres
Onsite Impact Areas	660
Reservoir Impact Areas	1500
Transmission-Line Corridor Areas	6212[(a)]
Offsite Impact Areas	335
Total Impact Areas	2495 (plus portion of 6212-ac transmission-line corridor)

Source: CH2M HILL 2010
(a) Acreages for transmission lines are total acres available in the corridor, not total acres affected.
(b) If impacts no all lands in the transmission-line corridors reflect the 26 percent total impact estimated by PEF for wetlands (CH2M HILL 2010), those impacts would encompass approximately 26 percent of 6212 ac, or 1615 ac. The review team therefore estimates that the total land requirements for the entire project would be 2495 ac plus 1615 ac, or 4110 ac.

Based upon FLUCFCS land-use data, approximately 77 ac of wetlands would be affected on the site during building (CH2M HILL 2010). Approximately 44 ac of wetlands would be affected in the offsite corridors (CH2M HILL 2010). Approximately 487 ac of wetlands would be affected to excavate the reservoir (CH2M HILL 2010). PEF states that the nuclear facility would be sited to avoid wetlands whenever possible and potential impacts on wetlands near building zones would be minimized through the use of established BMPs (PEF 2009b). Under Federal and State permitting requirements, PEF would be obligated to mitigate any unavoidable construction impacts on jurisdictional wetlands and listed species (FDEP 2011b).

New transmission-system infrastructure would be needed to support a nuclear power facility at the Putnam site. There are no existing transmission lines or transmission-line corridors present on the site. PEF has assumed that transmission lines would be collocated within existing transmission-line corridors to the extent possible, thereby minimizing potential terrestrial impacts (CH2M HILL 2010). In addition, transmission-line corridors, towers, and the access road would be situated to avoid sensitive habitats and species to the extent possible. The likely transmission-line corridors for the Putnam site include approximately 6212 ac, of which approximately 716 ac are wetlands (CH2M HILL 2010). PEF estimated that building the transmission lines would require filling approximately 6 percent of the wetlands in the corridor and clearing woody vegetation from approximately 20 percent of the wetlands in the corridor, resulting in a total impact on approximately 26 percent of the wetlands in the corridor (CH2M HILL 2010). Using these assumptions and the estimate of approximately 716 ac of wetlands in the corridor, the review team estimates that building the transmission lines would require filling approximately 43 ac of wetlands and clearing woody vegetation from approximately 143 ac of additional wetlands, totaling approximately 186 ac of wetland impacts

Under Federal and State permitting requirements, PEF would be obligated to mitigate any unavoidable construction impacts on jurisdictional wetlands and listed species. PEF stated that all land clearing associated with the nuclear facility, offsite structures, and transmission-line creation would be conducted according to Federal, State, and local regulations, permit requirements, existing procedures, and established BMPs (PEF 2009b; FDEP 2011b).

Building two new nuclear reactors at the Putnam site, including the reservoir and offsite corridors (exc excluding transmission-line corridors), would result in the loss of approximately 2495 ac of terrestrial habitat. Clearing land within the 6212-ac transmission-line corridor would also result in a loss of an undetermined amount of terrestrial habitat due to clearing and increase habitat fragmentation along the corridor. If impacts on all lands in the transmission-line corridors reflect the 26 percent total impact estimated by PEF for wetlands (CH2M HILL 2010), those impacts would encompass approximately 26 percent of 6212 ac, or 1615 ac. The total estimated land impact would therefore be approximately 4110 ac. Other sources of impacts on terrestrial resources such as noise, increased risk of collision and electrocution, and displacement of wildlife would likely be temporary and result in minimal impacts on the resource. Because of the extent of unavoidable terrestrial habitat losses, building the two new units would noticeably alter the available terrestrial habitat on and in the landscape surrounding the Putnam site.

Operational Impacts

Impacts on terrestrial ecological resources, including important species, from operation of two new nuclear units at the Putnam site include those associated with transmission system structures, maintenance of transmission-line corridors, and operation of the cooling towers. Also, during plant operation, wildlife would be subjected to impacts from collisions with increased traffic.

Impacts on crops, ornamental vegetation, and native plants from cooling-tower drift cannot be evaluated in detail in the absence of information about the specific location of cooling towers at each alternative site. Similarly, bird collisions with cooling towers cannot be evaluated in the absence of information about the specific location of cooling towers at the 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 nuclear power plants in general, including those with various numbers and types of cooling towers. On this basis, the review team 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 would be minor.

Outdoor noise levels on the Putnam site are predicted to range from 90 dBA near the loudest equipment to 65 dBA in areas more distant from major noise sources (PEF 2009b). Noise modeling predicts not perceptible to slight increases in noise from plant operations at the site boundary (PEF 2009b). Except in areas immediately adjacent to major noise sources, expected noise levels would be below the 60- to 65-dBA threshold at which birds and red foxes (a surrogate for small and medium-sized mammals) are startled or frightened (Golden et al. 1980). Thus, noise from operating cooling towers at the Putnam site would not be likely to disturb wildlife beyond the site boundary. Consequently, the review team concludes that the impacts of cooling-tower noise on wildlife would be minimal.

An evaluation of specific impacts resulting from building of transmission lines and transmission-line corridor maintenance cannot be conducted in any detail due to the lack of information, such as the specific locations of new rights-of-way that could result from transmission system upgrades. However, in general, impacts associated with transmission-line operation consist of bird collisions with transmission lines, EMF effects on flora and fauna, and habitat loss due to corridor maintenance. The impacts associated with transmission-line corridor maintenance activities include alteration of habitat, including wetland and floodplain habitat, due to cutting and herbicide application, and similar related impacts.

Transmission lines and associated structures pose a potential avian collision hazard. Direct mortality resulting from birds colliding with tall structures has been observed (Erickson et al. 2005). Factors that appear to influence the rate of avian impacts with structures are diverse and related to bird behavior, structure attributes, and weather. Migratory flight during darkness by flocking birds has contributed to the largest mortality events. Tower height, location, configuration, and lighting also appear to play a role in avian mortality. Weather, such as low cloud ceilings, advancing fronts, and fog also contribute to this phenomenon. Waterfowl may be particularly vulnerable due to their low, fast flight and flocking behavior (EPRI 1993). Bird collisions with transmission lines are recognized as being of minor significance at operating nuclear power plants, including transmission-line corridors with variable numbers of power lines (NRC 1996). Accordingly, although additional transmission lines would be required for new nuclear units at the Putnam site, increases in bird collisions would be minor and they would likely not be expected to cause a measurable reduction in local bird populations. PEF would also be required to have an Avian Protection Plan in compliance with State certification guidelines (FDEP 2011b). Consequently, the incremental number of bird collisions posed by the addition of new transmission lines for new nuclear units would be negligible.

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). At a distance of 300 ft, the magnetic fields from many lines are similar to typical background levels in most homes. Thus, 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 2003). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2003). Therefore, the incremental EMF impact posed by addition of new transmission lines for new nuclear units would be negligible.

Roads providing access to the existing transmission-line corridors at the Putnam site would likely be sufficient for use in any expanded corridors; however, new roads would be required during the construction of new transmission-line corridors. Management activities (cutting and herbicide application) related to transmission-line corridors and related impacts on floodplains and wetlands in transmission-line corridors are recognized as being of minor significance at operating nuclear power plants, including those with transmission-line corridors of variable widths (NRC 1996). The review team assumes that the same vegetation and construction management of corridors currently used by PEF would be used in the establishment and maintenance of the new corridors. Under the Conditions of Certification for the State, PEF would also be required to retain existing vegetation whenever practicable and use BMPs that comply with the Florida State regulations (FDEP 2011b). Consequently, the incremental effects of the maintenance of transmission-line corridors and associated impacts on floodplains and wetlands posed by expanding existing corridors or the addition of a new transmission-line corridor for new nuclear units would be negligible.

To summarize, the potential effects of operating two new nuclear reactors at the Putnam site would be primarily associated with the maintenance of transmission-line corridors and increased traffic. Operational impacts on terrestrial resources would generally be expected to be minimal.

Cumulative Impacts

Past and present actions in the geographic area of interest that have influenced terrestrial resources in a way similar to the building and operation of the proposed two new nuclear units at the Putnam site include the approximately 2000-ac Seminole Power Plant and the Putnam Steam Power Plant. Construction of the nuclear facility at the Putnam site would have impacts on terrestrial resources similar to those of the proposed project at the LNP site, and operation of the transmission system would have similar impacts on terrestrial resources as mentioned above. The Keuka sand mine, located north of the Putnam site, would also affect terrestrial resources in a similar way. Furthermore, terrestrial habitats throughout the geographic area of interest have been extensively altered by a history of forestry and agricultural practices as well as low density residential development.

Proposed reasonably foreseeable future actions that would affect terrestrial resources in a way similar to development at the Putnam site would include transmission-line creation and/or upgrading throughout the designated geographical ROI, and future urbanization would also be expected to occur. There are no areas within the geographical ROI that are managed for the benefit of wildlife.

The other impact on terrestrial resources at the Putnam site would be the effect of global climate change on plants and wildlife. The impact of global climate change on terrestrial wildlife and habitat in the geographic area of interest is not precisely known. Global climate change would result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation, and increases in average temperature (GCRP 2009). Such changes in climate could alter terrestrial community composition on or near the Putnam site through changes in species diversity, abundance and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce terrestrial habitat. Specific predictions of habitat changes in this region due to global climate change are inconclusive at this time. However, because of the regional nature of climate change, the impacts related to global climate change would be similar for all of the alternative sites.

Summary Statement

Impacts on terrestrial ecology resources are estimated based in the information provided by PEF and the review team's independent review. There are past, present, and future activities in the geographic area of interest that could affect terrestrial ecology in ways similar to the building of two units at the Putnam site. The Putnam site and its associated transmission lines are natural habitats that would be substantially altered by development and maintenance activities, noticeably affecting the level and movement of terrestrial wildlife populations in the surrounding landscape. Other anticipated development projects would further alter wildlife habitats and migration patterns in the surrounding landscape. The review team therefore concludes that the cumulative impacts on baseline conditions for terrestrial ecological resources would be MODERATE. This determination is based upon the extent of expected wetland loss and habitat fragmentation from ongoing and planned development projects, continued widespread manipulation of habitats for commercial forest management, and anticipated losses of habitat for important species. The incremental impacts from building and operating the Putnam project would be a significant contributor to the moderate cumulative impact, primarily because of a loss or modification of habitats that support wildlife, wetlands, and important species. Although incremental impacts on terrestrial resources could be noticeable near the Putnam project site, these impacts would not be expected to destabilize the overall ecology of the regional landscape.

9.3.5.4 Aquatic Resources

The following impact analysis includes impacts from building activities and operations on aquatic ecology resources. The proposed Putnam site has no existing infrastructure associated with development of a nuclear power plant. This greenfield site is adjacent to the St. Johns River, which is proposed as the water source for cooling and discharge. Water flow in the St. Johns River is managed by the St. Johns River Water Management District (SJRWMD), with an established minimum average flow of 240 cfs for the St. Johns River below the Lake Washington weir. PEF maintains that there would be adequate flow to supply water through a closed-cycle cooling design for a two-unit plant. However, under drought conditions, the St. Johns River may not be able to provide sufficient water, and PEF acknowledges that the building of a reservoir would be required to ensure consistent water supply (PEF 2009b). The geographic area of interest includes the site and vicinity streams as well as the St. Johns River upstream and downstream of the intake and discharge as the area most likely to be affected by new nuclear units, as well as associated transmission-line corridors.

The St. Johns River flows from swampy headwaters in Melbourne, Florida, northward to the mouth near Mayport on the Atlantic Ocean. Classified as an American Heritage River, the St. Johns River has experienced a severe decline in water quality and increased use as a freshwater resource, which have prompted the water management district to improve water quality and restore habitat, particularly in the lower river basin, which includes Putnam County (SJRWMD 2008a). Several initiatives are planned to target water quality, biological health, and sediment management in the lower St. Johns River basin and the connecting Lake George basin, which is also located in Putnam County (SJRWMD 2008b).

There are no sanctuaries or preserves that could be affected by the proposed action. The nearest State-managed areas are the Oklawaha River Aquatic Preserve in Marion County and the Wekiva River Aquatic Preserve to the south of Putnam County. The Oklawaha River Aquatic Preserve covers 4600 ac of submerged lands and flows into the St. Johns River at Palatka (FDEP 2009f). The Wekiva River Aquatic Preserve encompasses 19,000 ac of submerged land and flows into the middle St. Johns River basin (FDEP 2009g).

Commercially Important Species

Commercial fisheries allowed in the St. Johns River include menhaden (*Brevoortia tyrannus*), black mullet, and blue crab. For life history information on the black mullet and blue crab refer to Section 2.4.2.

The Atlantic menhaden inhabit inland tidal waters and spawn offshore during October through March. Juvenile development typically occurs in estuarine or tidal habitat with salinities less than 10 ppt (ASMFC 2009). Fished as both a bait and food fish, landings for Putnam County in 2008 recorded over 12,000 lb (FFWCC 2009a).

Recreationally Important Species

Largemouth bass, speckled perch (*Pomoxis nigromaculatus*), striped bass (*Morone saxatilis*), catfish (*Ameiurus* spp.), blue crab, and sunfish (*Lepomis* spp.) are the primary recreational species caught in the Lake George basin and Putnam County area of the St. Johns River (Florida BASS Online Inc. 2010).

Non-Native and Nuisance Species

Water hyacinth, water lettuce, and hydrilla are common invasive aquatic plant species that have been noted in the St. Johns River and are controlled by the SJRWMD through the FDEP/Florida Fish and Wildlife Conservation Commission's Invasive Plant Management Program (FDEP 2008). Power plant operations are not expected to affect these aquatic nuisance species.

Critical Habitats

No critical habitat has been designated by the FWS or NMFS in the vicinity of the Putnam County alternative site.

Federally and State-Listed Species

Federally and State-listed aquatic species that may occur near the Putnam County alternative site include the endangered Florida manatee and the endangered shortnose sturgeon (*Acipenser brevirostrum*). Federally and State-listed species may also occur along transmission-line corridors in Hillsborough County, such as the endangered green sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, and the threatened gulf sturgeon. Detailed species information is provided in Section 2.4.2.3.

Florida Manatee (*Trichechus manatus latirostris*)

The Florida manatee upper St. Johns River management unit, which includes Putnam County, constitutes approximately 5 percent of the total manatee population, but is the fastest growing of the four management units. Over 450 ac are regulated in Putnam County by FWS as Manatee Protection Zones (FFWCC 2007). PEF would comply with the Standard Manatee Conditions for In-Water Work (FDEP 2011b) for construction activities in the St. Johns River to prevent impacts on manatees in the vicinity of construction activities. Thermal discharges from operations may result in increased use of habitat near the point of discharge if discharge is to the St. Johns River. Plant outages that result in cold shock could affect manatees that become habituated to power plant thermal discharges.

Shortnose Sturgeon (*Acipenser brevirostrum*)

Shortnose sturgeon range along the eastern Canadian and U.S. coast from the St. John River in Canada to the St. Johns River in Florida. All spawning occurs in freshwater during a narrow 1- to 2-week period in the spring. Females only spawn every 3 to 5 years after reaching sexual maturity at age 8 to 12. Males may spawn every year after reaching age 6 to 10 (NMFS 1998). Shortnose sturgeon are sensitive to water-quality conditions and require rocky or gravel substrate for spawning. If habitat is not favorable, spawning will not occur, and the lower St. Johns River has little of this preferred habitat type. In the St. Johns River, most catch records for the shortnose sturgeon have occurred in the lower basin near Palatka. A sampling survey from 2002 to 2003 recorded a single shortnose sturgeon to the south of Palatka, despite more than 820 hours of sampling effort (FFWCC 2009c). To date, no evidence of spawning or adult migration in the St. Johns River has been collected to indicate that there is a viable reproducing population in this river.

Building Impacts

New cooling-water intake and discharge structures in addition to a cooling-water reservoir would be required at the Putnam County site. Installation of a new intake and discharge would result in the temporary displacement of aquatic biota within the vicinity of both structures. It is expected that these biota would return to the area after installation is complete. Sedimentation due to disturbances of the river bank and bottom during installation activities could affect local benthic populations. However, the impacts on aquatic organisms would be temporary and largely mitigable through the use of BMPs. The impacts of building a cooling-water reservoir may be significant depending on the siting of the reservoir. During the review team's visit to the Putnam site, observations of the site from public roads indicated the presence of streams that are either perennial or seasonal. These aquatic resources have not been examined for diversity of aquatic biota, but nonetheless, they represent aquatic habitat that would likely be affected by the building of facilities for the site. Offsite corridor preparations would not cross any streams, but would cross two open waterbodies (CH2M HILL 2009). The use of BMPs during building activities would result in minimal impacts on aquatic biota located in water resources within the site building areas.

New transmission-line infrastructure would be required for a new two-unit facility. There currently are no existing transmission-line corridors in the immediate vicinity of the greenfield site, and new corridors would need to be established. Transmission corridors appear to follow the Polk-Hillsborough-Pinellas corridor identified for the LNP site in addition to other corridors in Lake, Marion, Putnam, Seminole, and Volusia counties (CH2M HILL 2010). PEF anticipates transmission-line corridors would cross 7 streams and 94 open waterbodies and should have minimal impact on aquatic resources, including minimal impacts on threatened and endangered sea turtles and the threatened gulf sturgeon (CH2M HILL 2010).

Operational Impacts

Impingement and entrainment of organisms from the St. Johns River and from a constructed reservoir would be the most likely impacts on aquatic populations that could occur from operation of two new nuclear units at the Putnam County site. Assuming a closed-cycle cooling system, a maximum through-screen intake velocity of 0.5 fps or less and an intake flow of less than or equal to 5 percent of the mean annual flow which meets the EPA's Phase I regulations for new facilities (66 FR 65256), the anticipated impacts on aquatic populations from entrainment and impingement are expected to be minimal. Operational impacts associated with water quality and discharge cannot be determined without additional detailed analysis. However, based on the staff's experience with other facilities, the review team concludes that with proper design the impacts on aquatic resources due to the blowdown discharge from operation of two new nuclear units at the Putnam County site would likely be minimal with FDEP NPDES compliance.

The staff also concludes that operational impacts on aquatic biota from maintenance of the transmission-line corridors would be minimal assuming that appropriate BMPs are used.

Cumulative Impacts

Cumulative impacts on aquatic resources within the St. Johns River include the operation of Seminole Power Plant and Putnam Steam Power Plant, both of which use water from and discharge to the St. Johns River. Other impacts include small business and wastewater-treatment plants that discharge wastewater to the St. Johns River within the geographic area of interest for the Putnam site. These discharge operators and businesses have active NPDES permits for discharge.

Anthropogenic activities such as residential or industrial development near the vicinity of the nuclear facility can present additional constraints on aquatic resources. Future activities may include shoreline development (i.e., removal of habitat), increased water needs, and increased discharge of effluents into the St. Johns River. The effects of continued industrial discharge practices could result in additional habitat loss and/or degradation due to water use using surface waters and groundwater withdrawal, point and non-point source pollution, siltation, and bank erosion.

The review team is also aware of the potential for global climate change to affect aquatic resources. The impact of global climate change on aquatic organisms and habitat in the geographic area of interest is not precisely known. Global climate change would result in a rise in sea level and may cause regional increases in the frequency of severe weather, decreases in annual precipitation, and increases in average temperature (GCRP 2009). Such changes in climate could alter aquatic community composition on or near the Putnam site through changes in species diversity, abundance, and distribution. Elevated water temperatures, droughts, and severe weather phenomena may adversely affect or severely reduce aquatic habitat, but, specific predictions of aquatic habitat changes in this region due to global climate change are inconclusive at this time. The level of impact resulting from these events would depend on the intensity of the perturbation and the resiliency of the aquatic communities.

Summary Statement

Impacts on aquatic ecology resources are estimated based on the information provided by PEF, the State of Florida, and the review team's independent review. Properly siting associated transmission lines, avoiding habitat for protected species and minimizing interactions with waterbodies and watercourses along the corridors, and the use of BMPs during intake and discharge installation, transmission-line corridor preparation, and tower placement would minimize building and operation impacts. There would be impacts associated with the loss of aquatic habitat, particularly during low flow conditions in the river, due to the consumptive loss of water from closed-cycle cooling. There also would be unspecified impacts related to the construction and operation of a cooling reservoir however these could be minimized through proper siting and the use of BMPs during construction. The use of a cooling reservoir would partially mitigate the effects of consumptive water loss on aquatic habitat during low river flow. The review team concludes that the cumulative impacts of building and operating two new reactors on the Putnam site combined with other past, present, and future activities on aquatic resources in the St. Johns River would be SMALL.

9.3.5.5 Socioeconomics

The following impact analysis includes direct, indirect, and cumulative impacts from the building activities and operations of two new nuclear units at the Putnam site, which is located in rural Putnam County in northeastern Florida. The analysis considers other past, present, and reasonably foreseeable future actions that affect socioeconomics, including other Federal and non-Federal projects listed in Table 9-25. For the analysis of socioeconomic impacts at the

Putnam site, the geographic area of interest is the region within a 50-mi radius centered on the Putnam site (the region) with special consideration of the five counties of Putnam, Clay, Flagler, Marion, and St. Johns counties, because that is where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of site development and operation at the Putnam site, the review team undertook a reconnaissance survey of the site using readily obtainable data from the Internet or published sources.

The Putnam site is a greenfield site located in an area in which there is an operating coal-fired power plant and a combined-cycle gas/oil-fired power plant, sand mines, and a concrete batch plant. The review team drew upon UCSB 2010 data to find the available total construction workforce within the host county, adjacent counties, and any nearby counties with a major population center within a reasonable commuting distance from the site. For the Putnam site, this included Putnam, Clay, Alachua, Marion, Volusia, Flagler, St. Johns, and Duval counties. Because Alachua, Volusia, and Duvall counties constitute a substantial population within the 50-mi region where construction workers are expected to reside, based on this workforce availability, the review team assumed that up to 80 percent of the 3440-person workforce involved in building the two-unit plant, or 2752 workers, would be drawn from existing residents of this region, and that 20 percent, or 688 workers, would migrant into the area. This 20 percent would include special trades needed for nuclear power plant production that may not be available in the region.

The review team identified the EIA for a two-unit nuclear plant at the Putnam site to include Putnam County and the immediately adjacent counties of Clay, Flagler, Marion, and St. Johns, based on the review team’s expected effects of in-migrating workers and families. The review team expects that some of the in-migrating workers would choose to reside in Alachua, Duval, and Volusia counties because of the amenities available in the larger cities there, but these counties’ economies and community infrastructures are sufficiently large that the review team expects that project-related effects would not be noticeable. The review team focused on the effects of the workforce involved in building the two-unit plant because the operations workforce would be smaller than the construction and preconstruction workforce, with smaller socioeconomic impacts.

Table 9-28 provides some socioeconomic data for the EIA. For the purposes of this analysis the review team projected that about one-quarter, or 172 of the in-migrating workers, would be distributed among Alachua, Duval, and Volusia counties because they offer more urban amenities than the counties in the EIA. The review team assumed that the other three-quarters (516 in-migrating workers) would be distributed in Putnam (16 percent), Clay (9 percent), Flagler (9 percent), Marion (43 percent), and St. Johns (23 percent) counties. The review team further assumed that all in-migrating workers would bring families; this is unlikely but provides an upper bound on population impacts associated with the project. The review team used the 2.49 average Florida family size to project the distribution of population due to in-migrating workers shown in Table 9-29.

Table 9-28. Socioeconomic Data for the Putnam Site EIA

Data Category	Putnam	Clay	Flagler	Marion	St. Johns	Data Source
Population						
1980	50,549	67,052	10,913	122,488	51,303	(a)
1990	65,070	105,986	28,701	194,833	83,829	(b)
2000	70,423	140,814	49,832	259,914	123,148	(b)
2010	74,364	190,865	95,696	331,298	190,039	(c)
Median Household Income (2009)	$31,492	$48,854	$40,214	$31,944	$50,099	(c)
Vacant Housing Units	7928	6686	9409	26,324	14,492	(d)
Total Housing Units	37,337	75,478	48,595	164,050	89,830	(d)
Workforce						
Employed	17,507	44,191	13,981	78,536	58,498	(e)
Construction	3861	3434	1047	7238	3307	(e)
Total schools	1 E, 5 M, 9 E-M, 2 H, 1 M-H, 1 E-M-H	1E, 7 M, 22 E-M, 6 H, 1 M-H, 1 E-M-H	0 E, 2 M, 5 E-M, 3 H, 1 M-H	2 E, 9 M, 29 E-M, 8 H, 1 M-H, 1 E-M-H	0 E, 7 M, 17 E-M, 5 H, 2 M-H	(f)
Number of Schools Failing Student-Teacher Ratio	1	1	1	4	0	(f)
Police	Sheriff Dept	Sheriff Dept – 40-60 deputies	Sheriff Dept – 4 patrol squads, traffic unit.	Sheriff Dept plus police depts in Dunnellon, Belleview, and Ocala	Sheriff Dept – almost 200 employees and 300 in support	(g)

Table 9-28. (contd)

Data Category	Putnam	Clay	Flagler	Marion	St. Johns	Data Source
Emergency Services	Dept of emergency services; 70+ EMS staff at 7 stations; 2 staffed and 18 volunteer fire departments	Emergency management dept. 14 fire stations, emergency dispatchers	Emergency services includes fire and EMS – 80 budgeted positions, including fire and paramedics	Emergency operations department – joint county, Ocala, Dunnellon; 22 staffed and 7 volunteer fire stations	Emergency management department details not available	(h)
Population[i]						
White	77.3	81.8	82.3	81.0	89.3	(c)
African American	16.2	9.9	11.4	12.3	5.6	(c)
Hispanic	9.0	7.7	8.6	10.9	5.2	(c)
Low Income	25.6	9.2	11.3	15.9	8.7	(c)

(a) USCB 1990
(b) USCB 2000b
(c) USCB 2010b
(d) USCB 2010c,
(e) USCB 2010a
(f) DOE 2009a
(g) Putnam: Putnam Sheriff 2009; Clay Sheriff 2009; Flagler Sheriff 2009; Marion: Section 2.5.2.6; St. Johns Sheriff 2009
(h) Putnam: Putnam EM 2009; Clay Public Safety 2009; Flagler EM 2009; Marion EM 2009; Marion Fire 2009; St. Johns EM 2009
(i) BEA 2010
E = elementary school; M = middle school; H = high school; EMS = emergency management services

Table 9-29. Projected Distribution of Workers and Associated Population Increase in the EIA

County	Percent Population Increase 1990-2000[(a)]	Percent Population Increase 2000–2010[(b)]	Workers In-Migrating to Build Putnam Plant	Population of In-Migrating Workers and Families	Population of Workers and Families (as a percent of projected 2010)
Putnam	8.2	5.6	83	207	0.27
Clay	32.9	35.5	46	115	0.06
Flagler	73.6	92.0	46	115	0.12
Marion	32.9	27.5	222	553	0.16
St. Johns	46.9	54.3	119	296	0.15

(a) Based on USCB data, as reported in PEF 2007b
(b) USCB 2010b

Physical and Aesthetics Impacts

The physical impacts on workers and the public from building and operating a two-unit plant at the Putnam site would be very similar to those described for the LNP site. People who work or live around the site could be exposed to noise, fugitive dust, and gaseous emissions from building activities. Building workers and personnel working onsite could be the most affected. Air-pollution emissions are expected to be controlled by applicable BMPs and Federal, State, and local regulations. During plant operations, standby diesel generators used for auxiliary power would have air-pollution emissions. These generators would see limited use and, if used, would be used for only short periods of time. Applicable Federal, State, and local air-pollution requirements would apply to all fuel-burning engines. During normal operations, the annual average exposure from gaseous emission sources is anticipated to not exceed applicable regulations at the site boundary. The review team expects the impacts of plant operations on air quality to be minimal. As with building impacts, potential offsite receptors of operations noise and emissions are generally located well away from the site boundaries.

Building activities and unit operations are not expected to affect any offsite buildings. Most buildings are well removed from the site boundaries. Because this is a greenfield site, there are no onsite buildings to be affected by shock and vibration from pile-driving and other related activities. No long-term physical impacts on structures, including any residences near the site boundaries, would be expected. Therefore, based on consideration of reconnaissance-level information, the review team concludes that the physical impacts of station building and operation on offsite buildings would be minor.

PEF reports that a reservoir may need to be created for water supply. There would likely be vegetative screening around the reservoir that would potentially mitigate the aesthetic impacts. Therefore, the review team expects the aesthetic impacts of a reservoir would be minimal.

The Putnam site is in a rural area within an area that has experienced sustained, substantial population growth over the past several decades, as indicated in Table 9-28. Residential and commercial areas are located away from the alternative site boundaries, applicable air-pollution regulations would have to be met by PEF, and applicable BMPs would be put in place, including during the construction and use of the site access road. Therefore, based on information provided by PEF and the review team's independent review of reconnaissance-level information, the review team concludes that the physical impacts of building and operating the station would have minimal impact on workers and the local public around the Putnam site.

As the transmission lines to connect the site to the distribution grid are put in place and the buildings and cooling towers associated with the new reactors reach their final heights and begin operating, they would introduce a noticeable aesthetic impact that could be similar to those created by the existing fossil-fuel plants already operating within the county. In places requiring the clearing of new transmission-line corridors, aesthetic impacts would be noticeable but not destabilizing, depending on the proximity of viewers and the nature of vegetation remaining between them and the corridors. Given the general characteristics of the area, there would likely be vegetative screening around the site that would potentially mitigate the aesthetic impacts at the reactor site.

Demographic Impacts

Table 9-29 indicates the estimated project-related population migrating into the EIA at peak workforce levels and the population increase in each county between 1990 and 2000 and between 2000 and 2010. As seen in the table, each county except Putnam saw a large rate of population increase between 1990 and 2000 and between 2000 and 2010. For Putnam County, the rates are similar for both the 1990–2000 and the 2000–2010 periods, with a somewhat lower rate of increase for 2000–2010 than for the prior decade, although this increase is upon a larger base. Given the estimated increase of 0.27 percent or less over the population for 2010, the review team found that the demographic impact of the in-migrating population associated with building two new nuclear generating units would be minor.

Economic Impacts

The review team determined that the combined impact of the direct and indirect jobs and income associated with building the two units would have a minor effect on total employment and income in the EIA, with in-migrating workers projected at less than 2.2 percent of the 2010 employee base in any county. The impact of approximately 541 operations jobs (70 percent of the total operations jobs) filled by in-migrating operations workers within a 1-hour commute of the site, and the indirect jobs they would create would be minor, given the size of the economy of the area.

State and local taxes would be governed by Florida law. The review team assumed that tax revenues generated from sales and use taxes associated with the building and operation of the proposed project at the Putnam site would be very similar to those evaluated for the LNP site in Sections 4.4.3.2 and 5.4.3.2, with a similar minor impact on revenues in the EIA and region. The review team concluded that increased property taxes from the proposed project at the Putnam site during operation would have a substantial beneficial impact on Putnam County. The State of Florida Conditions of Certification for LNP would require PEF to discontinue the operations of two fossil-fueled units at the CREC in Citrus County by December 31, 2020, assuming licensing, construction, and operation of LNP were to occur in a timely manner (DOE/EIA 2010b: FDEP 2011b). Because of the age and size of the two units planned for closure, the review team does not expect their value to be very high, but Citrus County would still lose a small component of its property tax base, resulting in a minor but adverse tax-based economic impact on the County.

The review team found that additional property taxes on new houses built by in-migrating workers would constitute a small percentage increase in the local tax base in the EIA; thus the impact of operations on residential property tax revenues would be minor and beneficial for all of the region except Putnam County, where the review team determined property tax impacts would be substantial and beneficial.

Housing

The review team compared the 2010 figures for vacant housing in the EIA listed in Table 9-28 with the number of in-migrating workers projected for peak workforce years listed in Table 9-29. Table 9-28 housing figures do not include RV parks, campgrounds, or hotels, and thus provide a lower bound of what would be available to house workers. In the EIA, less than 2 percent of the vacant housing present in 2010 would be needed to house in-migrating workers, assuming that each worker occupied a separate housing unit.

The U.S. Census Housing Profile (USCB 2010c) in the EIA estimated the following:

- Putnam County – a total housing stock of 37,337 units with a vacancy rate of 21 percent (approximately 7928 housing units were unoccupied at the time of the survey).
- Clay County – a total housing stock of 75,478 units with a vacancy rate of 9 percent (approximately 6686 housing units were unoccupied at the time of the survey).
- Flagler County – a total housing stock of 48,595 units with a vacancy rate of 13 percent (approximately 9409 housing units were unoccupied at the time of the survey).
- Marion County – a total housing stock of 122,663 units with a vacancy rate of 19 percent (approximately 15,908 housing units were unoccupied at the time of the survey).
- St. Johns County – a total housing stock of 89,830 units with a vacancy rate of 16 percent (approximately 14,492 housing units were unoccupied at the time of the survey).

The review team expects that the in-migrating workforce could be absorbed into the existing housing stock in the EIA and the region without a measureable impact. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that housing impacts of building and operating two nuclear units at the Putnam site would be minor.

Public Services

The review team assumed that the Putnam EIA, like the three-county local area for the LNP EIA, have planned to meet needs for public services based on forecast population increases that did not include the presence of a workforce associated with building and operating a nuclear plant. The review team based its analysis of potential impacts on public services on the level of population increase represented by in-migrant workers during peak workforce years, an estimated increase of 0.27 percent or less over projected populations for 2010, as shown in Table 9-29. Using this approach, the review team expects that the impacts of building two units on county public services during peak workforce years would be minor in the entire 50-mi region.

Traffic

Main roads in Putnam County include US-17, a two-lane north-south road on the eastern side of the county; SR-20, a two-lane east-west road across the center of the county; and SR-9, a two-lane north-south road that extends from the center of the county and trends northeast to join US-17 in the county capital, Palatka. All three roads have a LOS standard of "C." SR-20 forms part of the Strategic Intermodal System, for which the FDOT sets the standards (FDOT 2009a). The other roads are not part of the Strategic Intermodal System and are assigned LOS standards according to the Putnam County Comprehensive Plan (Putnam County 2009a).

One-way annual (2008) AADT counts for US-17 ranged from 17,000 to 16,500 near the bridge east of Palatka and east of the junction with SR-20; 5000 to 4900 north of Palatka; and 2600 to 4600 in the south of the county. Two-way AADT estimates for SR-20 ranged from 7600 in the west of the county to 15,900 near the intersection with SR-19 and 7700 just south of the intersection with US-17. Two-way AADT estimates for SR-19 range from 2900 in the south of the county to 8600 south of the junction with SR-20 (FDOT 2008).

The review team considered these roads to be the main routes that would be used by workers commuting to the plant site, with US-17 linking to the site access road. The review team considered the impact of project-related traffic in terms of likelihood that it would change the LOS along US-17 to be lower than the assigned standard "C." The review team assumed 2281 trips daily (following LNP site analysis in Section 4.4.4.1), with 50 percent to/from the north and 50 percent to/from the south, based on the distribution of in-migrating worker residence discussed previously as well as commuters from Duval, Alachua, and Volusia counties. At morning shift change, this would add 1977 cars to the total flow on SR-70, 711 incoming from the north, 711 from the south; and 275 outgoing to the north, 275 to the west. The incoming traffic from both north and south would increase the flow by about 15 percent over the 2008 AADT for US-17 north of Palatka, in the general site vicinity, which, according to FDOT's generalized planning standards (FDOT 2009b), would not reduce the LOS below "C." Effects south of Palatka would be less. An increase of 711 cars entering the Palatka area from US-17 south, SR-19 south, and SR-20 west would not significantly add to the 2008 counts. The review team found no evidence that the LOS for US-17 would change as a result of project-related traffic. While more analysis would be required once specific proposals for turn lanes, signals, and other modifications were made, the review team identified the potential for a noticeable, intermittent impact at the intersection of US-17 with the site access road, analogous to that predicted for the LNP site. Given the lower number of commuters during operations, the review team believes the traffic-related impacts during operations would be minor.

Education

Table 9-28 provides data about schools in the EIA. Schools in the socioeconomic impact area met the State teacher-student ratio classroom requirements in 2007–2008 with the exception of four schools in Marion County and one school each in each Putnam, Clay, and Flagler counties. The review team assumed that school districts in the EIA, like those in the EIA for the LNP site, would address short-term gains in student population with mobile classrooms and that the PK-12 public schools would be funded according to the Florida equalized funding formula (FDOE 2009b). The review team assumed that students would accompany each in-migrating worker family. To calculate the number of new students moving into the EIA, the review team took the average of the ratios of students per household from counties in the LNP site listed in Table 2-35. The estimated numbers of new students in each of the counties of the EIA during peak workforce years are listed in Table 9-30.

Table 9-30. Students from In-Migrating Families at Peak Workforce Years

County	In-Migrating Worker Households	New Elementary School students	Elementary School Rooms[(a)]	New Middle School Students	Middle School Rooms[(b)]	New High School Students	High School Rooms[(c)]
Putnam	83	13	1	7	0	7	0
Clay	46	7	0	4	0	4	0
Flagler	46	7	0	4	0	4	0
Marion	222	35	2	17	1	20	1
St. Johns	119	18	1	9	0	11	0

Source: Table 4-14; State of Florida 2002
(a) 0.158 per household; 18 students per teacher required by State law.
(b) 0.081 per household; 22 students per teacher required by State law.
(c) 0.091 per household; 25 students per teacher required by State law.
PK = preschool

The review team found that the addition of up to four classrooms in Marion County, one classroom each in Putnam and St. Johns counties, and none in Clay or Flagler County would amount to less than one additional classroom per school, which would constitute a minor impact.

Recreation

The review team learned that fishing for a number of species is important along the St. John's River in Putnam County (Florida Bass Online.com 2010). The review team anticipates that building activities would have short-term minor effects on the recreation industry.

The economy in the Putnam site EIA draws on its natural resources, including many lakes and parks. Because the exact footprint of the site is not determined, specific impacts on specific recreational facilities from site structures and the intake and discharge structures are not known, but, based on the considerations discussed for the LNP site, the review team anticipates that adverse impacts of building units at the Putnam site would have minor impacts on use of the recreational facilities from which activities would be visible or audible. The increased population in the EIA may increase use of local recreational areas, which is expected to have negligible impact on either the sites or the recreational experience, given the number, geographic distribution, and variety of recreational locations available.

Summary of Socioeconomics

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. Based on information provided by PEF and its own independent evaluation, the review team finds that the socioeconomic effects of building two units at the Putnam site would be minor with few exceptions. There would be noticeable, intermittent and temporary adverse effects on traffic in Putnam County in the immediate vicinity of the site. Once plant operations begin, the review team believes transportation impacts would be minor and tax impacts on Putnam County would be substantial and positive. Closure of the operations of two fossil-fueled units at the CREC in Citrus County would result in a minor but adverse tax-based economic impact on Citrus County. The aesthetic impacts of the transmission lines and corridors would be noticeable in the areas along the corridors.

Cumulative Impacts

In addition to assessing the incremental socioeconomic impacts from the building and operation of two nuclear units on the Putnam site, the cumulative impact assessment considers other past, present, and reasonably foreseeable future actions including other Federal and non-Federal projects that could contribute to the cumulative socioeconomic impacts on a 50-mi radius centered on the Putnam site (the region) with special consideration of Putnam, Clay, Flagler, Marion, and St. Johns counties, because that is where the review team expects socioeconomic impacts to be the greatest (Economic Impact Area or EIA). Table 9-25 identifies the projects that have contributed and will continue to contribute to the demographics, economic climate, and community infrastructure of the region.

The Putnam site is a greenfield site in a semi-rural area. The region and the EIA are located within commuting distance of several large cities and the coast, and have been growing rapidly over the past several decades. Within the region, active residential/retirement/recreational and commercial developments, along with planned improvements to the area transportation infrastructure are expected to result in continued urbanization that would have noticeable socioeconomic effects on the economy and residents of the EIA. The review team determined that cumulative socioeconomic effects of building new units at the Putnam site and the actions identified in Table 9-25 would not differ noticeably from the project effects analyzed above. Thus, the review team determined that the cumulative socioeconomic effects of the proposed project and other past, present, and reasonably foreseeable projects would be SMALL, with the following exceptions: Putnam County would experience MODERATE, but short-term and spatially limited impacts on roads and traffic during construction and SMALL impacts during operation. Cumulative impacts would be LARGE and beneficial from property tax receipts in Putnam County after the plant begins operations, and small and beneficial elsewhere in the region. Building new units at the Putnam site would be a significant contributor to the MODERATE impacts on roads and traffic. Building and operating the Putnam site would be a significant contributor to MODERATE impacts on aesthetics along the transmission lines and corridors.

9.3.5.6 Environmental Justice

The review team used the approach in Section 2.6 in identifying minority and low-income populations of interest. Figure 9-6 shows the distribution of aggregate minority populations of interest by census block group within the region. Figure 9-7 shows the distribution of block groups with concentrations of low-income populations of interest in the region. The census block group within 1 mi to the east of the Putnam site in Figure 9-6 represents a population of interest for aggregate minority and Hispanic populations, as well as for low-income people. The closest African-American or Black population of interest is about 8 mi to the southeast of the Putnam site. Most populations of interest are at some distance from the Putnam site. The largest geographic area with a concentration of minority populations is to the south-southeast of the Putnam site extending to the border of the region. There are geographic clusters of block groups with low-income populations of interest distributed widely within the area defined by the region.

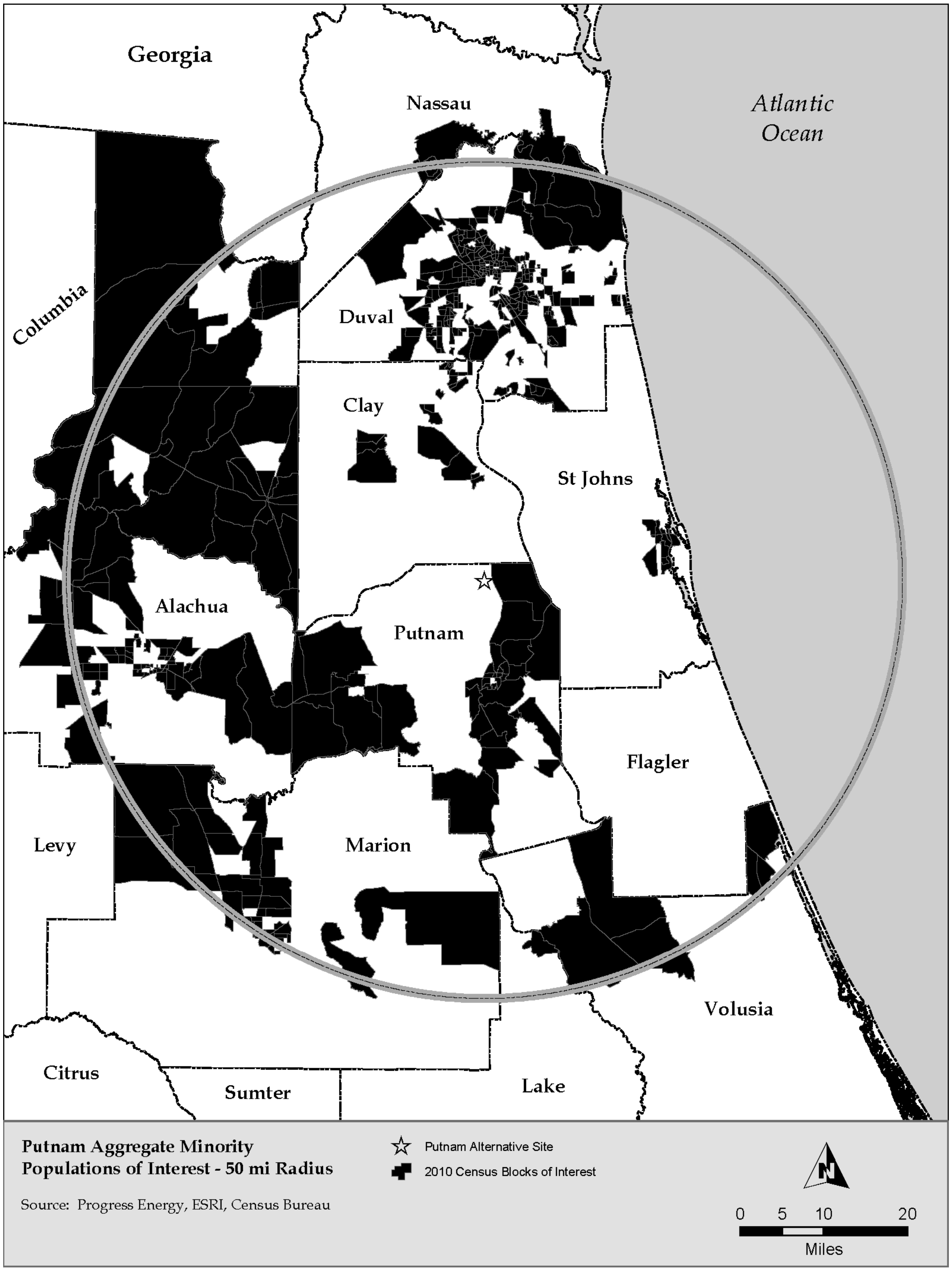

Figure 9-6. Putnam Site Aggregate Minority Populations (USCB 2011)

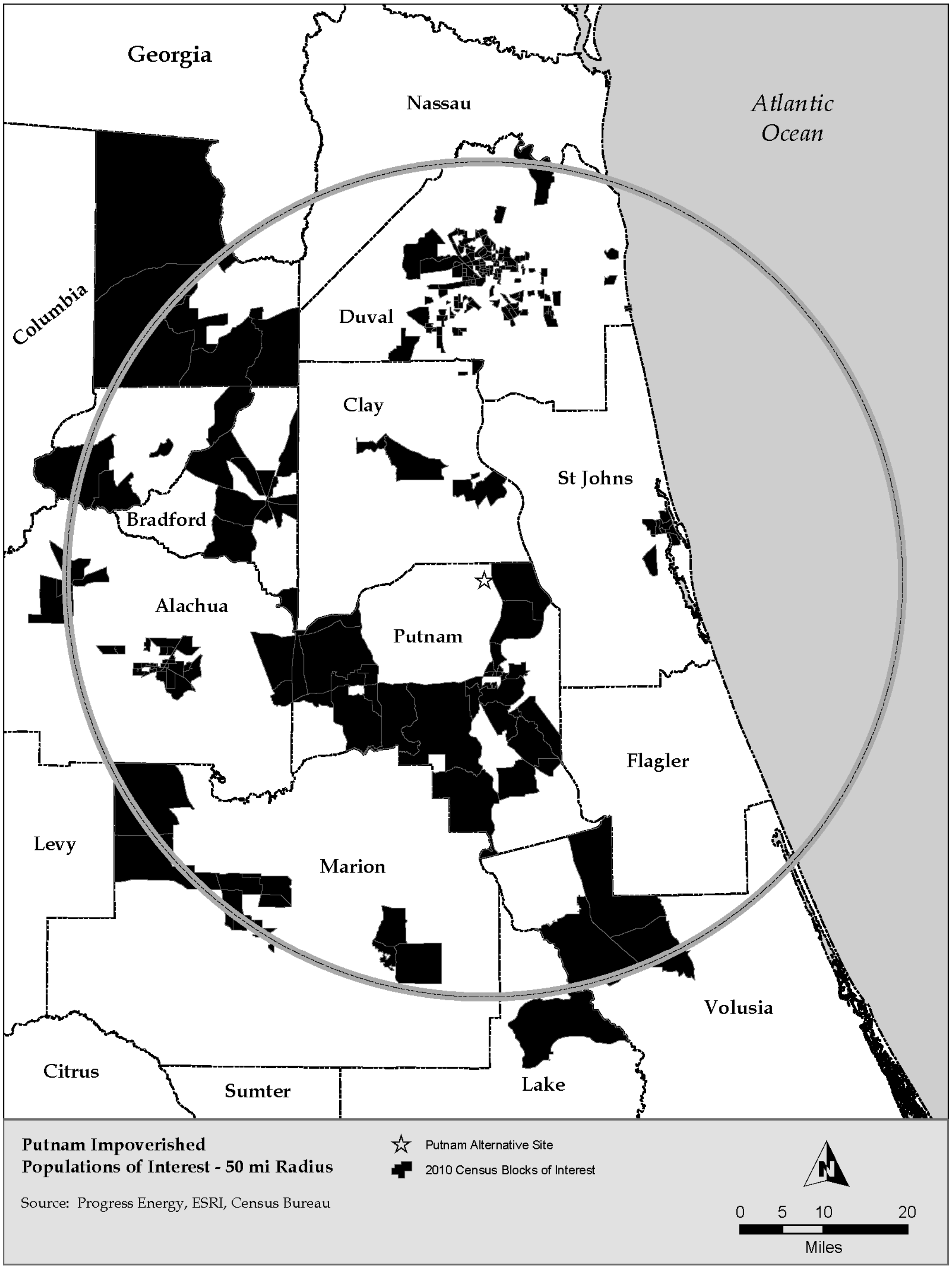

Figure 9-7. Putnam Site Low-Income Populations (USCB 2011)

The physical effects of building activities (noise, fugitive dust, air emissions, traffic) would not impose a disproportionately high and adverse affect on minority or low-income populations of interest because the effects would be small and spatially limited, with none extending to the geographic area of the minority or low-income populations of interest. The review team investigated the presence of unique characteristics or practices in minority or low-income communities that could result in different socioeconomic impacts from the Putnam site compared to the general population and found one unique characteristic that could lead to disproportionate impacts: reliance on subsistence. Personnel from the Putnam County Health Department, FDEP, and Florida Fish and Wildlife Conservation Commission were unable to provide data on subsistence behavior in the region (Putnam County 2009b). The review team assumes that some subsistence fishing may take place along the St. John's River, in addition to the recreational fishing mentioned in Section 9.3.5.5, and in the lakes in the west and southwest of the county. The review team assumes that subsistence fishing activities may be affected by building activity runoff or spills, perhaps requiring fishermen to use different locations. In the absence of specific information about effects on local lakes and streams that are used for subsistence fishing, the review team concludes provisionally that there may be disproportionately high and adverse effects on low-income populations that engage in subsistence fishing.

Minority and low-income populations would experience the minor adverse effects on housing availability, public services; and education, and the noticeable, intermittent, and geographically concentrated adverse effects on transportation discussed in Section 9.3.5.5 during the peak workforce years. The review team has no evidence that impacts would be disproportionately high and adverse toward minority populations, nor toward low-income populations.

Cumulative Impacts

The building and operation of the proposed nuclear power plant at the Putnam site would be unlikely to have a disproportionately and adverse impact on minority or low-income populations due to physical impacts, economic impacts, or impacts on community infrastructure. With the exception of a potentially disproportionate MODERATE adverse impact on subsistence fishing, the review team expects that the impacts associated with the building and operation of two new units at Putnam on minority and low-income populations would be SMALL as discussed above. The review team concluded that, in addition to other past, present, and reasonably foreseeable future projects, building and operating two new nuclear units at Putnam would impose only a minor impact on minorities or low-income populations. Therefore, the environmental justice impacts would be SMALL, expect for subsistence fishing which may be MODERATE. Building and operating two units at the Putnam site would be a significant contributor to the MODERATE impact to subsistence fishing.

9.3.5.7 Historic and Cultural Resources

The following cumulative impact analysis includes building and operating two new nuclear generating units at the Putnam site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect historic and cultural resources, including the other Federal and non-Federal projects listed in Table 9-25. For the analysis of cultural impacts at the Putnam site, the geographic area of interest is considered to be the APE for this site. This includes the direct effects APE, defined as the area physically affected by the site-development and operation activities at the site and within the transmission-line corridors. The indirect effects APE is defined as the area visually affected and includes an additional 0.5-mi–radius APE around the transmission-line corridors and a 1-mi-radius APE around the cooling towers.

Reconnaissance activities in a cultural resource review have particular meaning. Typically, the activities include preliminary field investigations to confirm the presence or absence of cultural resources. However, in developing this EIS, the review team relied upon reconnaissance-level information to perform its alternative site evaluation in accordance with ESRP 9.3 (NRC 2000). Reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through visits to the site area. To identify the historic and cultural resources at the Putnam site, the following information was used:

- PEF ER (2009b)
- National Register of Historic Places database (NPS 2010)
- Florida Historical Markers Program (FDOS 2010)
- NRC Alternative Sites Visit October 14–17, 2008 (NRC 2009).

Historically, the Putnam site and vicinity were largely undisturbed and likely contained intact archaeological sites associated with the past 10,000 years of human settlement. Over time, the area has been disturbed by mostly agricultural development (PEF 2009b). In its ER, PEF states that an initial database search for potentially significant cultural resources in Putnam County identified NRHP-listed sites, and that further investigation would be required before siting new reactors at this location. PEF also states that consultation with the SHPO would occur if any significant historic, cultural, or archaeological resources are identified and that appropriate mitigation measures would be put in place before building and operation.

A search of the National Register revealed 15 sites listed in Putnam County, including several historic districts – Palatka Ravine Gardens Historic District, Crescent City Historic District and Palatka South Historic District (NPS 2010). A search of the Florida Historical Markers Program revealed nine sites in Putnam County, including the CFBC and the Mount Royal Site, a Native-American mound and earthworks site (FDOS 2010).

Building Impacts

To accommodate building two new nuclear generating units on the Putnam site, PEF would need to clear land for the main power plant as described in Section 9.3.5.1 in this EIS. If the Putnam site were chosen for the proposed project, identification of cultural resources would be accomplished through cultural resource surveys and consultation with the SHPO, Tribes, and interested parties. The results would be used in the site-planning process to avoid cultural resources impacts. If significant cultural resources were identified by these surveys, the review team assumes that PEF would develop protective measures in a manner similar to that for the LNP site, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could destabilize important attributes of historic and cultural resources.

There are no existing transmission-line corridors connecting to the Putnam site. Section 9.3.5.1 describes the proposed transmission-line corridors associated with this site. Visual impacts from transmission lines may result in significant alterations to the visual landscape within the geographic area of interest. If the Putnam site were chosen for the proposed project, the review team assumes that PEF would conduct its transmission-line-related cultural resource surveys and procedures in a manner similar to that for the LNP site, as described in Section 4.6. In addition, the review team assumes the State of Florida's Conditions of Certification regarding transmission-line siting and building activities would also apply, and therefore the impacts would be minimal. If direct effects on significant cultural resources could not be avoided, land clearing, excavation, and grading activities could destabilize important attributes of historic and cultural resources.

Operations Impacts

Impacts on historic and cultural resources from operation of two new nuclear generating units at the Putnam site would include those associated with the operation of new units and maintenance of transmission lines. The review team assumes that the same procedures currently used by PEF, including the State of Florida's Conditions of Certification, would be used for onsite and offsite maintenance activities. Consequently, the incremental effects of the maintenance of transmission-line corridors and operation of the two new units and associated impacts on the cultural resources would be negligible for the physical and visual APEs.

Cumulative Impacts

Past actions in the geographic area of interest that have similarly affected historic and cultural resources include rural development and agricultural development and activities associated with these land-disturbing activities such as road development. Table 9-25 lists past, present, and reasonably foreseeable projects and other actions that may contribute to cumulative impacts on historic and cultural resources in the geographic area of interest. Projects from Table 9-25 that may fall within the geographic area of interest for cultural resources include future urbanization.

Long linear projects such as new or expanded roads may intersect the proposed transmission-line corridors. Because cultural resources can likely be avoided by long linear projects, impacts on cultural resources would be minimal. If building associated with such activities results in significant alterations (both physical alteration and visual intrusion) of cultural resources in the transmission-line corridors, then cumulative impacts on cultural resources would be greater.

Cultural resources are nonrenewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by PEF and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear generating units on the Putnam site and other projects would be SMALL. This impact-level determination reflects no known cultural resources that could be affected; however, if the Putnam site were to be developed then cultural resource surveys and evaluations would need to be conducted and PEF would assess and resolve adverse effects of the undertaking. Adverse effects could result in greater cumulative impacts.

9.3.5.8 Air Quality

The following impact analysis includes impacts from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affected or could affect air quality, including the shutdown of two coal-fired units at CREC, and other Federal and non-Federal projects listed in Table 9-25. The geographic area of interest for the Putnam site is Putnam County, which is in the Jacksonville (Florida)-Brunswick (Georgia) Interstate Air Quality Control Region (40 CFR 81.91).

The emissions related to building and operating a nuclear plant at the Putnam site would be similar to those at the LNP site. The air quality status for Putnam County as set forth in 40 CFR 81.310 reflects the effects of past and present emissions from all pollutant sources in the region. Putnam County is classified as being in attainment for all NAAQSs.

The atmospheric emissions related to building and operating a nuclear plant at the LNP site in Levy County, Florida are described in Chapters 4.7.1 and 5.7.1. The criteria pollutants were found to have a SMALL impact. In Chapter 7, the cumulative impacts of criteria pollutants at the LNP site were evaluated and also determined to have a SMALL impact.

Cumulative Impacts

Reflecting on the projects listed in Table 9-25 the most significant in regard to air quality are the Seminole Generating Station, which consists of two coal-fired boilers, and the Putnam Steam Plant, which consists of four combustion turbines fueled with either natural gas or fuel oil. Other industrial projects listed in Table 9-25 would have *de minimis* impacts. The impact of closing two coal-fired units at CREC on criteria pollutants at the Putnam site are not considered because the CREC is located outside of the geographic area of interest for this site. Given that these projects would be subject to institutional controls, it is unlikely that the air quality in the region would degrade to the extent that the region would be declared to be in non-attainment for any of the NAAQSs.

The air quality impact of Putnam site development would be local and temporary. The distance from building activities to the site boundary would be sufficient to generally avoid significant air quality impacts. There are no land uses or projects, including the aforementioned sources at the Seminole Generating Station and Putnam Steam Plant, that would have emissions during site development that would, in combination with emissions from the Putnam site, result in a degradation of air quality in the region.

Releases from the operation of two new units at the Putnam site would be intermittent and made at low altitudes with little or no vertical velocity. The air quality impacts of current emissions near the Putnam site are included in the baseline air quality status. The cumulative impacts from emissions of effluents from the Putnam site and other sources would be noticeable, primarily due to emissions from the Seminole Generating Station and the Putnam Steam Power Plant.

The cumulative impacts of GHG emissions related to nuclear power are discussed in Section 7.6. The impacts of the emissions are not sensitive to the location of the source. Consequently, the discussion in Section 7.6 is applicable to a nuclear power plant located at the Putnam site. The review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable. The review team further concludes that the cumulative impacts would be noticeable, with or without the GHG emissions of the project at the Putnam site.

Cumulative impacts on air quality resources are estimated based on the information provided by PEF and the review team's independent evaluation. Other past, present, and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants and global for GHG emissions) that could affect air quality resources. The cumulative impacts on criteria pollutants from emissions from the Putnam site and other projects could be noticeable, principally as a result of the contribution of the coal-fired units at the Seminole Generating Station and the Putnam Steam Power Plant. The national and worldwide cumulative impacts of GHG emissions are noticeable, and the review team concludes that cumulative impacts from construction, preconstruction, and operation and other past, present, and reasonably foreseeable future actions on air quality resources in geographic areas of interest would be SMALL to MODERATE for criteria pollutants (due primarily to the operation of the Seminole Generating Station) and MODERATE for GHG emissions. The incremental contribution of impacts on air quality resources from building and operating two new units at the Putnam site would be insignificant for both criteria pollutants and GHG emissions.

9.3.5.9 Nonradiological Health

The following analysis assesses impacts from building activities and operations for the Putnam site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect nonradiological health, including the other Federal and non-Federal projects listed in Table 9-25. Impacts from building activities that have the potential to affect the health of members of the public and workers include exposure to dust and vehicle exhaust, occupational injuries, noise, and the transport of construction materials and personnel to and from the site. The operation-related activities that have the potential to affect the health of members of the public and workers includes exposure to etiological agents, noise, EMFs, and increased traffic associated with the transport of workers to and from the site.

Most of the nonradiological health impacts associated with building and operation (e.g., air emissions, noise, occupational injuries) would be limited to areas within approximately 2 mi from the site. Occupational injuries would occur only within the boundaries of the site, and noise from construction and operation has likewise been assessed as minimal for offsite receptors beyond a 2-mi radius. For nonradiological health impacts associated with transmission lines, the geographic area of interest would be the transmission-line corridor. If the facility were built and operated at the Putnam site, the St. Johns River would serve as the source of cooling water. In addition, a reservoir would need to be built to assure an adequate cooling-water supply.

Building Impacts

Nonradiological health impacts on construction workers and members of the public from building two new nuclear units at the Putnam site would be similar to those evaluated in Section 4.8 for building at the LNP site. The impacts include noise, vehicle exhaust, dust, occupational injuries, and transportation accidents, injuries, and fatalities. A detailed noise study has not been performed for the Putnam site, but it is likely that noise impacts from building, except for rare, high-noise activities such as pile-driving, would comply with Federal, State and local noise ordinances, and that the overall noise impact associated with building would be minimal. Fugitive dust and vehicle emissions during building would be controlled by good management practices and compliance with Federal, State, and local air quality regulations. The incidence of construction worker accidents would be the same as that for the LNP site, the only difference being potential injuries associated with building of the cooling-water reservoir.

Analyses in Section 9.3.5.5 indicated that noticeable but intermittent traffic impacts would be observed during peak building activities at the Putnam site at the intersection of US-17 and the site access road. These impacts would be of the same magnitude as those predicted for building at the LNP site. Given the existing traffic patterns in the area near the Putnam site, there is little potential for cumulative traffic impacts with other projects, and additional injuries and fatalities from traffic accidents involving transportation of materials and personnel for building of a new nuclear power plant at the Putnam site would be similar to those estimated in Section 4.8.3 for building at the LNP site.

Past construction of the Seminole Power Plant, the Putnam Steam Power Plant, and Hard Rock Material's concrete batch and ready-mixed concrete plants listed in Table 9-25 occurred within 10 mi of the Putnam site. However, because all reasonably foreseeable potential future construction projects identified in Table 9-25 are relatively distant (greater than 10 mi) from the Putnam site, future combined nonradiological impacts from building at the Putnam site and other projects would not occur. Cumulative impacts of building at the Putnam alternative site would therefore be minimal.

Operational Impacts

Noise, air emissions, and occupational injuries from the operation of two new nuclear units at the Putnam site would be similar to those evaluated in Section 5.8 for the LNP site. Occupational health impacts on workers (e.g., falls, electric shock or exposure to other hazards) at the Putnam site would likely be the same as those evaluated for workers at two new units operating at the LNP site. The cooling-system discharge from the facility might encourage the growth of etiologic organisms in the St. Johns River. Etiological agent growth could be reduced by the use of biocides in the cooling systems, thermal discharge would be restricted by NPDES permit limitations, and exposure to impaired water would be limited by controls on access to the discharge zone (fencing, signage, and other security measures). However, because the cooling-system discharge may amount to a significant proportion of the recommended minimum flow in the St. Johns River, and water quality in the river has been identified as impaired due to the presence of nutrients, fecal coliform, depressed dissolved oxygen, turbidity, and other pollutants (FDEP 2009f), the review team has concluded that the discharge of blowdown to the river could have a noticeable effect on the growth of etiological agents. Exposure to etiological agents in the cooling-water reservoir would not pose an additional health risk as long as access to the reservoir is limited by virtue of its being within the controlled and fenced site boundaries

Noise and EMF exposure from operations would be monitored and controlled in accordance with applicable OSHA regulations. Although no detailed noise modeling has been performed for the Putnam site, it is likely that noise impacts would be similar to those predicted for operations at the LNP site. The effects of EMF on human health in the transmission-line corridors would be controlled and minimized by conformance with NESC criteria and adherence to the standards for transmission systems regulated by the FDEP. Nonradiological impacts of traffic associated with the operations workforce would be less than the impacts during building.

A number of the projects and activities identified in Table 9-25 (surface mining, minor permitted municipal discharges) may also affect water quality in the St. Johns River near the Putnam site. However, these releases are unlikely to have significant cumulative impacts on water quality with a nuclear facility built at the Putnam site because all of the current and future projects are distant from the site. In addition, the amounts of chemicals released from the nuclear facility would be limited by NPDES permits to levels that would not adversely affect water quality, even in combination with the existing pollutant load in the St. Johns River. As noted above, however, blowdown discharge may result in increased water temperature that could facilitate the growth of etiological agents.

The review team is also aware of the potential climate changes that could affect human health; recent analyses of these issues (GCRP 2009) have been considered in the preparation of this EIS. Projected changes in the climate for the region include an increase in average temperature and a decrease in precipitation, which may alter the presence of microorganisms and parasites in surface water. While the overall impacts of climate change may not be insignificant (see Section 7.7), the effect of, or contribution to, climate change impacts by the operation of two new units at the Putnam site is likely to be minor. In its analysis of climate change impacts, the review team did not identify any additional data that would alter its conclusion regarding the presence of etiological agents or change in the incidence of waterborne diseases associated with operation of a nuclear facility at the Putnam site.

Summary

The assessment of impacts on nonradiological health from building and operation of the two new units at the Putnam alternative site is based on the information provided by PEF and the review team's independent evaluation. The review team concludes that nonradiological health impacts on workers and the public resulting from building two new units and associated transmission lines at the Putnam alternative site would be minimal. Similarly, the review team also expects occupational injuries and other nonradiological health impacts on workers and the public of two new nuclear units operating at the Putnam site would be minimal except for potential growth of etiological agents in the St. Johns River from the influence of the cooling-system blowdown discharges during droughts or low-flow periods. These effects could be reduced if the blowdown were discharged to the cooling reservoir, rather than directly to the river. Exposure to etiological agents could be increased if access to the cooling reservoir is not limited by physical and administrative controls. Based on these findings, the review team concludes that cumulative impacts on nonradiological health from related past, present, and future actions in the geographic area of interest and building and operations of two nuclear units at the Putnam site would be SMALL to MODERATE. The severity of impacts would depend on the design characteristics of the facility, which have not been fully defined. If exposure to water heated by thermal discharge is not limited by administrative or physical controls, the contribution from building and operations at the Putnam site could be a significant contributor to the cumulative nonradiological health impacts.

9.3.5.10 Radiological Impacts of Normal Operations

The following impact analysis includes radiological impacts from building activities and operation for two additional nuclear units at the Putnam site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects listed in Table 9-25. As described in Section 9.3.5, the Putnam site is a greenfield site. The geographic area of interest is the area within a 50-mi radius of the Putnam site. There are no major facilities that result in regulated exposures to the public or biota within 50 mi of the Putnam site. However, there are likely to be hospitals and industrial facilities within 50 mi of the Putnam site that use radioactive materials.

The radiological impacts of building and operating the proposed two AP1000 units at the Putnam site include direct radiation and liquid and gaseous radioactive effluents. Releases of radioactive materials and all pathways of exposure would produce low doses to people and biota offsite, well below regulatory limits. The impacts are expected to be similar to those estimated for the LNP site. The NRC staff concludes that the dose from direct radiation and effluents from hospitals and industrial facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Putnam site. This conclusion is based on the radiological monitoring programs conducted around currently operating nuclear power plants.

Based on the information provided by PEF and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 units and other past, present, and reasonably foreseeable projects and actions in the geographic area of interest around the Putnam site would be SMALL.

9.3.5.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from operations for two nuclear units at the Putnam site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-25. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase the probability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Putnam site. As described in Section 9.3.5, the Putnam site is less than 100 mi from the existing CREC power plant site; there is one nuclear facility at the CREC site. There are no proposed reactors that have the potential to increase the probability-weighted consequences from a severe accident at any location within 50 mi of the Putnam site.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the LNP site would be minimal for AP1000s. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet the NRC safety criteria. The AP1000 design is independent of site conditions and the meteorological conditions of the Putnam and LNP sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Putnam site would be minimal.

Assuming the meteorology, population distribution, and land use for the Putnam site are similar to those at the LNP site, risks from a severe accident for an AP1000 reactor located at the Putnam site are expected to be similar to those analyzed for the LNP site. These risks for the LNP site are presented in Tables 5-17 and 5-19 and are well below the median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For the existing plant within the geographic area of interest, namely CREC Unit 3, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR Part 51, Appendix B, Table B-1). If the NRC approves the requested 20 percent power uprate at CREC Unit 3, its approval will be based, in part, on the NRC staff's determination that the risk implications of the planned 20 percent power uprate are acceptable. Therefore, the impact would continue to be SMALL. On this basis, the NRC staff concludes that the cumulative risks of severe accidents at any location within 50 mi of the Putnam site would be SMALL.

9.3.6 Comparison of the Impacts of the Proposed Action and Alternative Sites

This section summarizes the review team's characterization of the cumulative impacts related to locating a two-unit AP1000 nuclear power facility at the proposed LNP site and at each alternative site. The four sites selected for detailed review as part of the alternative sites environmental analysis are the Crystal River, Dixie, Highlands, and Putnam sites in Florida. Comparisons are made between the proposed and alternative sites to evaluate if one of the alternative sites would be environmentally preferable to the proposed site. The NRC's determination is independent of the USACE's determination of a LEDPA pursuant to the Clean Water Act Section 404(b)(1) Guidelines at 40 CFR Part 230. While the USACE concurs as part of the review team with the designation of impact levels for terrestrial or aquatic resource areas in this EIS; in so far as waters of the United States are concerned, the USACE must conduct a quantitative comparison of impacts on waters of the United States as part of the LEDPA analysis. The USACE will conclude its analysis of both offsite and onsite alternatives in its ROD. The need to compare the proposed site with alternative sites arises from the requirement in Section 102(2)(c)(iii) of NEPA (42 USC 4332) that EISs include an analysis of alternatives to the proposed action. The NRC criteria to be used in assessing whether a proposed site is to be rejected in favor of an alternative site is based on whether the alternative site is "environmentally preferable" and if so whether it is "obviously superior" to the site proposed by the applicant (Public Service Company 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).”

Section 9.3.6.1 reviews the cumulative environmental impacts of building and operating a two-unit nuclear power plant at the proposed LNP site. Cumulative impact levels from Chapter 7 (for the proposed LNP site), and the four alternative sites (from Sections 9.3.2 through 9.3.5) are listed in Table 9-31. Section 9.3.6.2 and Section 9.3.6.3 discuss the cumulative impacts of the proposed project located at the LNP site and at the alternative sites as they relate to a determination of environmental preference or obvious superiority.

9.3.6.1 Comparison of Cumulative Impacts at the Proposed and Alternative Sites

The following section summarizes the review team’s independent assessment of the proposed and alternative sites. The team characterized the expected cumulative environmental impacts of building and operating new units at the LNP site and alternative sites; these impacts are summarized by resource area in Table 9-31.

The environmental resource areas listed in the table have been evaluated using the NRC’s three-level standard of impact significance: SMALL, MODERATE, or LARGE. These levels were developed using the CEQ guidelines and set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

> 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.

Table 9-31. Comparison of Cumulative Impacts at the Proposed and Alternative Sites

Resource Area	Levy	Crystal River	Dixie	Highlands	Putnam
Land Use	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Water Related					
Surface-Water Use	SMALL	SMALL	MODERATE	MODERATE	MODERATE
Surface-Water Quality	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Groundwater Use	SMALL	SMALL	SMALL	SMALL	SMALL
Groundwater Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecology					
Terrestrial Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Aquatic Ecosystems	SMALL to MODERATE	SMALL to MODERATE	MODERATE	SMALL	SMALL
Socioeconomic[(a)]					
Physical	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Demography	SMALL	SMALL	MODERATE	SMALL	SMALL
Taxes and Economy	SMALL (adverse) to LARGE (beneficial)	SMALL to LARGE (beneficial)	SMALL (adverse) to LARGE (beneficial)	SMALL (adverse) to LARGE (beneficial)	SMALL (adverse) to LARGE (beneficial)
Housing	SMALL	SMALL	SMALL	SMALL	SMALL
Traffic	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Public Services	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL
Education	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL
Recreation	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE
Historic and Cultural Resources	SMALL	SMALL	SMALL	SMALL	SMALL
Air Quality	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Nonradiological Health	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Radiological Health	SMALL	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	SMALL	SMALL	SMALL	SMALL	SMALL

(a) Ranges indicate differences in counties

Full explanations of the specific cumulative impact characterizations are provided in Chapter 7 for the proposed site and in Sections 9.3.2, 9.3.3, 9.3.4, and 9.3.5 for the alternative sites. The staff's impact category levels are based on professional judgment, 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 COL is underway. The considerations and assumptions were similarly applied at each of the alternative sites to provide a common basis for comparison. In the following discussion, the review team compares the impact levels between the proposed site and each alternative site.

9.3.6.2 Environmentally Preferable Sites

As shown in Table 9-31, the cumulative impacts of building and operating two new units at the proposed site and the alternative sites are characterized as SMALL for many resource areas. The resource areas for which the impact level at an alternative site is the same as that for the proposed site do not contribute to the alternative site being judged to be environmentally preferable to the proposed site. Therefore, these resource areas are not discussed further in determining whether an alternate site is environmentally preferable to the proposed site. The resource areas for which an alternative site has a different impact level than the proposed site are discussed further to determine if an alternative site is environmentally preferable to the proposed site. Where there is a range of impacts for a resource, the upper value of the impacts is used for the comparison. In addition, for the cases in which the cumulative impacts for a resource are greater than SMALL, consideration is given to those cases in which the impacts of the project at the specific site do not make any significant contribution to the cumulative impact level. As shown in Table 9-31, there are some differences in impacts among the sites.

Crystal River Site

The LNP site may be marginally preferable to the Crystal River site with regard to tax revenues. Revenues from property taxes and sales taxes from operating the two new nuclear units at the site result in a LARGE beneficial impact level. This LARGE beneficial tax benefit would fully offset the loss of tax revenues to Citrus County that would occur if the coal-fired CREC Units 1 and 2 are decommissioned; but the net beneficial impact to tax revenues from the two new units at the Crystal River site would still be LARGE.

For land use, terrestrial ecosystems, public services and education, and aesthetics at both sites, the project would be a significant contributor to the incremental MODERATE impact level. Ongoing and planned development projects at these sites also contribute to the impact level.

Cumulative impacts on aquatic ecological resources would be SMALL to MODERATE based on past operation activities of CREC that resulted in noticeable effects on aquatic resources from impingement, entrainment, and thermal discharge. However, building and operating two new nuclear units at the Crystal River site would not contribute significantly to the MODERATE impact.

The Crystal River site is characterized more favorably than the LNP site for traffic. The SMALL to MODERATE cumulative impact at the LNP site relates to the combined impact of the large construction and preconstruction work forces and traffic from local mining activities, particularly during shift changes.

Based on the results and comparison of the resource areas and associated impact characterizations, the review team concludes that building and operating two new nuclear units at the Crystal River site or the LNP site would result in similar environmental impacts, with little difference between the sites. In such a case, the proposed site prevails because the alternative site is not environmentally preferable.

In its June 30, 2010 letter to USACE (PEF 2010), PEF indicated that for business reasons, it no longer considers the Crystal River site to be practicable for the purposes of the USACE LEDPA determination. PEF determined that adding two nuclear units to the existing units at the Crystal River site would result in the concentration of a large fraction of PEF's total generation capacity at one site, which could be subject to disruption by a single event. While the review team acknowledges this business-related concern, it falls outside the bounds of the review team's environmental evaluation.

Dixie Site

The LNP site is characterized more favorably than the Dixie site in Table 9-31 for the resource areas of surface-water use, aquatic ecosystems, demography, and nonradiological health effects. Conversely, the Dixie site is not characterized by the review team as more favorable than the LNP site in Table 9-31 for any resource area. For aquatic ecosystems, demography, and nonradiological health effects, the differences relate directly to the impacts of the proposed project at the two sites. For surface-water use, the MODERATE impact for the Dixie site is related to water use by other projects. However, because building and operating two new nuclear units at the Dixie site would not contribute significantly to that impact, this does not represent a distinction between the Dixie site and the LNP site. For land use, terrestrial ecosystems, and aesthetics, building and operating two new nuclear units would be a significant contributor to the MODERATE impact levels at both sites.

For aquatic ecosystems, the concern at the Dixie site is the potential for the water use impact to adversely affect the Gulf sturgeon, a Federally protected species. The review team found that the impact to aquatic resources would be SMALL at the LNP site and MODERATE at the Dixie site. For nonradiological health, the operation of a proposed facility at the Dixie site could result in a SMALL to MODERATE impact due to an increased risk of human exposure to etiological agents. The LNP site was determined to have a potential for only a SMALL impact with respect to nonradiological health effects. For impacts on demography, the MODERATE impact at the Dixie site is based on the magnitude of the increase in the population of the county during the building phase for the new units. Impacts on demography at the LNP site would be SMALL.

Based on the results and comparison of the resource areas and associated impact characterizations, the review team concludes that the Dixie site would not be environmentally preferable to the LNP site for two new nuclear generating units.

Highlands Site

The LNP site is characterized more favorably than the Highlands site in Table 9-31 for the following resource areas: surface-water use, environmental justice, and nonradiological health effects. Conversely, the Highlands site is characterized by the review team as more favorable than the LNP site in Table 9-31 for the resource areas aquatic ecosystems, of public services and education.

For surface-water use, building and operating the proposed plant at the Highlands site would be a significant contributor to water use because the amount of water needed to operate two units would represent a significant portion of the river flow. In an October 6, 2010 comment letter (SFWMD 2010b), the SFWMD indicated that the availability of surface water is limited and obtaining groundwater is also problematic, as discussed in Section 9.3.4.2 of this EIS. This information validates the review team's concern regarding the impacts of surface-water use at the Highlands site. Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, states that there should be reasonable assurance that permits for consumptive use of water for the plant can be obtained by the applicant from the appropriate regulatory agency, in this case SFWMD. At the time it prepared the draft EIS, the review team believed that this aspect of the guidance had been satisfied. However, the letter from SFWMD seems to indicate that there is not reasonable assurance that the necessary water use permit could be obtained.

The higher impact level for environmental justice at the Highlands site relates to potential effects on subsistence fishing, especially on local Native-American populations. For nonradiological health, the operation of a proposed plant at the Highlands site could result in a SMALL to MODERATE impact due to an increased risk of human exposure to etiological agents. The LNP site was determined to have a potential for only a SMALL impact with respect to nonradiological health effects. For public services and education at the LNP site, the MODERATE impact level is a result of short-term adverse effects on police, emergency service, fire-protection services, and schools in specific local communities during peak construction and preconstruction. The review team's finding of a MODERATE impact for the two resource areas at the LNP site is based on the fact that specific community public services were either at capacity or otherwise limited. The higher impact level for public services and education at LNP is directly related to peak construction and preconstruction of two new nuclear units at the site. The staff concluded that the impacts on aquatic ecosystems for the LNP site were SMALL to MODERATE, based primarily on the impacts of the existing CREC units. New units at the LNP site would not be a significant contributor to these impacts. Therefore, this does not represent a distinction between the Highlands site and the LNP site.

For land use at Highlands, building two new reactor units at the site is a significant contributor to the MODERATE impact assessment because of the disturbance of a substantial amount of land for the power plant, reservoir, and transmission lines. The review team concluded that cumulative land-use impacts also are MODERATE at the LNP site, and that building and operating two nuclear units would contribute significantly to the MODERATE impact. For terrestrial ecosystems at both sites, the MODERATE impacts are based on the alteration of natural habitats.

Based on the results and comparison of the resource areas and associated impact characterizations, the review team concludes that the Highlands site would not be environmentally preferable to the LNP site for two new nuclear generating units.

Putnam Site

The LNP site is characterized more favorably than the Putnam site in Table 9-31 for the following resource areas: surface-water use, environmental justice, and nonradiological health. Conversely, the Putnam site is characterized more favorably than the LNP site in Table 9-31 for public services and education.

For surface-water use, the MODERATE impact for the Putnam site is related to water use by other projects. However, because building and operating two new nuclear units at the Putnam site would not contribute significantly to that impact, this does not represent a distinction between the Putnam site and the LNP site. For environmental justice at Putnam, the MODERATE level is based on a potentially disproportionate impact on subsistence fishing. For nonradiological health, the operation of a proposed plant at the Putnam site could result in a SMALL to MODERATE increased risk of human exposure to etiological agents. The LNP site was determined to have a potential for only a SMALL effect with respect to environmental justice and nonradiological health. At the LNP site, the review team's finding of a MODERATE impact assessment for public services and education is based on the fact that, during construction, these services would be stressed because they are at capacity or otherwise limited. Operating two new units at the LNP site would not contribute significantly to long-term public service and education impacts. The staff concluded that the impacts on aquatic ecosystems for the LNP site were SMALL to MODERATE, based primarily on the impacts of the existing CREC units. New units at the LNP site would not be a significant contributor to these impacts. Therefore, this does not represent a distinction between the Putnam site and the LNP site.

For land use, terrestrial ecosystems, and aesthetics, the two sites have essentially the same cumulative impact levels, and building and operating two new nuclear units would be a significant contributor to the impact levels at both sites. This is because of the substantial amount of land needed for the proposed power plant, supplemental cooling reservoir (at Putnam), and transmission infrastructure and the long-term impacts along transmission lines and corridors.

Based on the results and comparison of the resource areas and associated impact characterizations, the review team concludes that the Putnam site would not be environmentally preferable to the LNP site for two new nuclear generating units.

Summary

Although there are differences and distinctions between the cumulative environmental impacts of building and operating two new nuclear generating units at the proposed LNP site and the alternative sites, the review team concludes that none of these differences is sufficient to determine that any of the alternative sites would be environmentally preferable to the proposed site for building of two new nuclear generating units.

9.3.6.3 Obviously Superior Sites

None of the alternative sites was determined to be environmentally preferable to the proposed LNP site. Therefore, the NRC staff concludes that none of the alternative sites would be obviously superior to the LNP site. As discussed in Section 9.0, the USACE will conclude its analysis of both offsite and onsite alternatives in its ROD for a DA permit under Section 404 of the Clean Water Act.

9.4 System Design Alternatives

The review team considered a variety of alternatives for heat-dissipation systems and CWSs. While other heat-dissipation systems and water systems exist, by far the largest and the most likely to dominate the environmental consequences of operation is the cooling-water system that cools and condenses the steam for the turbine generator. Other water systems, such as service-water systems, are much smaller and reject much less heat than the CWS. As a result, the review team only considers alternative heat-dissipation and water-treatment systems for the CWS. The review team also considers alternative water sources for both the CWS and the service-water system because withdrawal of water for both of these systems has a potential to affect the environment. The proposed CWS is a closed-loop system that relies on evaporative cooling from mechanical draft cooling towers and draws makeup water from the CFBC. The proposed service-water system relies on groundwater wells to provide makeup water. Both of these proposed systems are discussed in detail in Chapter 3.

9.4.1 Heat-Dissipation Systems

About two-thirds of the heat from a commercial nuclear reactor is rejected as heat to the environment. The remaining one-third of the reactor's generated heat is converted into electricity. Normal heat-sink cooling systems transfer this rejected heat load into the atmosphere and/or nearby waterbodies, primarily as latent heat exchange (evaporating water) or sensible heat exchange (warmer air or water). Different heat-dissipation systems rely on different exchange processes. The following sections describe alternative heat-dissipation systems considered by the review team for proposed LNP Units 1 and 2.

The impacts associated with the proposed heat-dissipation system, mechanical draft wet-tower cooling system, are discussed in Sections 4.2, 4.3, 5.2, and 5.3. The review team determined in Chapter 4 that the impacts of building the proposed heat-dissipation system would be SMALL for both hydrologic and ecological resources. The review team determined in Chapter 5 that the impacts of operating the proposed heat-dissipation system would be SMALL for both hydrologic and ecological resources.

PEF considered a range of heat-dissipation systems in its ER, including once-through cooling and several closed-cycle cooling systems. In addition to the closed-cycle alternative using mechanical draft cooling that they have selected, PEF also considered cooling ponds and spray ponds, dry cooling towers, hybrid wet/dry cooling towers, and wet natural draft cooling towers (PEF 2009b).

9.4.1.1 Plant Cooling System – Once-Through Operation

Once-through cooling systems withdraw water from the source waterbody and return virtually the same volume of water to the receiving waterbody at an elevated temperature. Typically, the source waterbody and the receiving waterbody are the same body and the intake and discharge structures are separated to limit recirculation. While there is no consumptive use of water in a once-through heat-dissipation system, the elevated temperature of the receiving waterbody will result in induced evaporative loss that decreases the net water supply. The large intake and discharge flows associated with once-through cooling systems require large intake and discharge structures; the high flow rates may result in hydrologic alterations in the source/receiving waterbodies. In addition, the high flow rates result in higher levels of impingement and entrainment of aquatic organisms. Based on EPA 316(b) Phase I regulations (66 FR 65256), the review team has determined that once-through cooling systems for new nuclear reactors are unlikely to be permitted in the future, except in rare and unique situations.

The proposed LNP site is approximately 7 mi from the Gulf of Mexico, and construction of intake and outfall structures that would support once-through cooling at this location are not considered practical (PEF 2009b). The review team determined that once-through cooling would not be environmentally preferable because of the magnitude of the impacts of building large intake and outfall structures, the significant volume of makeup water needed, the characteristics of the Gulf of Mexico near the LNP site, and the potential for significant impacts on sensitive aquatic biota.

9.4.1.2 Cooling Pond and Spray Ponds

Cooling-pond cooling systems circulate water in man-made ponds. Heat transfer from the cooling-pond surface to the atmosphere occurs primarily through evaporation, black-body radiation, and conduction. Spray ponds enhance evaporative cooling by spraying water into the air over the pond. While spray ponds require substantiality less area than cooling ponds, both require a significant parcel of contiguous level property. Based on the additional land required for cooling-pond or spray-pond construction, the review team concludes that neither cooling ponds nor spray ponds would be environmentally preferable alternatives for the proposed LNP site.

9.4.1.3 Dry-Cooling Towers

Dry-cooling towers would eliminate all water-related impacts from the cooling system operation. No makeup water would be needed and no blowdown water would be generated. However, dry-cooling systems require much larger cooling systems, result in some loss in electrical generation efficiency because the theoretical approach temperature is limited to the dry-bulb temperature and not the lower wet-bulb temperature, and involve parasitic energy losses for the large array of fans used. This loss in generation efficiency translates into increased fuel-cycle impacts. Because the impacts associated with aquatic ecology, water use, and water quality for the construction and operation of the proposed cooling system have been determined to be SMALL in Chapters 4 and 5, the review team determined that, although dry cooling eliminates water-related impacts, it is not environmentally preferable to the proposed alternative.

9.4.1.4 Combination Wet/Dry-Cooling Tower System

A combination mechanical draft wet/dry-cooling tower system uses both wet- and dry-cooling cells to limit consumption of cooling water, often with the added benefit of reducing plume visibility. Water used to cool the turbine generators generally passes first through the dry portion of the cooling tower where heat is removed by drawing air at ambient temperature over tubes through which the water is moving. Cooling water leaving the dry portion of the tower then passes through the wet tower where the water is sprayed into a moving air stream and additional heat is removed through evaporation and sensible heat transfer. When ambient air temperatures are low, the dry portion of these cooling towers may be sufficient to meet cooling needs. The use of the dry portion of the system would result in a loss in generating efficiency, which would translate into increased fuel-cycle impacts. Although a combination mechanical draft wet/dry-cooling tower system could reduce water-related impacts, the review team determined that the impacts associated with aquatic ecology, water use, and water quality for building and operating the proposed cooling system were SMALL. The review team concluded that building and operating a combination wet/dry-cooling tower system would not be an environmentally preferable alternative for the LNP site.

9.4.1.5 Wet Natural Draft Cooling Towers

Wet natural draft cooling towers, which use about the same amount of water as the proposed design, induce airflow up through large (500 ft tall and 400 ft in diameter) towers by cascading hot water downward in the lower portion of the cooling tower. As heat transfers from the water to the air in the tower, the air becomes more buoyant and moves upward. This buoyant movement induces more air to enter the tower through its open base. The size of the cooling towers results both in a large visual and land-use footprint. The review team determined that natural draft cooling towers are not environmentally preferable to the proposed design because they result in equivalent impacts on the aquatic environment and their height would pose some risk of avian collisions.

9.4.2 Circulating-Water Systems

The review team evaluated alternatives to the proposed intake and discharge for the proposed cooling system, based on the water requirements of the proposed heat-dissipation system. The capacity requirements of the intake and discharge system are defined by the proposed heat-dissipation system. For proposed LNP Units 1 and 2, the proposed heat-dissipation system is a closed-cycle system with mechanical draft cooling towers. The review team considered alternatives for the water-supply sources for the normal heat-sink cooling system.

9.4.2.1 Water Supplies

The impacts associated with the proposed water supply, the CFBC, are discussed in Sections 4.2, 4.3, 5.2, and 5.3. Because PEF does not propose to use surface water for building the proposed units, the review team determined in Chapter 4 that the impacts of building the proposed units would be SMALL for both hydrologic and aquatic resources. The review team determined in Chapter 5 that the impacts of withdrawing water to operate the proposed units would be SMALL for both hydrologic and aquatic resources.

The review team considered alternative sources for the CWS including water reuse, groundwater, and surface water. Alternative sources of surface water include freshwater and saltwater.

9.4.2.2 Water Reuse

Sources of water for reuse can either come from the plant itself or from other local water users. Sanitary wastewater-treatment plants are the most common source of water for reuse.

Agricultural processing, industrial processing, and oilfield production can also provide significant supplies of water for reuse. Additional treatment (e.g., tertiary treatment, chlorination) may be required to provide water of appropriate quality for the specific plant need. Population is very low and there is little industry around the proposed LNP site, so no sources of water for reuse at the LNP site were identified (PEF 2009b). Therefore, the review team determined that water reuse would not be feasible and thus not an environmentally preferable alternative to PEF's proposed water supply.

9.4.2.3 Groundwater

During operation, PEF proposes to use groundwater for the raw-water system but not for the cooling-water system. The analysis of groundwater supply performed to support the siting and permitting of the wellfield for the raw-water system indicates that the groundwater resource could not meet the cooling-water demands of proposed LNP Units 1 and 2 without significant environmental impacts (PEF 2009b). Therefore, the review team determined that groundwater use for cooling-water system makeup water would not be an environmentally preferable alternative for water supply at the LNP site.

9.4.2.4 Surface Water

Surface-water supplies at the proposed LNP site are either saltwater from the CFBC or freshwater from the Withlacoochee River and Lake Rousseau. The Withlacoochee River is designated as an Outstanding Florida Water and therefore has regulatory protection (Fla. Admin. Code 62-302). In addition, the Withlacoochee River Basin Board has made the restoration of Lake Rousseau and the Lower Withlacoochee River a priority in its Fiscal Year 2006 Basin Priorities Statement. Both of these surface waters contribute to a major groundwater recharge area (PEF 2009e). Given that local and State regulators have focused their attention on protecting or restoring these resources and that the CFBC provides a virtually unlimited supply of water from the Gulf of Mexico and does not require the construction of an extensive pipeline, the review team concludes that other alternative water supplies would not be environmentally preferable to PEF's proposed water supply.

9.4.2.5 Intake Alternatives

Because water would be withdrawn from the CFBC, the alternatives for intake structures are limited. Water can be withdrawn from the CFBC either through radial collector wells or through an intake structure on the bank of the canal near the barge slip. The impacts associated with the proposed intake system are discussed in Sections 4.2, 4.3, 5.2, and 5.3.

A radial collector-well system was considered by the review team because in many cases it reduces the impact on aquatic resources and, when water is being withdrawn from turbid environments, it can reduce the water treatment needed before its introduction into the cooling system. A radial collector-well system consists of an excavated central concrete caisson with well screens projected laterally outward in a radial pattern (Riegert 2006). Radial collector wells slowly draw surface water through sediments and, thereby, filter out some sediment that might have required some treatment if the water had been directly withdrawn from the surface-waterbody. In general, collecting surface water in this way eliminates most of the direct operational impacts on aquatic ecosystems (e.g., entrainment and impingement) associated with water withdrawal. The staff determined that radial collector wells, which would induce flow through the sediments of the CFBC into lateral subterranean pipes extending from the shoreline out beneath the canal, would require multiple large structures near the shoreline. PEF did not consider such an alternative water source, but the review team independently determined that a radial collector-well system is not environmentally preferable to the proposed direct withdrawal from the CFBC due to the environmental impacts associated with excavating the caissons, drilling the laterals and building new shoreline structures associated with each well, and because the impacts associated with aquatic ecology for the proposed intake have been determined to be SMALL in Chapters 4 and 5. Therefore, the review team determines that there are no alternative intake designs that would be environmentally preferable to the proposed intake design.

9.4.2.6 Discharge Alternatives

The impacts associated with the proposed discharge system are discussed in Sections 4.2, 4.3, 5.2, and 5.3. Discharges for the normal cooling system can be constructed along the shoreline or offshore. Shoreline discharges release water into the shallow tidal zone with more limited mixing than would an offshore discharge. These shallow tidal areas can be important habitat and, due to the limited mixing, a shoreline discharge can influence the temperature and chemistry for a relatively large amount of this habitat. As discussed in Sections 5.2 and 5.3, the overall impacts of using the existing CREC offshore discharge would be SMALL. In addition, creation of a new offshore discharge would require temporary disturbance of sensitive environments during construction of a pipeline in the Gulf of Mexico. Therefore, the review team determined that there were no alternative discharge designs that would be environmentally preferable to the proposed discharge design.

9.4.2.7 Water Treatment

Both inflow and effluent water may require treatment to ensure that they meet plant water needs and effluent water standards. PEF proposes to add chemicals to plant water to meet appropriate water-quality process needs. The chemistry of effluent water is regulated by the FDEP through the NPDES permitting process. The largest chemical inputs are required to maintain the appropriate chemistry in the cooling towers to preclude biofouling. The review team identified no environmentally preferable alternative to PEF's proposed chemical water treatment. The effluents from cooling-tower blowdown are specifically regulated in 40 CFR Part 423 by the EPA to protect the environment.

9.4.3 Service-Water System Alternatives

The review team evaluated alternatives to the proposed source of water for systems using freshwater within the LNP units. For proposed LNP Units 1 and 2, during plant operations, water would be withdrawn from groundwater wells to supply water to the service-water system, and provide raw water to the potable-water supply, the demineralized-water system, for fire protection, and for media filter backwash (PEF 2009b). Four groundwater wells would be located south of the plant as shown in Figure 3-1. The review team considered surface-water alternatives for the water-supply source to meet these freshwater needs.

PEF examined a variety of potential sources of water for the service-water system, including municipal freshwater supply from an adjacent city or the CREC, reclaimed water (municipal wastewater) from an adjacent city, reduced groundwater demand by use of alternative service-water cooling technology, recycle of process water, seawater desalination, fresh surface water, brackish water from deep wells, reducing groundwater demand by using a combination of sources (for example groundwater combined with an alternate source, such as stormwater runoff), and the use of groundwater as a backup supply to an alternative source of freshwater (PEF 2011i). The review team considered these alternatives. Obtaining water from the CREC or a nearby community and obtaining reclaimed water are not given further consideration because nearby communities and CREC do not have excess capacity and there are no communities in the vicinity of the Levy County site that have sufficient wastewater to meet system needs. Alternative cooling system technologies would be a departure from the AP1000 DCD and therefore was not given futher consideration. Recycled process water and stormwater runoff can only supply a fraction of the water needed. Extraction of brackish water from the lower Floridan aquifer may be feasible, but lack of site-specific information about the characteristics of the middle Floridan confining interval may lead to the same concerns about potential impact on wetlands that pumping from the shallow aquifer does and therefore was not given further consideration. The review team only considered surface-water sources as alternatives to the proposed water supply discussed in Chapter 5.

As mentioned above, surface-water supplies at the proposed LNP site are either saltwater from the CFBC or freshwater from the Withlacoochee River and Lake Rousseau. The Withlacoochee River is designated as an Outstanding Florida Water and therefore has regulatory protection (Fla. Admin. Code 62-302). In addition, the Withlacoochee River Basin Board has made the restoration of Lake Rousseau and the Lower Withlacoochee River a priority in its Fiscal Year 2006 Basin Priorities Statement. Given that local and State regulators have focused their attention on protecting or restoring these resources and that the CFBC provides a virtually unlimited supply of water from the Gulf of Mexico, the review team eliminated from further consideration the withdrawal of surface freshwater as a source of water for the service-water system and considered instead the building of a desalination plant at the LNP site to meet the freshwater needs of the site by desalinating water from the CFBC.

A desalination (also called desalinization or desal) plant could be built on the LNP site. Water could be routed from the proposed CWS intake structure to the desalination plant. PEF has estimated that plant operations would require an annual average total withdrawal of 1.58 Mgd (1097 gpm) of groundwater, and a potential maximum daily withdrawal of 5.8 Mgd (4028 gpm) (PEF 2009e) to meet freshwater needs. PEF indicates that desalination would produce 45 gal of freshwater for every 100 gal of water processed (PEF 2011i), so between 2500 gpm and 9000 gpm would need to be withdrawn from the CFBC to meet the freshwater needs. PEF has indicated that the rate for water withdrawal from the CFBC to provide makeup water to the CWS would be 84,780 gpm (Table 3-4). The potential added withdrawal to supply a desalination plant represents an increased withdrawal from the CFBC of approximately 3 percent for normal conditions and 9 percent for maximal conditions.

Discharge of brine from the desalination plant would likely be mixed with blowdown from the cooling tower basins for discharge through the Crystal River Discharge Canal (CRDC). The salt concentration of the discharge stream would likely be about twice that of the CFBC salinity and be similar to salinity of the cooling-tower blowdown water. PEF has indicated that the blowdown rate for water from the cooling-tower basins to the CRDC would be 57,923 gpm (Table 3-4). The potential added discharge from a desalination plant (approximately 1300 gpm normal or 4900 gpm maximal) represents an increase of approximately 2 percent for normal conditions and 8 percent for maximal conditions.

Given that (1) the CFBC provides a virtually unlimited supply of water from the Gulf of Mexico, (2) the increase in withdrawal through the proposed intake structure would be a small increment, and (3) that the discharge from the desalination plant would be similar in chemistry to the blowdown water from the cooling towers and a small incremental increase in discharge, the review team determined that the use of desalination to meet the plants need for freshwater is a viable alternative.

As discussed in Section 5.3, the review team determined that the wells used to supply freshwater during operation could have a SMALL impact on wetlands, but could have a MODERATE impact on wetlands without timely monitoring and mitigation. However, the review team has determined that because groundwater monitoring would begin during construction and preconstruction several years in advance of operation and because the initial period of withdrawal would be at lower flow rates, any uncertainty in predicted impacts on wetlands would be minimal. Trends possibly indicative of greater than SMALL impacts would likely be manifested in groundwater monitoring and predicted early enough to allow a response capable of averting adverse impacts on wetlands. If adverse effects are observed or predicted, PEF would be required pursuant to Conditions of Certification to install an alternative to groundwater wells. In addition, as discussed in Section 5.3 PEF must propose a plan for groundwater and wetlands monitoring to USACE. The review team expects that there will be a condition in any DA individual permit issued for the LNP site that will require this monitoring and require PEF to switch to an alternative water source if impacts are detected that exceed the criteria established in the permit condition. Therefore, desalination is not considered environmentally preferable. However, if monitoring indicates that an impact greater than SMALL might occur during operation, desalination would be the environmentally preferable alternative.

Summary of System Design Alternatives

The review team considered alternative systems designs including alternative heat-dissipation systems and alternative intake, discharge, and water-supply systems. As discussed in the above sections, the review team identified no alternative that was environmentally preferable to the proposed plant systems design.

9.5 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."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, Licenses, Certifications, and Approvals for Nuclear Power Plants."

33 CFR Part 320. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 320, General Regulatory Policies."

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."

40 CFR Part 230. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 230, “Guidelines for Specification of Disposal Sites for Dredged or Fill Material.”

40 CFR Part 423. Code of Federal Regulations, Title 40, Protection of Environment, Part 423, “Steam Electric Power Generating Point Source Category.”

40 CFR 1502. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 1502, “Environmental Impact Statement.”

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

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33 USC 1344. United States Code, Title 33, *Navigation and Navigable Waters,* Section 1344 “Permits for Dredged or Fill Material.”

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10.0 Conclusions and Recommendations

The U.S. Nuclear Regulatory Commission (NRC) received an application from Progress Energy Florida, Inc. (PEF) for combined construction permits and operating licenses (COLs) for Levy Nuclear Plant (LNP) Units 1 and 2. The location of proposed LNP Units 1 and 2 is in Levy County, Florida, 7.9 mi east of the Gulf of Mexico and 30.1 mi west of Ocala, Florida. In its application, PEF specified the Westinghouse Electric Company, LLC AP1000 pressurized water reactor as the reactor design for LNP Units 1 and 2.

On June 2, 2008, PEF submitted a Site Certification Application to the Florida Department of the Environment. The U.S. Army Corps of Engineers (USACE) received a copy of this application on June 30, 2008. In its March 16, 2009 Public Notice (USACE 2009), the USACE stated that the Environmental Resource Permit application contained in the Site Certification Application, along with its supporting documents, make up the Department of the Army permit application. On August 26, 2009, the Florida Governor and Cabinet (acting as the Siting Board) approved the Site Certification with specified Conditions of Certification for LNP Units 1 and 2, associated facilities, and transmission lines that were subsequently modified on January 12, 2010, February 23, 2010, and January 25, 2011 (FDEP 2011a). The Clean Water Act Section 401 certification is issued by the FDEP as part of Florida's Power Plant Siting Act (PPSA) Certification (29 Fla. Stat. 403) and ensures that the project does not conflict with State water-quality standards. PEF received this certification on September 8, 2009, and a modification to the certification on February 18, 2011 (FDEP 2009; 2011b). The USACE is participating with the NRC in preparing this environmental impact statement (EIS) as a cooperating agency.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321 et seq.), directs that an EIS is required for major Federal actions that significantly affect the quality of the human environment. Section 102(2)(C) of NEPA requires that an EIS include information on the following:

- 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.

NRC has implemented NEPA in Title 10 of the Code of Federal Regulations (CFR) Part 51. In 10 CFR 51.20, NRC requires preparation of an EIS for issuance of COLs. Subpart C of 10 CFR Part 52 contains the NRC regulations related to COLs.

The proposed actions related to the COL application are (1) the NRC issuance of COLs for construction and operation of two new nuclear units at the LNP site in Levy County, Florida, and (2) the USACE issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (also referred to as the Clean Water Act) (33 USC 1251 et seq.) and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403 et seq.). If issued, the USACE permit would authorize the impact on waters of the United States, including wetlands, to construct the LNP electrical generation facility, and various associated, integral project components, including electrical transmission lines and substations, access roads, a barge slip, blowdown piplines, a makeup water pipeline, and cooling-water intake structure.

The environmental review described in this EIS was conducted by a review team consisting of NRC staff, its contractor's staff, and staff from the USACE. During the course of preparing this EIS, the review team reviewed the ER submitted by PEF (2009a) and supplemental documentation; consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in NUREG-1555, *Environmental Standard Review Plans* (NRC 2000), and NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* (NRC 2007), and Staff Memorandum "Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements" (NRC 2011). In addition, the NRC considered the public comments related to the environmental review received during the scoping process. The public comments are provided in Appendix D. The NRC staff also considered public comments received on the draft EIS (NRC 2010). The comments and responses are provided in Appendix E of this EIS.

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 two new nuclear units at the LNP site, (2) mitigation measures for reducing or avoiding adverse effects, (3) the environmental impacts of alternatives to the proposed action, and (4) the NRC staff's recommendation regarding the proposed action based on its environmental review.

The USACE's role as a cooperating agency in the preparation of this EIS is to ensure to the maximum extent practicable that the information presented is adequate to fulfill the requirements of USACE regulations. The Clean Water Act Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230) contain the substantive environmental criteria used by USACE in evaluating discharges of dredged or fill material into waters of the United States. While the USACE concurs as part of the review team with the designation of impact levels for terrestrial or aquatic resource; in so far as waters of the

United States are concerned, the USACE must conduct a quantitative comparison of impacts on waters of the United States as part of the 404(b)(1) analysis. USACE's Public Interest Review (PIR) (33 CFR 320.4) directs the USACE to consider a number of factors as part of a balanced evaluation process. USACE's PIR will be part of its permit-decision document and will not be addressed in this EIS. The USACE will document its conclusion of the review process, including the requirement for compensatory mitigation, in accordance with 33 CFR Part 332, Compensatory Mitigation for Losses of Aquatic Resources, in its permit-decision document.

Environmental issues are evaluated using the three-level standard of significance – SMALL, MODERATE, or LARGE – developed by the NRC using guidelines from the Council on Environmental Quality (CEQ) (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 review team considered planned activities and actions that PEF indicates it and others would likely take if PEF receives the COLs. In addition, PEF provided estimates of the environmental impacts resulting from the building and operation of two proposed new nuclear units on the LNP site.

10.1 Impacts of the Proposed Action

In a final rule dated October 9, 2007 (72 FR 57416), the Commission limited the definition of "construction" to those activities that fall within its regulatory authority (10 CFR 51.4). Many of the activities required to build a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. Because the "preconstruction" activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. Although the preconstruction activities are not part of the NRC action, they support or are requisite to the NRC action. In addition, certain preconstruction activities require permits from the USACE, as well as other Federal, State, and local agencies.

Chapter 4 describes the relative magnitude of impacts related to preconstruction and construction activities with a summary of impacts in Table 4-17. Impacts associated with operation of the proposed facilities are discussed in Chapter 5 and are summarized in Table 5-23. Chapter 6 describes the impacts associated with the fuel cycle, transportation, and decommissioning. Chapter 7 describes the impacts associated with preconstruction and construction activities and operation of LNP Units 1 and 2 when considered along with the cumulative impacts of other past, present, and reasonably foreseeable future projects in the geographic region around the LNP site.

10.2 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 if the proposal is implemented. Unavoidable adverse environmental impacts are those potential impacts of the NRC action and the USACE action that cannot be avoided due to constraints inherent in utilizing the LNP site and its associated offsite facilities.

The unavoidable adverse environmental impacts associated with the granting of the COLs for LNP Units 1 and 2 would include impacts of construction, preconstruction, and operation.

10.2.1 Unavoidable Adverse Impacts During Construction and Preconstruction

Chapter 4 discusses in detail the potential impacts from construction and preconstruction of the proposed Units 1 and 2 at the LNP site and presents mitigation and controls intended to lessen the adverse impacts. Table 10-1 presents the unavoidable adverse impacts associated with construction and preconstruction activities to each of the resource areas evaluated in this EIS, as well as the mitigation measures that would reduce the impacts. Those impacts remaining after mitigation is applied (e.g., avoidance and minimization, but not including compensatory mitigation) are identified in Table 10-1 as unavoidable adverse impacts. Unavoidable adverse impacts are the result of both construction and preconstruction activities, unless otherwise noted. The impact determinations in Table 10-1 are for the combined impacts of construction and preconstruction. However, the impact determinations for NRC-regulated construction are the same for all resource areas except land use, terrestrial and wetland ecosystems, physical and aesthetic impacts, and economic impacts. For impact determinations that differ for the combined construction and preconstruction activities and the NRC-regulated activities, the impacts from the NRC-regulated activities are also identified in Table 10-1.

The unavoidable adverse impacts are primarily attributable to preconstruction activities due to the initial land disturbance from clearing the land, land use, excavation, filling wetlands and waterways, impervious surface addition, dredging, and removal or demolition of three sites with historic or cultural value. NRC-authorized construction activities partially contribute to most of the unavoidable adverse impacts.

Table 10-1. Unavoidable Adverse Environmental Impacts from Construction and Preconstruction

Resource Area	Impacts	Mitigation Measures	Unavoidable Adverse Impacts
Land Use	MODERATE (NRC-authorized construction impact level is SMALL)	Comply with requirements of applicable Federal, State, local permits, and Conditions of Certification	Approximately 627 ac disturbed on a long-term basis. About 1790 ac of land would be reclassified from existing uses to utility corridor use as a result of installing the transmission system to connect the new units to the grid.
Water Use	SMALL	Control erosion and contamination; monitor water levels and water quality in accordance with the Florida Department of Environmental Protection (FDEP) Conditions for Certification	Drawdown of aquifers and redirection of recharge source water would occur, but impacts would be temporary.
Water Quality	SMALL	Implement best management practices (BMPs) and a site-specific stormwater pollution prevention plan (SWPPP)	Onsite and offsite water bodies would receive stormwater runoff during building phase.
		Comply with Federal and State permits and implementation of BMPs	Dredging in the Cross Florida Barge Canal (CFBC) near the CWIS, barge slip, and at the blowdown discharge line crossing.
		Compliance with FDEP permitting rules and implementation of BMPs	Inadvertent spills that seep into aquifers.
Ecological (terrestrial)	MODERATE (NRC-authorized construction impact level is SMALL)	Implement wetland mitigation plan, BMPs, Avian Protection Plan[(a)], and conduct other surveys as required by State and Federal agencies	Impacts would occur on approximately 777 ac (627 ac permanent, 150 ac temporary) of wildlife habitat on the LNP site, and up to 632 ac for the offsite facilities. Total jurisdictional and nonjurisdictional wetland impacts (onsite and offsite) would affect 668 ac. Wildlife and important species could be harmed by construction and preconstruction activities.

Table 10-1. (contd)

Resource Area	Impacts	Mitigation Measures	Unavoidable Adverse Impacts
Ecological (aquatic)	SMALL	Implement BMPs; control erosion and sedimentation	Impacts on the CFBC aquatic resources due to in-water activities associated with cooling-water intake structure (CWIS), barge-unloading facility, and discharge pipelines. Impacts would be localized, temporary, and largely mitigable.
Socioeconomic Physical and Aesthetic	SMALL to MODERATE (NRC-authorized construction impact level is SMALL)	Alert local governmental agencies concerning needed road repairs.	Minor temporary impacts during building phase.
		Develop and implement a construction traffic management plan during building phase.	Noticeable impacts on traffic in Levy County during building phase.
			Noticeable aesthetic impacts from transmission corridor and lines during the building phase.
Demography	SMALL	None.	None.
Economic Impacts on Community and Taxes	SMALL to MODERATE (beneficial) (NRC-authorized construction impact level is SMALL [beneficial])	None.	None.
Infrastructure and Community Services	SMALL TO MODERATE	Add infrastructure and personnel as necessary.	Some temporary shortages of facilities may occur during the building period.
		Maintain communication with local government and planning officials so that ample time is given to plan for the influx of population and traffic during the building phase. Add modular classrooms, infrastructure, and personnel as necessary during building phase.	Some temporary infrastructure shortages in services, traffic congestion, and requirements for additional classrooms in education facilities during the building period.

Table 10-1. (contd)

Resource Area	Impacts	Mitigation Measures	Unavoidable Adverse Impacts
Environmental Justice	SMALL	None.	None.
Historic and Cultural Resources	SMALL	Inadvertent discovery procedures are in place to minimize impacts on potential onsite historic and cultural resources. No mitigation plans in place but if any cultural resources are unavoidably impacted PEF is required to work with the Florida State Preservation Office (SHPO) on specific mitigation measures. The USACE permit will have special conditions for historic and cultural resources.	None.
Meteorology and Air Quality	SMALL	Compliance with Federal, State, and local regulations governing construction activities and construction vehicle emissions.	Dust emissions, noise, occupational injuries, traffic accidents.
Nonradiological Health	SMALL	Compliance with Federal, State, and local regulations governing construction activities and construction vehicle emissions, compliance with Federal and local noise-control ordinances, compliance with Federal and State occupational safety and health regulations, implementation of traffic management plan.	Dust emissions, noise, occupational injuries, traffic accidents.
Radiological Health	SMALL	Use of as low as reasonably achievable principles	Dose to construction workers on Unit 2 after Unit 1 startup.
Nonradioactive Waste	SMALL	Implement BMPs to minimize waste generation. Manage wastes in accordance with Federal, State, and county requirements.	Consumption of some landfill capacity. Minor discharges to outfall and to atmosphere.

(a) Although the wetland mitigation plan is included as a "Mitigation Measure" in this table, the impacts included under "Unavoidable Adverse Impacts" do not reflect the contribution from compensatory mitigation measures.

Conclusions and Recommendations

The primary unavoidable adverse environmental impacts during building activities would be related to land use and terrestrial habitat loss, because approximately 627 ac of habitat on the LNP site would be permanently disturbed and about 150 ac would be temporarily disturbed, including approximately 403 ac of wetlands (PEF 2009b). Permanent and temporary impacts resulting from the offsite facilities could total 2008 ac, including up to 370 ac of wetlands. Offsite facilities include the CWIS, heavy-haul road; barge slip; associated structures for the intake and blowdown pipelines; transmission lines; and access roads to the LNP, transmission lines, and barge slip. Additional areas could be disturbed on a short-term basis as a result of temporary activities and facilities and laydown areas (PEF 2009a). Many of the upland and wetland habitats that would be affected by construction and preconstruction actions have been altered by prior land-use activities, particularly commercial forest management on the LNP site, and thus provide lower quality habitat for wildlife. Wildlife and important species could be harmed by habitat loss or alteration, hazards posed by clearing and other site-preparation activities, noise and disturbance, avian collisions with elevated structures, and increased traffic. Implementation of the conceptual mitigation plan would compensate for the loss or impairment of functions in wetlands affected by the LNP project. The higher-quality habitat provided by restored communities under the conceptual wetland mitigation plan would likely be beneficial to wildlife and many important species.

The Floridan aquifer could be affected during construction and preconstruction. However, the impacts would be localized and temporary. Building techniques to be used by PEF during excavation within the powerblock area would eliminate resultant dewatering impacts. The Upper Floridan aquifer may be affected because water for building activities will be obtained from wells screened within this aquifer. The FDEP Conditions for Certification require PEF to develop an environmental monitoring plan, which includes a hydraulic testing program during drilling and installation of the proposed water-supply wells to obtain site-specific hydraulic property estimates and determine whether the wellfield can meet groundwater usage requirements without significantly affecting water levels in the surficial aquifer. The FDEP Conditions for Certification require that PEF operate the wellfield in a way that limits drawdown in the surficial aquifer to levels which ensure no adverse impacts on wetlands. In addition, the alteration of the land surface at LNP Units 1 and 2 would cause a localized change in the recharge rate to these aquifers.

There are no streams onsite or plans for filling any streams.

No sites eligible for listing in the National Register of Historic Places would be adversely affected by the proposed action, and no mitigation measures are currently in place. However, PEF is required to work with the Florida State SHPO to develop specific mitigation measures, such as data recovery or documentation and interpretive plans. PEF also has agreed to develop and implement cultural resource specific procedures (PEF 2009a).

Socioeconomic impacts of building the proposed units would include an increase in traffic from construction workers, and demand pressure on some public services. No unusual resource dependencies on minority and low-income populations in the region were identified. Atmospheric and meteorological impacts include fugitive dust from land disturbing and building activities that can be mitigated by the dust-control plan. The building and maintenance of transmission corridors and lines would have a moderate impact on aesthetics.

10.2.2 Unavoidable Adverse Impacts During Operation

Chapter 5 provides a detailed discussion of the potential impacts from operation of the proposed Units 1 and 2 at the LNP site and presents mitigation and controls intended to lessen the adverse impacts. Table 10-2 presents the unavoidable adverse impacts on each of the resource areas evaluated in this EIS associated with operation of the two proposed units, and the mitigation measures that would reduce the impacts. Those impacts remaining after mitigation is applied (e.g., avoidance and minimization, but not including compensatory mitigation) are identified in Table 10-2 as unavoidable adverse impacts. The unavoidable adverse impacts from operation for land use would be minimal and are associated with making land unavailable for other uses until after decommissioning of the two proposed units.

Water-related impacts during operation would be mitigated through PEF's adherence to State permits for water withdrawal and discharge. The State of Florida's Conditions of Certification require that PEF operate the wellfield in a way that limits drawdown in the surficial aquifer to levels which ensure no adverse impacts on wetlands. Remaining adverse impacts on hydrological water-use and water-quality impacts during operation would be minimal and limited to increased water use, potential increases in sedimentation to bodies of surface water, and potential surface water and groundwater contamination from inadvertent spills.

Unavoidable adverse impacts on terrestrial ecology resources would include increased risks of bird collisions with structures and transmission lines, reduced wildlife use or avoidance of some habitats due to noise and disturbance, and minor impacts to vegetation from salt deposition near the mechanical draft cooling towers. Uncertainty exists regarding the potential for groundwater drawdown effects on wetlands. Assuming that PEF operates the wellfield in a manner that ensures no adverse impacts on wetlands as stated in the Conditions of Certification, the conceptual wetland mitigation plan is implemented, an avian protection plan is prepared and implemented, and BMPs are followed, terrestrial impacts during operation would be minor.

Table 10-2. Unavoidable Adverse Environmental Impacts from Operation

Resource Area	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Land Use	SMALL	Adherence to local land-management plan.	Land would not be available for other use until after decommissioning of the entire LNP site, including the two proposed new units.
Water Use	SMALL	Compliance with State of Florida Conditions of Certification.	Modification of flow patterns in the CFBC because of the operation of Units 1 and 2.
		Compliance with State of Florida Conditions of Certification.	Groundwater use from the Floridan Aquifer because of operation of Units 1 and 2.
Water Quality	SMALL	Implement BMPs and Stormwater Management Plan.	Increased sediment load in stormwater and potential to contaminate surface and groundwater through inadvertent spills.
		Compliance with PEF's National Pollutant Discharge Elimination System (NPDES) permit.	Discharge of blowdown water to the Crystal River Discharge Canal.
Ecological (terrestrial)	SMALL to MODERATE	Implement conceptual wetland mitigation plan, BMPs, and Avian Protection Plan. Comply with State Conditions of Certification regarding wellfield operation.	Increased risks of avian collision mortality from structures and transmission lines, reduced use or avoidance of some habitats by wildlife, minor vegetation impacts from salt drift, and possible groundwater drawdown effects on wetlands.
Ecological (aquatic)	SMALL	PEF has taken measures to mitigate operation impacts.	Impacts on individual organisms are expected, but not on aquatic communities.
Socioeconomic			
Physical and Aesthetic	SMALL to MODERATE	Continue to implement strategies from the building phase	Minor levels of increased traffic. Continued aesthetic impacts from transmission corridors and lines.

Table 10-2. (contd)

Resource Area	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Demography	SMALL	None.	Project-related population smaller than during peak construction years.
Economic Impacts on Community and Taxes	SMALL to LARGE (beneficial)	None.	Citrus County would receive a minor adverse impact on its property tax base because of the closure of the two coal-fired units at CREC.
Infrastructure and Community Services	SMALL to MODERATE	Potential adverse impacts in Levy County would be able to be mitigated once operations begin at the LNP site and property taxes are paid to Levy County.	Minor impact on traffic from additional workers. Continued impact on some education services in Marion County, which will not receive property tax payments from the facility that would enable expansion of schools.
Environmental Justice	SMALL	None.	None.
Historic and Cultural Resources	SMALL	Formal inadvertent discovery procedures are in place to minimize impacts on potential onsite historic and cultural resources.	None.
Metorology and Air Quality	SMALL	Compliance with Federal, State, and local air quality permits and regulations.	Slight increase in certain criteria pollutants and carbon dioxide due to plant auxiliary combustion equipment (e.g., diesel engines, combustion turbines); plumes and drift deposition from cooling towers.

Table 10-2. (contd)

Resource Area	Impact	Mitigation Measures	Unavoidable Adverse Impacts
Nonradiological Health	SMALL	Use of antimicrobial agents in the cooling system, physical and administrative controls on exposure to cooling system discharge, compliance with Federal and local noise regulations, with Federal and State occupational safety regulations, and transmission-line design compliant with National Electric Safety Code standards.	Increase in etiological agent growth, cooling tower and pump noise, occupational injuries, acute and chronic electromagnetic field exposures.
Radiological Health	SMALL	Doses to members of the public would be maintained below NRC and U.S. Environmental Protection Agency (EPA) standards; workers' doses would be maintained below NRC limits and as low as reasonably achievable (ALARA); and mitigative actions instituted for members of the public would also ensure doses to biota other than humans would be well below National Council on Radiation and Measurements (NCRP) and International Atomic Energy Agency (IAEA) guidelines.	Small radiation doses to members of the public below NRC and EPA standards; ALARA doses to workers; and biota doses less than NCRP and IAEA guidelines.
Nonradioactive Waste	SMALL	All wastes disposed in compliance with applicable Federal, State, and local requirements.	Consumption of some landfill capacity. Minor discharges to outfall and to atmosphere.

Aquatic impacts would be minor during operation because PEF's adherence to its permits would likely result in minimal impacts on aquatic resources. Socioeconomic impacts would primarily increase the demand for services and traffic. However, increased tax revenue would support the increase in services. The review team did not identify any cultural resources that would be affected by operation of the proposed units. PEF has agreed to follow appropriate procedures if historic or cultural resources are discovered during operation activities. It is expected that air quality impacts would be negligible, and pollutants emitted during operations would be insignificant. Nonradiological and radiological health impacts would be minimal. Nonradiological health impacts to members of the public from operation, including etiological agents, noise, electromagnetic fields, occupational health, and transportation of materials and personnel would be minimal because PEF would apply controls and measures to ensure compliance with Federal and State regulations. Radiological doses to members of the public from operation of the two proposed units would be below annual exposure limits set to protect the general public.

Adverse socioeconomic impacts likely would be similar in character to those during the building phase but, aside from the aesthetic effects of the transmission corridor and lines, would be smaller due to the smaller project-related population and workforce and the fact that these impacts will follow the larger building period demand, which is likely to have resulted in adaptations and growth in the affected communities. Socioeconomic impacts would primarily be increased traffic, some damage to roads, an increase in the demand for housing and public services, along with increased employment opportunities and a substantial increase in tax revenue in Levy County once the first unit becomes operational. Localized impacts near the site for Marion County, specifically on education, may continue as a result of property taxes being paid by PEF to Levy County. Citrus County would likely receive a minor adverse impact from lost property taxes from the closing of two coal-fired units at the CREC.

10.3 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 local use of the human environment by the proposed project can be summarized in terms of the unavoidable adverse environmental impacts of construction and operation and the irreversible and irretrievable commitments of resources. With the exception of the consumption of depletable resources as a result of plant construction and operation, these uses may be classed as short term. The principal short-term benefit of the plant is represented by the production of electrical energy. The economic productivity of the site, when used for this purpose, would be extremely large compared to the productivity from agriculture or other probable uses for the site.

The maximum long-term impact on productivity would result when the plant is not immediately dismantled at the end of the period of plant operation, and, consequently, the land occupied by the plant structures would not be available for any other use. However, the enhancement of regional productivity resulting from the electrical energy produced by the plant is expected to generate a correspondingly large increase in regional long-term productivity that would not be equaled by any other long-term use of the site. In addition, most long-term impacts resulting from land-use preemption by plant structures can be eliminated by removing these structures or by converting them to other productive uses. Once the units are shutdown the plant 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. The review team concludes that the negative aspects of plant construction and operation as they affect the human environment would be outweighed by the positive long-term enhancement of regional productivity through the generation of electrical energy.

10.4 Irreversible and Irretrievable Commitments of Resources

Section 102(2)(C)(v) of NEPA requires that an EIS include information about any irreversible and irretrievable commitments of resources that would occur if the proposed actions are implemented. The term “irreversible commitments of resources” refers to environmental resources that would be irreparably changed by the building or operation activities authorized by the Corps or NRC permit and licensing decisions, where the environmental resources could not be restored at some later time to the resource’s state before the relevant activities. “Irretrievable commitments of resources” refers to materials that would be used for or consumed by the new units in such a way that they could not, by practical means, be recycled or restored for other uses. The resources discussed in this section are the environmental resources discussed in Chapters 4, 5, and 6.

10.4.1 Irreversible Commitments of Resources

Irreversible commitments of environmental resources resulting from the construction, preconstruction and operation of Units 1 and 2, in addition to the materials used for the nuclear fuel, are described below.

10.4.1.1 Land Use

Land committed to the disposal of radioactive and nonradioactive wastes is committed to that use and cannot be used for other purposes. The land used for Units 1 and 2, with the exception of any filled wetlands, is not irreversibly committed because once Units 1 and 2 cease operations and the plant is decommissioned in accordance with NRC requirements, the land supporting the facilities could be returned to other industrial or nonindustrial uses.

10.4.1.2 Water Use

Approximately 28,600 gpm of cooling water would be lost from the circulating-water system and the service-water system through consumptive use (i.e., evaporation and drift) during operation.

10.4.1.3 Aquatic and Terrestrial Biota

Construction and preconstruction activities would cause temporary and long-term changes to both the aquatic and terrestrial biota at the plant site and facilities. Construction would temporarily adversely affect the abundance and distribution of local terrestrial flora and fauna on the LNP site and localized permanent loss of habitat associated with the construction footprint for LNP Units 1 and 2. Although wetlands would be permanently altered during construction and preconstruction, a conceptual mitigation plan has been developed to compensate for the loss or impairment of functions in all affected wetlands. Terrestrial habitats could be restored after decommissioning of the proposed reactors. Thus, no irretrievable loss of terrestrial habitats, including wetlands, would be expected. Although the terrestrial flora and fauna in the proposed construction footprint would be displaced for their lifetimes or suffer mortality during construction and operation, populations of these species would not be adversely affected, and no irretrievable loss of species would be expected. These impacts on terrestrial resources would be minimal and would not be expected to adversely affect the resource. In addition, no irretrievable loss of resources would be expected as a result of operations. The review team expects that no irretrievable commitment of resources affecting terrestrial habitats or species would be expected to occur associated with upgrades to the transmission corridor.

Construction and preconstruction activities would temporarily adversely affect the abundance and distribution of the aquatic community, including essential fish habitat (EFH), in the CFBC in the vicinity of the CWIS, barge slip, and discharge pipeline placement. These activities are temporary and largely mitigable. Operation activities are not expected to have adverse impacts on the abundance and distribution of the aquatic community, including EFH in the CFBC or Crystal Bay near shore area in the Gulf of Mexico. The review team expects that no irretrievable commitment of resources affecting habitat or individual species is expected to occur associated with the new transmission corridors. The aquatic habitat and aquatic populations would be unchanged from operational conditions once Units 1 and 2 cease operations and the plant is decommissioned in accordance with NRC requirements.

10.4.1.4 Socioeconomic Resources

The review team expects that no irreversible socioeconomic commitments would be made to socioeconomic resources because they would be reallocated for other purposes once the plant is decommissioned.

10.4.1.5 Historic and Cultural Resources

Cultural resource attributes would be permanently altered by the construction, preconstruction, and operation of the proposed plant and transmission lines. Nearly all impacts would be attributable to preconstruction activities, particularly transmission lines. Cultural resource attributes that could be affected include the context and landscape of the surrounding area, the relationship of these resources to regional history, settlement patterns, and the historical use of the land. Visual impacts (alteration of the historic landscape) could affect the integrity of the resources.

10.4.1.6 Air and Water

During construction, dust and other emissions, such as vehicle exhaust, would be released into the air. During operations, vehicle exhaust emissions would continue, and other air pollutants and chemicals, including very low concentrations of radioactive gases and particulates, would be released from the facility into the air and surface water. Because these releases would conform to applicable Federal and State regulations, their impact on the public health and the environment would be limited. The review team expects no irreversible commitment to air or water resources because all Unit 1 and 2 releases would be made in accordance with duly issued permits.

10.4.2 Irretrievable Commitments of Resources

A study by the U.S. Department of Energy (DOE) (DOE/EIA 2004) on new reactor construction estimated the following quantities of materials would be required for a single reactor: 12,239 yd^3 of concrete, 3107 tons of rebar, 13,000,000 ft of cable, and 275,000 ft of piping. Therefore, about twice these amounts would be needed for proposed LNP Units 1 and 2 and considerably more would be required for all of the other site structures.

The review team expects that the use of construction materials in the quantities associated with those expected for LNP Units 1 and 2, 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 (OECD, NEA, and IAEA 2008), so the irreversible and irretrievable commitment would be negligible.

10.5 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 alternatives, alternative sites, system and design alternatives.

The no-action alternative, described in Section 9.1, refers to a scenario in which the NRC would deny the request for the COLs or the USACE would deny the Department of the Army (DA) Individual Permit request. If no other power plant were built or electrical power supply strategy implemented to take its place, the electrical capacity to be provided by the project would not become available, the benefits (electricity generation) associated with the proposed action would not occur, and the need for power would not be met.

Alternative energy sources are described in Section 9.2. Alternatives that would not require additional generating capacity are described in Section 9.2.1. 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. A combination of energy alternatives is discussed in Section 9.2.4. The NRC staff concluded that none of the alternative energy options were both (1) consistent with PEF's objective of building baseload generation units and (2) environmentally preferable to the proposed action.

Alternative sites are discussed in Section 9.3. The cumulative impacts of building and operating the proposed facilities at the alternative sites are compared to the impacts at the proposed Levy County site in Section 9.3.6. Table 9-31 contains the review team's characterization of cumulative impacts at the proposed and alternative sites. Based on this review, the NRC staff concludes that while there are differences in cumulative impacts at the proposed and alternative sites, none of the alternative sites would be environmentally preferable or obviously superior to the proposed Levy County site. The NRC's determination is independent of the USACE determination of the least environmentally damaging practicable alternative pursuant to Clean Water Act Section 404(b)(1) guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

Alternative heat-dissipation, water sources, and circulating-water system designs are discussed in Section 9.4. The NRC staff concluded that none of the alternatives considered would be environmentally preferable to the proposed system designs.

10.6 Benefit-Cost Balance

NEPA requires that all agencies of the Federal government prepare detailed environmental statements on proposed major Federal actions that can significantly affect the quality of the human environment. A principal objective of NEPA is to require each Federal agency, in its decision making process, to consider the environmental impacts of each proposed major action and the available alternative actions. In particular, Section 102 of NEPA (42 USC 4321 et seq.) requires all Federal agencies to the fullest extent possible to do the following:

> (B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations."

However, neither NEPA nor CEQ requires the costs and benefits of a proposed action to be quantified in dollars or any other common metric.

The intent of this section is not to identify and quantify all of the potential societal benefits of the proposed activities and compare these to the potential costs of the proposed activities. Instead, this section will focus on the benefits and costs of such magnitude or importance that their inclusion in this analysis can inform the decision-making process. This section compiles and compares the pertinent analytical conclusions reached in earlier chapters of this EIS. It gathers all of the expected impacts from building and operations of the proposed LNP Units 1 and 2 and aggregates them into two final categories: (1) the expected costs and (2) the expected benefits to be derived from approval of the proposed action. As such, costs and benefits include the costs and benefits of both preconstruction activities and NRC-authorized construction and operations activities.

Although the analysis in this section is 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) and external (i.e., societal) costs of the proposed activities. The purpose of this assessment is to determine if the benefits of the proposed activities outweigh the aggregate costs.

General issues related to PEF's financial viability and those of its parent organizations are outside NRC's environmental mission and authority and, thus, are not considered in this EIS. Issues related to the financial qualifications of PEF will be addressed in the staff's Safety Evaluation Report. 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.

Section 10.6.1 discusses the benefits associated with the proposed action. Section 10.6.2 discusses the costs associated with the proposed action. A summary of benefits is provided in Table 10-3. Section 10.6.3 provides a summary of the impact assessments, bringing previous sections together to establish a general impression of the relative magnitude of the proposed project's costs and benefits.

Table 10-3. Summary of Benefits of the Proposed Action

Benefit Category	Description	Monetized Value or Impact Assessment
	Benefits	
Electricity generated	16,400,000 to 17,900,000 MWh per year for the 40-year life of the plant (assuming capacity factors in the range of 85 to 93 percent).	
Generating capacity	2200 MW(e) (two units at 1100 MW[e] each).	
Fuel diversity and energy security	Nuclear generation provides diversity to coal- and natural-gas-fired baseload generation.	
Tax revenues	PEF will pay property taxes to the State of Florida upon operation of the LNP. In addition, the State will collect sales and use taxes on locally purchased goods and services during construction. Finally, the operations workforce will generate property taxes over the 40-year life of the plant.	\$104 million in property taxes annually (Levy County would receive the majority of this tax revenue); \$75 million in sales taxes statewide annually over an 8-year construction period;
Local economy	Increased jobs would benefit the area economically and increase the economic diversity of region (see Sections 4.4.3.1 and 5.4.3.1).	773 operations workers and 519 indirect jobs added over 40-year life of plant; \$91 million income per year in the region during 40-year life of plant.
Technical or other non-monetary benefits	Fuel diversity would reduce exposure to supply and price risk associated with reliance on any single fuel source.	
Price volatility	Would lessen potential for fuel price volatility.	
Electrical reliability	Would enhance reliability of electricity supply.	

10.6.1 Benefits

The most apparent benefit from a power plant is that it generates power and provides thousands of residential, commercial, and industrial consumers with electricity. Maintaining an adequate supply of electricity in any given region has social and economic importance because adequate electricity is the foundation for economic stability and growth, and is fundamental to maintaining current standards of living. Because the focus of this EIS is on the proposed expansion of the LNP's generating capacity, this section focuses primarily on the relative benefits of the LNP option rather than the broader, more generic benefits of electricity supply.

10.6.1.1 Societal Benefits

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 of this EIS defines and discusses the need for power in more detail. From a societal perspective, nuclear power offers two primary benefits relative to most other generating systems: (1) long-term price stability and (2) energy security through fuel diversity. These benefits are described in this subsection.

Long-Term Price Stability

Because of its relatively low and stable fuel costs, nuclear energy is a dependable generator of electricity that can provide electricity to the consumer at relatively stable prices over long periods of time. Unlike some other energy sources, nuclear energy is generally not subject to unreliable weather or climate conditions, unpredictable cost fluctuations, and is less dependent on potentially unstable foreign suppliers than other energy sources. Nuclear power plants are generally not subject to the fuel price volatility that affects natural gas and oil power plants. In addition, uranium fuel constitutes only 3 percent to 5 percent of the cost of a kilowatt-hour of nuclear-generated electricity. Doubling the price of uranium increases the cost of electricity by about 9 percent. Doubling the price of gas would add about 66 percent to the price of electricity, and doubling the cost of coal would add about 31 percent to the price of electricity (WNA 2010).

Energy Security Through Fuel Diversity

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, is 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 power-generation system and reducing the nation’s dependence on imported fossil fuels.

A diverse fuel mix helps to protect consumers from contingencies such as fuel shortages or disruptions, price fluctuations, and changes in regulatory practices. Chapter 8 of this EIS discusses the State of Florida’s finding that a need exists for the LNP project as proposed by PEF. The proposed LNP units would generate approximately 2200 MW(e) net, which would help meet the region’s baseload need. Assuming a reasonably low capacity factor of 85 percent, the plant’s average annual electrical energy generation would be more than 16,400,000 MWh. A reasonably high-capacity factor of 93 percent would result in more than 17,900,000 MWh of electricity.

10.6.1.2 Regional Benefits

Regional benefits of the proposed construction and operation of LNP include enhanced tax revenues, regional productivity, and community impacts.

Tax Revenue Benefits

As discussed in Sections 4.4.3.3 and 5.4.3.3, once both units become operational, Levy County would receive a large proportion (the amount of which is currently being negotiated) of the expected $104 million in tax revenues collected annually over the 40-year license period. This stream of revenue represents about a 300-percent increase over recent Levy County total revenue levels.

The staff also determined that the State of Florida would collect about $75 million annually during construction in sales and use taxes for local purchases of nonexempt materials for use in the construction. These revenues would be shared back to the counties from the State and would not be expected to provide significant local revenues in the affected region. Florida does not collect income taxes.

Regional Productivity and Community Impacts

The new units would require an operating workforce of 773 people who would stimulate the creation of 519 additional indirect jobs (Sections 4.4 and 5.4) within the local three-county area, or a total of approximately 1292 new jobs within the local area that 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 the communities near the proposed site in Levy, Citrus, and Marion counties (PEF 2009a). Sections 4.4.3.1 and 5.4.3.1 provide additional information about the economic impacts of constructing and operating proposed LNP Units 1 and 2 on the Levy County site.

10.6.2 Costs

Internal costs to PEF for LNP Units 1 and 2, as well as external costs to the surrounding region and environment, would be incurred during the preconstruction, construction, and operation of two new units at the Levy County site. A summary of the costs is provided in Table 10-4.

Internal costs include all of the costs included in a total capital cost assessment – the direct and indirect cost to physically build the power plant (capital costs) plus the annual costs of operation and maintenance, fuel costs, waste disposal, and decommissioning costs. In accordance with the NRC staff's guidance in NUREG-1555 (NRC 2000), internal costs of the proposed project are presented in monetary terms. External costs include all costs imposed on the environment and region surrounding the plant that are not internalized by the company, such as a loss of regional productivity, environmental degradation, or loss of wildlife habitat. The external costs listed in Table 10-4 summarize environmental impacts on resources that could result from preconstruction, construction, and operation of the proposed LNP Units 1 and 2.

Table 10-4. Summary of Costs of Construction, Preconstruction, and Operation

Cost Category	Description	Impact Assessment[a]
	Internal Costs[b]	
Construction cost[c]	$14.1 billion for the two LNP Units (overnight capital cost – 2008$)	NA
Operating cost[c]	$83 to $111 per MWh (2008$); Fuel cost is about 0.7 cents per kWh[d]	NA
Transmission-line construction cost[c]	$2.5 billion (2008$)	NA
Spent fuel management[e]	Approximately 0.1 cents per kWh	NA
Decommissioning[f]	Approximately 0.1 to 0.2 cents per kWh	NA
	External Costs	
Land use	Disturbance of 777 ac of currently undeveloped land; 627 ac occupied on a long-term basis by the two new nuclear reactors and associated infrastructure. Offsite areas amounting to about 198 ac would be developed. Transmission-line construction would disturb about 1790 ac (see Sections 4.1 and 5.1).	MODERATE for preconstruction activities; SMALL for NRC-authorized construction activities
Air quality impacts	Air emissions from diesel generators, auxiliary boilers and equipment, and vehicles would have a small impact on workers and local residents. Emission sources would be operated intermittently, and emissions would be within Federal, State, and local air quality limits. Negligible impacts from sulfur dioxide, nitrogen oxide, carbon monoxide, carbon dioxide, and particulate emissions (relative to other baseload fossil-fired power generation) (Sections 4.7 and 5.7).	SMALL
Ecological impacts	Some cost to wildlife is anticipated due to mortality, and from the loss or alteration of habitats (including wetlands), during construction. However, these costs are not expected to adversely affect regional wildlife populations. Mortality to wildlife and aquatic biota during operations is expected to be minimal. PEF's adherence to its NPDES permit would likely result in balanced aquatic populations. No threatened or endangered terrestrial or aquatic species are likely to be adversely affected, with the exception of the Florida scrub jay (see Sections 4.3 and 5.3). The FWS issued a Biological Opinion and incidental take statement concluding that limited mortality of this species could result from habitat losses, but are not expected to appreciably affect overall survival and recovery of the species (FWS 2011; see Section 4.3.1.3).	MODERATE for preconstruction activities; SMALL for NRC-authorized construction activities; SMALL to MODERATE for operations.

Table 10-4. (contd)

Cost Category	Description	Impact Assessment[a]
Physical impacts	The physical impacts from building and operating the two units would be minor and occur within the boundaries of the site; they would have negligible effect on immediate neighborhoods (see Sections 4.4.1 and 5.4.1).	SMALL
Housing	Sufficient housing stock is available (see Sections 4.4.4.3 and 5.4.4.3).	SMALL
Transportation	Noticeable, intermittent congestion at a major intersection during building, minor during operations (see Sections 4.4.4.1 and 5.4.4.1).	SMALL for preconstruction activities; MODERATE during peak employment associated with NRC-authorized activities
Public services	Potential short-term noticeable strain on some community services in Levy and Marion counties during the building period, with the greatest impacts expected during the years of peak workforce. Most impacts would be minor during operations because of a smaller workforce. At the beginning of the operations period, some community services impacts may still be noticeable, but most would be mitigated when property tax revenues would begin to be paid by PEF. Some localized moderate impacts may continue throughout the life of the plant near the LNP site (see Sections 4.4.4.4 and 5.4.4.4).	SMALL for preconstruction activities; MODERATE with NRC-authorized activities
Nonradioactive waste	Minor consumption of local or regional landfill space, offset by payment of tipping fees for waste disposal. Minor consumption of regional hazardous waste treatment or disposal capacity, offset by treatment and disposal costs (see Sections 4.10 and 5.10).	SMALL
Uranium fuel cycle	Minor impacts distributed at multiple locations throughout the United States from the mining, milling, and enrichment of uranium, from fuel fabrication, from transportation of radioactive materials, and from management of radioactive wastes (see Chapter 6).	SMALL

Table 10-4. (contd)

Cost Category	Description	Impact Assessment[(a)]
Aesthetics and recreation	Minor impacts on aesthetics and recreation from the population and activities associated with building and operating the two units, with the exception of localized moderate, long-term impacts on aesthetics from the creation of additional transmission-line corridors (see Sections 4.4.1.4, 4.4.4.2, 5.4.1.4, and 5.4.4.2).	SMALL for NRC-authorized construction activities; MODERATE for preconstruction activities
Historic and cultural resources	Minor impacts on historic and cultural resources from impacts associated with building and operating the two units including inadvertent discovery.	SMALL
Health impacts (nonradiological and radiological)	Minor estimated temperature increases would not significantly increase the abundance of thermophilic microorganisms. Radiological doses and nonradiological health hazards 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
Materials, energy, and uranium	Irreversible and irretrievable commitments of materials and energy, including depletion of uranium. Construction materials include concrete, aggregate, rebar, conduit, cable, piping, building supplies, tools. Equipment needs include cranes, cement trucks, excavation equipment, dump trucks, and graders.	SMALL
Hazardous and radioactive waste	Mixed waste stored, transported, treated, and disposed in compliance with both NRC and EPA regulations would consume some regional or national waste treatment or disposal capacity, offset by treatment and disposal costs (see Sections 4.10 and 5.10).	SMALL
Water use and water quality	LNP water usage during construction and operations would have a minor impact on the availability and quality of the water resource in the area. Planned usage includes water withdrawn from the Gulf of Mexico to meet operational makeup water requirements, and a relatively small amount of groundwater usage for construction and general plant operations. FDEP Conditions of Certification require that PEF develop and implement an environmental monitoring program that ensures no adverse impacts on wetlands, groundwater quality, and the availability of groundwater for other permitted users.	SMALL

Table 10-4. (contd)

Cost Category	Description	Impact Assessment[a]

(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) Internal costs are those incurred by PEF to implement proposed building and operation of the LNP Units 1 and 2, exclusive of financing costs. Note that no impact assessments are provided for these private financial impacts.
(c) PEF 2009a; construction costs are overnight capital costs.
(d) NRC staff calculation of price per kWh based on MIT (2009).
(e) U.S. used-fuel program is funded by a 0.1 cent/kWh.
(f) U.S. experience (WNA 2010).

10.6.2.1 Internal Costs

The most substantial monetary cost associated with nuclear energy is the cost of capital. Nuclear power plants have relatively high capital costs for building the plant, but low fuel costs relative to alternative power-generation systems. The real prices of key heavy construction commodities, such as cement, steel, and copper, have fluctuated substantially in recent years, which could have a significant impact on nuclear plant capital costs (although it should be noted these price changes would affect construction costs for non-nuclear power plants as well).[a] 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 a key factor in 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, longer construction times mean a longer time before any costs can be offset by revenues. Furthermore, the longer it takes to build the plant, the higher the interest expenses on borrowed construction funds will be. In general, because no new nuclear plants have been built in the United States in many years, there is a great deal of uncertainty about the true costs of a new unit, which can affect the cost of capital.

Construction Costs

In evaluating the monetary costs related to constructing LNP Units 1 and 2, PEF reviewed recently published literature and internally generated, site-specific information. These estimates are based on a number of studies that were conducted by government agencies, universities,

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(a) Although in real terms, the construction costs for large projects remained relatively flat from 1998 to 2002, various construction cost indices from such sources as the Electric Power Research Institute and McGraw Hill estimate real cost escalation for large power plant construction projects to be approximately 4 percent per year since 2002 (through 2007). This is based on actual field data as well as data on commodity costs, labor cost information, and other equipment (USDI/Reclamation 2008).

and other entities; the estimates include a significant contingency to account for uncertainty. In its ER, PEF expressed the construction-cost estimate in terms of "overnight capital cost," which is a commonly used approach in the construction industry. "Overnight capital cost" is a term used to describe the monetary cost of constructing large capital projects such as a power plant, where costs are exclusive of interest and escalation, but include engineering, procurement, and construction costs, as well as the owner's costs and contingencies. The owner's costs include both preconstruction and construction activities, such as site work and preparation, CWISs and cooling towers, import duties on components, insurance, spare parts, transmission interconnection, development costs, project management costs, owner's engineering, State and local permitting, legal fees, and staffing-related training.

In the ER PEF's cost analysis was primarily based on the four following studies:

- Massachusetts Institute of Technology (MIT). 2009. *The Future of Nuclear Power*.
- Massachusetts Institute of Technology (MIT). 2010. *Update of the MIT 2003 Future of Nuclear Power: An MIT Interdisciplinary Study*.
- University of Chicago. 2004. *The Economic Future of Nuclear Power*.
- U.S. Department of Energy (DOE). 2004. *Study of Construction Technologies and Schedules, O&M Staffing and Cost, Decommissioning Costs and Funding Requirements for Advanced Reactor Designs.*
- Organization for Economic Co-Operation and Development and International Energy Agency (OECD/IEA). 2005. *Projected Costs of Generating Electricity, 2005 Update*.

In addition to the four studies referenced by PEF, the NRC staff reviewed two additional reports, one published by The Keystone Center titled *Nuclear Power Joint Fact-Finding* (Keystone 2007), which concluded, based upon alternative discount rates and construction times, that overnight construction costs range between $3600 and $4200 per kW(e). The second study is a 2009 update to the MIT study (MIT 2009) that revised capital cost estimates to $4000 per kW(e).

Capital costs are costs incurred during construction, including preconstruction, when the actual outlays for equipment and construction and engineering are made. The construction cost estimates provided in Table 10-4 are based on costs reported to the Florida Public Service Commission (FPSC) as part of the docket resulting in Final Order PSC-08-0518-FOF-EI and discussed in Chapter 8.

After consideration of these studies in the ER, PEF applied to the FPSC, petitioning for a "Determination of Need" under Section 403.519 of the Florida Statutes (Fla. Stat. 29-403.519). As part of its determination, FPSC requires the petitioner to provide reasonably detailed cost estimates, which FPSC found the PEF had done according to the FPSC Final Order granting the need determination (FPSC 2008).

In the FPSC Final Order (FPSC 2008), FPSC found the in-service cost of proposed LNP Units 1 and 2 to be $14.1 billion. In addition, PEF estimates that transmission facilities needed to deliver the power from the proposed LNP would cost $2.5 billion (PEF 2009a). Based on standard utility industry approaches to developing transmission resources (FPSC 2008), FPSC found the PEF transmission cost estimates to be reasonable.

Costs reported to the FPSC record as part of the need determination reflected PEF's best estimate and include an allowance for funds used during construction (AFUDC). AFUDC costs reflect the financing costs incurred until the project becomes operational, and these costs are not included in the studies cited as background for determining PEF's costs in the PEF ER.

Operation Costs

Operation costs are frequently expressed as levelized cost of electricity, which is the lowest price per kWh of producing electricity that covers operating costs, annualized capital costs, and a reasonable profit. For nuclear power plants, overnight capital costs typically account for a third of the levelized cost, and interest costs on the overnight costs account for another 25 percent (University of Chicago 2004). PEF estimated that the levelized cost for LNP would be in the range of $36 to $83/MWh (3.6 to 8.3 cents/kWh) (PEF 2009a). In addition, the review team examined the update to the MIT study (MIT 2009) which re-evaluated the overnight levelized cost of electricity at 8.4 cents per kWh (2007$). In 2008 dollars, this yields an overall range of 3.8 to 8.6 cents per kWh. However, the Keystone Study estimates the levelized cost for their low and high construction-cost estimates to range from $0.083 to $0.111/kWh (Keystone 2007). Factors affecting the range include choices for discount rate, construction duration, plant life span, capacity factor, cost of debt and equity, split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty. Estimates include decommissioning.

Fuel Costs

The cost of fuel is included in the calculation of levelized cost. Based on the 2009 MIT study (MIT 2009), the review team estimates nuclear fuel costs to be 0.7 cents per kWh.

Waste Disposal

The back-end costs of nuclear power contribute a small share of total cost because of both the long lifetime of a nuclear reactor and the fact that provisions for waste-related costs can be accumulated over that time. Spent fuel management costs are estimated to be 0.1 cents per kWh (WNA 2010, DOE 2008). It should be recognized, however, that radioactive nuclear waste poses unique disposal challenges for long-term management. While spent fuel and radioactive nuclear waste are being stored successfully in onsite facilities, the United States has yet to implement final disposition of spent fuel or high-level radioactive waste streams created at various stages of the nuclear fuel cycle.

Decommissioning

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. Decommissioning costs are about 9 percent to 15 percent of the initial capital cost of a nuclear power plant. However, when discounted, they contribute only a few percent to the investment cost and even less to generation cost. In the United States, they account for 0.1 to 0.2 cents per kWh (WNA 2010).

10.6.2.2 External Costs

External costs are social and/or environmental effects that would be caused by the construction of and generation of power by two new reactors at the LNP site. This EIS includes the review team's analysis that considers and weighs the environmental impacts of constructing and operating new nuclear units at the LNP or at alternative sites and mitigation measures available for reducing or avoiding these adverse impacts. It also includes the NRC staff's recommendation to the Commission regarding the proposed action.

Environmental and Social Costs

Chapter 4 of this EIS describes the impacts of building the proposed LNP 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 building of the proposed new units at the LNP site. Chapter 5 examines environmental issues associated with operation of the proposed new nuclear Units 1 and 2 for an initial 40-year period. Potential operational impacts on land use, air quality, water, terrestrial and aquatic ecosystems, socioeconomics, historic and cultural resources, environmental justice, nonradiological and radiological health effects, and postulated accidents are considered, along with applicable measures and controls that would limit these impacts during the 40-year operating period. 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) has been assigned.

Chapter 6 of this EIS 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 LNP. Chapter 9 of this EIS includes the review team's review of alternative sites and alternative power generation systems.

Unlike electricity generated from coal and natural gas, normal 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, or carbon dioxide) or methyl mercury. Combustion-based power plants are responsible for 40 percent of the carbon dioxide (DOE/EIA 2008), at least 70 percent of the sulfur dioxide, at least 21 percent of nitrogen oxides, and 51 percent of the mercury emissions from industrial sources in the United States (EPA 2009). Coal-fired plants generate 82 percent of the electric power industry's emissions (DOE/EIA 2008). Chapter 9 analyzes coal- and natural-gas-fired alternatives to the building and operation of proposed Units 1 and 2. Air emissions from these alternatives and nuclear power are summarized in Chapters 4, 5, and 9 of this EIS.

As mentioned previously, Table 10-4 summarizes the external costs (i.e., environmental impacts) associated with preconstruction, construction, and operation of the proposed LNP Units 1 and 2. Impacts on air quality, water use and water quality, housing, cultural resources, and radiological and nonradiological health all would be SMALL. Because the overall impact on these resources from the proposed project in its entirety would be SMALL, the NRC portion of the project (i.e., construction as defined in 10 CFR 51.4 and operation of the proposed new units) accordingly would also be SMALL.

The review team concluded that MODERATE impacts on land use, ecology, transportation, public services, and aesthetics and recreation would be possible. Land clearing and transmission-line corridor development activities would cause noticeable, but not destabilizing impacts from preconstruction activities. NRC-authorized activities represent only a minor portion of these impacts. Therefore the review team determined that impacts of NRC-authorized activities on land use and aesthetics and recreation would be SMALL. Noticeable impacts on transportation and public services would be expected during project peak employment when the NRC-authorized activities would be occurring, with some continued localized impacts on public services near the site during operations. Therefore, the review team concluded that impacts of NRC-authorized activities on transportation and public services would be MODERATE. The impacts of NRC-authorized construction on ecological resources would be SMALL and the impacts of operations on ecological resources would be SMALL to MODERATE.

10.6.3 Summary of Benefits and Costs

The internal costs to construct additional units appear to be substantial. However, PEF's decision to pursue this expansion implies it has concluded that the internal benefits of the proposed facility (production of 16,400,000 to 17,900,000 MWh per year for the 40-year life of the plant and 2200 MW of baseload capacity) outweigh the internal costs. Although no specific monetary values could reasonably be assigned to the identified societal benefits, it would appear the potential societal benefits of building the proposed LNP, including the primary benefit of the generated power and baseload capacity, are substantial. In comparison, the external socio-environmental costs imposed on the region appear to be relatively minor.

Table 10-4 includes a summary of both internal and external costs of the proposed activities at LNP Units 1 and 2, as well as the identified benefits. The table includes a reference to other sections of this EIS when more detailed analyses and impact assessments are available for specific topics.

On the basis of the assessments in this EIS, the construction and operation of the proposed LNP Units 1 and 2, with the mitigation measures identified by the review team, would have accrued benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (NRC-authorized construction and operation) the accrued benefits would also outweigh the costs of construction and operation of Units 1 and 2.

10.7 Staff Conclusions and Recommendations

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs should be issued. The NRC staff's evaluation of the safety and emergency preparedness aspects of the proposed action will be addressed in the Safety Evaluation Report that is anticipated to be published in April 2012.

The staff's preliminary recommendation is based on (1) the ER submitted by PEF (2009a); (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's own independent review; (4) the staff's consideration of public scoping comments and comments on the draft EIS; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and the EIS. In addition, in making its recommendation, the NRC staff determined that none of the alternative sites assessed is obviously superior to the LNP site.

The NRC's determination is independent of the USACE's permit decision, which will be documented in the USACE's Record of Decision.

10.8 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, Licenses, Certifications and Approvals for Nuclear Power Plants.

33 CFR Part 320. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 320, "General Regulatory Policies."

33 CFR Part 332. Code of Federal Regulations, Title 33, *Navigation and Navigable Waters*, Part 332, "Compensatory Mitigation for Losses of Aquatic Resources."

40 CFR Part 230. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 230, "Guidelines for Specification of Disposal Sites for Dredged or Fill Material."

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

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Organisation for Economic Co-Operation and Development, Nuclear Energy Agency, and International Atomic Energy Agency (OECD, NEA, and IAEA). 2008. *Uranium 2007.* 22nd Edition, Paris, France.

Progress Energy Florida, Inc. (PEF). 2009a. *Levy Nuclear Plant Units 1 and 2 COL Application, Part 3, Applicant's Environmental Report – Combined License Stage*. Revision 1, St. Petersburg, Florida. Accession No. ML092860995.

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11. ABSTRACT (200 words or less)
The environmental impact statement (EIS) has been prepared in response to the application submitted by Progress Energy Florida, Inc. (PEF) to the U.S. Nuclear Regulatory Commission (NRC) for combined licenses (COLs) for Units 1 and 2 at the Levy Nuclear Plant (LNP) site in Levy County, Florida. This EIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action and mitigation measures for reducing and avoiding adverse impacts.

The NRC staff's preliminary recommendation to the Commission, considering the environmental aspects of the proposed action, is that the COLs be issued. This recommendation is based on (1) the COL application, including the Environmental Report (ER) submitted by PEF; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public scoping comments; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS

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