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Protecting People and the Environment

NUREG-2176, Vol. 1

Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7

Final Report

Chapters 1 to 6

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

U.S. Army Corps of Engineers
Jacksonville District
Jacksonville, Florida 32232-0019

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Final Environmental Impact Statement for the Combined License (COL)
FOR THE TURKEY POINT NUCLEAR PLANT

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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 Florida Power & Light Company (FPL) for two combined construction permits and operating licenses (combined licenses or COLs). The proposed actions related to the FPL application are (1) NRC issuance of COLs for two new power reactor units (Units 6 and 7) at the Turkey Point Nuclear Power Plant site in Miami-Dade County, Florida, and (2) U.S. Army Corps of Engineers (USACE) decision to issue, deny, or issue with modifications a Department of the Army (DA) permit to perform certain dredge and fill activities in waters of the United States and to construct structures in navigable waters of the United States related to the project. The NRC, its contractors, and USACE make up the review team. The National Park Service (NPS) is also a cooperating agency on this EIS but does not now have a request to take any specific regulatory action before it. Due to this unique set of circumstances, impact determinations made in this EIS should only be attributed to the review team. This EIS documents the review team's analysis, which considers and weighs the environmental impacts of constructing and operating two new nuclear units at the Turkey Point site and at alternative sites, including measures potentially available for reducing or avoiding adverse impacts.

The EIS includes an evaluation of the impacts of construction and operation of Turkey Point Units 6 and 7 on waters of the United States pursuant to Section 404 of the Clean Water Act and on navigable waters of the United States pursuant to Section 10 of the Rivers and Harbors Act of 1899. The USACE will base its evaluation of FPL's DA permit application, on the requirements of USACE regulations, the Clean Water Act Section 404(b)(1) Guidelines, and the USACE public interest review process.

After considering the environmental aspects of the proposed action before the NRC, 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 FPL; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public comments received on the environmental review; 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

This environmental impact statement (EIS) presents the results of a U.S. Nuclear Regulatory Commission (NRC) environmental review of an application for a combined construction permit and operating license (combined license or COL) for two new nuclear reactor units at a proposed Turkey Point site in Miami-Dade County, Florida. The U.S. Army Corps of Engineers (USACE) participated in the preparation of the EIS as a cooperating agency and as a member of the review team, which consisted of the NRC staff, its contractor staff, and the USACE staff. The National Park Service (NPS) participated in the environmental review as a cooperating agency by providing special expertise for the areas in and around the adjacent national parks (Biscayne and Everglades National Parks). The NPS does not have a request to take any specific regulatory actions related to the proposed COLs before it. Due to this unique set of circumstances, all impact determinations made in this EIS should not be attributed to NPS, but only to the NRC and USACE (also referred to as the review team). The NPS's participation in connection with this EIS does not imply NPS concurrence.

Background

On June 30, 2009, the Florida Power & Light Company (FPL) submitted an application to the NRC for a combined construction permit and operating license (combined license or COL) for Turkey Point Units 6 and 7.

Upon acceptance of FPL's application, the NRC review team began the environmental review process by publishing a Notice of Intent to prepare an EIS and conduct scoping in the *Federal Register* on June 15, 2010. As part of this environmental review, the review team did the following:

- conducted public scoping meetings on July 15, 2010 in Homestead, Florida
- conducted a site visit of the proposed Units 6 and 7 plant area on the Turkey Point site in June 2010
- conducted visits to alternative sites in July 2010
- reviewed FPL's Environmental Report (ER)
- consulted with Tribal Nations and other agencies such as the U.S. Fish and Wildlife Service (FWS), Advisory Council on Historic Preservation, Florida Fish and Wildlife Conservation Commission, National Marine Fisheries Service, Miami-Dade Office of Historic and Archaeological Resources, and Florida Division of Historical Resources
- conducted the review following guidance set forth in NUREG-1555:
  - "Standard Review Plans for Environmental Reviews for Nuclear Power Plants
  - Supplement 1: Operating License Renewal"
- considered public comments received during the 60-day scoping process from June 15, 2010 to August 16, 2010

- conducted public meetings on the draft EIS on April 22, 2015, in Miami, Florida, and on April 23, 2015, in Homestead, Florida
- considered public comments received during the comment periods for the draft EIS, which extended from March 5 to May 22 and from May 28 to July 17, 2016.

Proposed Action

FPL initiated the proposed Federal action by submitting an application for Turkey Point Units 6 and 7 to the NRC. The NRC's Federal action is issuance of COLs for two Westinghouse AP1000 reactors at the Turkey Point site near Homestead, Florida.

The USACE is a cooperating agency in preparation of this EIS. The USACE's Federal action is its decision of whether to issue, deny, or issue with modifications a Department of Army (DA) permit pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 to authorize certain construction activities potentially affecting waters of the United States.[(1)]

Purpose and Need for Action

The purpose of the proposed NRC action, issuance of the COL, is to provide for additional baseload electric generating capacity for use in the FPL service territory.

The USACE determines both a basic and an overall project purpose pursuant to the Clean Water Act Section 404(b)(1) Guidelines, 33 CFR § 230.10. The basic purpose is to meet the public's need for electric energy. The overall purpose is to meet the public's need for reliable increased electrical baseload generating capacity in FPL's service territory.

Affected Environment

The Turkey Point site is located in southeast Miami-Dade County, Florida, near Homestead (Figure ES-1). Turkey Point Units 6 and 7 would be located on the same site as the existing Turkey Point site, which has five other power plants, including two nuclear power reactors. Turkey Point would be located 25 mi south of Miami and 4.5 and 8 mi east of Homestead and Florida City, respectively. The primary source of cooling water would be reclaimed wastewater and the alternative source would be saltwater supplied from radial collector wells beneath Biscayne Bay. The ultimate heat sink for Turkey Point Units 6 and 7 would be the atmosphere, using three mechanical draft cooling towers per reactor.

(1) Waters of the United States" is used to include both "waters of the United States" as defined by 33 CFR Part 328 (TN1683) defining the extent of USACE geographic jurisdiction pursuant to Section 404 of the Clean Water Act and "navigable waters of the United States" as defined by 33 CFR Part 329 (TN4770) defining the extent of USACE geographic jurisdiction pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768).

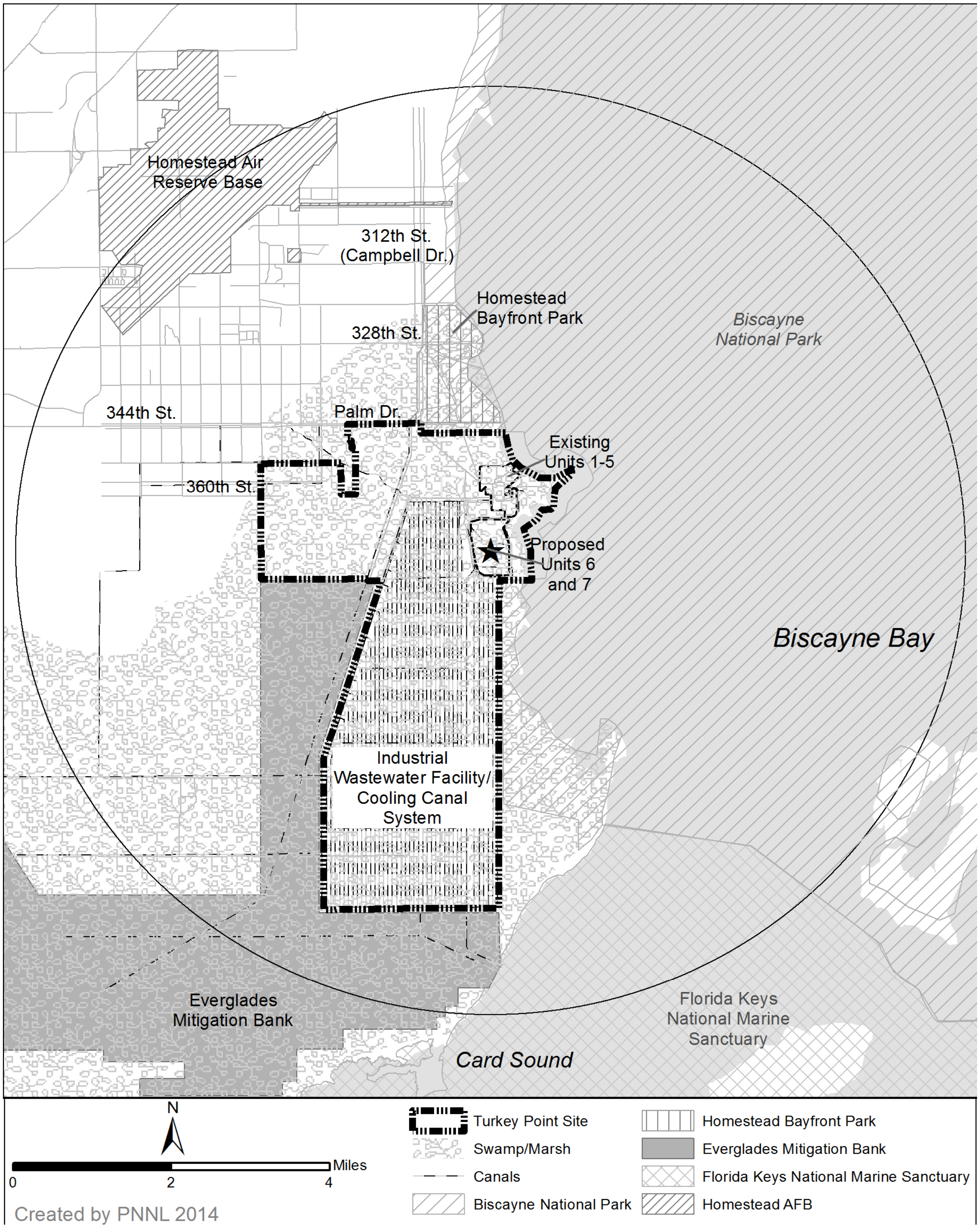


Figure ES-1. The Turkey Point Site and Affected Environment

Evaluation of Environmental Impacts

This EIS evaluates the potential environmental impacts of the construction and operation of the two new nuclear plants proposed for the Turkey Point site related to the following resource areas:

- land use
- air quality
- aquatic ecology
- terrestrial ecology
- surface and groundwater
- waste (radiological and nonradiological)
- human health (radiological and nonradiological)
- socioeconomics
- environmental justice
- cultural resources
- fuel cycle, decommissioning, and transportation

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.

The impacts are designated as SMALL, MODERATE, or LARGE. The incremental impacts related to the construction and operations activities requiring NRC authorization are described and characterized, as are the cumulative impacts resulting from the proposed action when the effects are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources. A summary of the construction and operation impacts are outlined in Table ES-1. Table ES-2 summarizes the review team's assessment of cumulative impacts. The review team's detailed analysis which supports the impact assessment of the proposed new units can be found in Chapters 4, 5, and 7, respectively.

Table ES-1. Environmental Impact Levels of the Proposed Turkey Point Units 6 and 7

Resource Category	Preconstruction and Construction	Operation
Land Use	MODERATE (NRC authorized construction impact level is SMALL)	MODERATE
Water-Related		
Water Use – Surface Water	SMALL	SMALL
Water Use – Groundwater Use	SMALL	SMALL
Water Quality – Surface Water	SMALL	SMALL
Water Quality – Groundwater	SMALL	SMALL
Ecology		
Terrestrial Ecosystems	MODERATE (NRC authorized construction impact level is SMALL)	MODERATE
Aquatic Ecosystems	SMALL to MODERATE	SMALL
Socioeconomic		
Physical Impacts	SMALL (adverse) to MODERATE (beneficial)	SMALL (adverse) to MODERATE (beneficial)
Demography	SMALL	SMALL
Economic Impacts on the Community	SMALL	SMALL and beneficial
Infrastructure and Community Services	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	NONE[(a)]	NONE[(a)]
Historic and Cultural Resources	MODERATE (NRC authorized construction impact level is SMALL)	SMALL
Air Quality	SMALL	SMALL
Nonradiological Health	SMALL	SMALL
Nonradiological Waste	SMALL	SMALL
Radiological Health	SMALL	SMALL
Postulated Accidents	n/a	SMALL
Fuel Cycle, Transportation, and Decommissioning	n/a	SMALL

(a) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts to minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while there are adverse impacts, those impacts do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

Table ES-2. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Turkey Point Units 6 and 7

Resource Category	Impact Level
Land Use	MODERATE
Water-Related	
Water Use – Surface Water	SMALL
Water Use – Groundwater Use	SMALL
Water Quality – Surface Water	MODERATE
Water Quality – Groundwater	SMALL
Ecology	
Terrestrial Ecosystems	MODERATE to LARGE
Aquatic Ecosystems	MODERATE
Socioeconomic	
Physical Impacts	SMALL adverse to MODERATE beneficial
Demography	SMALL
Economic Impacts on the Community	SMALL and beneficial
Infrastructure and Community Services	SMALL to MODERATE
Environmental Justice	NONE[(a)]
Historic and Cultural Resources	MODERATE
Air Quality	SMALL to MODERATE for criteria pollutants and MODERATE for GHGs
Nonradiological Health	SMALL
Nonradiological Waste	SMALL
Radiological Health	SMALL
Postulated Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

(a) A determination of “NONE” for Environmental Justice analyses does not mean there are no adverse impacts to minority or low-income populations from the proposed project. Instead, an indication of “NONE” means that while there are adverse impacts, those impacts do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

Alternatives

The review team considered the environmental impacts associated with alternatives to issuing a COL for the two new nuclear units proposed by FPL for the Turkey Point site. These alternatives included a no-action alternative (i.e., not issuing the COL) and alternative energy sources, siting locations, and system designs.

The no-action alternative would result in the COL not being granted or the USACE not issuing its permit. Upon such a denial, construction and operation of new units at the Turkey Point site would not occur and the predicted environmental impacts would not take place. If no other facility would be built or strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided would also not occur and the need for baseload power would not be met.

Based on the NRC staff’s review of energy alternatives, the NRC staff concluded that, from an environmental perspective, none of the viable alternatives is environmentally preferable to building a new baseload nuclear power generation plant at the Turkey Point site. The NRC staff eliminated several energy sources (e.g., wind, solar, geothermal, and biomass) from full consideration because they are not currently capable of meeting the need of this project. None of the viable baseload alternatives (natural gas, coal, or a combination of alternatives) was environmentally preferable to the proposed Turkey Point units.

After comparing the cumulative effects of a new nuclear power plant at the proposed site against those at the alternative sites, the NRC staff concluded that none of the alternative sites would be environmentally preferable to the proposed site for building and operating a new nuclear power plant (Table ES-3). The four alternatives sites selected were as follows (Figure ES-2):

- Glades
- Martin
- Okeechobee 2
- St. Lucie.

Table ES-3. Comparison of Cumulative Impacts at the Turkey Point and Alternative Sites

Resource Category	Turkey Point Site[(a)]	Glades[(b)]	Martin[(b)]	Okeechobee 2[(b)]	St. Lucie[(b)]
Land Use	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Water-Related					
Surface-water use	SMALL	MODERATE	MODERATE	MODERATE	SMALL
Groundwater use	SMALL	SMALL	SMALL	SMALL	SMALL
Surface-water quality	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Groundwater quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecology					
Terrestrial and wetland ecosystems	MODERATE to LARGE	MODERATE	MODERATE	MODERATE	MODERATE
Aquatic ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	SMALL to MODERATE
Socioeconomics					
Physical impacts	SMALL adverse except for MODERATE beneficial impacts on road quality	MODERATE adverse to SMALL beneficial impacts on road quality	MODERATE adverse to MODERATE beneficial impacts on road quality	MODERATE adverse to SMALL beneficial impacts on road quality	LARGE adverse to MODERATE beneficial impacts on road quality
Demography	SMALL	SMALL	SMALL	SMALL	SMALL, except for LARGE residential displacement impacts
Economic impacts on the community	SMALL and beneficial	SMALL and beneficial, except for LARGE and beneficial property tax revenues for Glades County and School District	SMALL and beneficial, except for MODERATE and beneficial property tax revenues for Martin County and School District	SMALL and beneficial, except for LARGE and beneficial property tax revenues for Okeechobee County and School District	SMALL and beneficial

Table ES-3. (contd)

Resource Category	Turkey Point Site[a]	Glades[b]	Martin[b]	Okeechobee 2[b]	St. Lucie[b]
Infrastructure and community services	SMALL except for MODERATE adverse impacts on traffic	SMALL except for MODERATE adverse impacts on traffic	SMALL except for MODERATE adverse impacts on traffic	SMALL except for MODERATE adverse impacts on traffic	SMALL except for MODERATE adverse impacts on traffic
Environmental Justice	None[c]	None[c]	None[c]	None[c]	None[c]
Historic and Cultural Resources	MODERATE	MODERATE	SMALL	MODERATE	SMALL
Air Quality					
Criteria pollutants	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Greenhouse gas emissions	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Nonradiological Health	SMALL	SMALL	SMALL	SMALL	SMALL
Radiological Health	SMALL	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	SMALL	SMALL	SMALL	SMALL	SMALL

(a) Cumulative impact determinations taken from EIS Table 7-3.
(b) Cumulative impact determinations taken from EIS Table 9-28.
(c) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts on minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while there are adverse impacts, those impacts do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

Table ES-3 provides a summary of the cumulative impacts for the proposed and alternative sites. The NRC staff concluded that all of the sites were generally comparable, and it would be difficult to state that one site is preferable to another from an environmental perspective. In such a case, the proposed site prevails because none of the alternatives is environmentally preferable to the proposed site.

Table ES-4 provides a summary of the EIS-derived impacts for a new nuclear power plant in comparison with the energy alternatives. The NRC staff concluded that none of the viable energy alternatives is preferable to construction of a new baseload nuclear power-generating plant located within FPL's region of interest.

The NRC staff considered various alternative systems designs, including seven alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives that were environmentally preferable to the proposed Turkey Point Units 6 and 7 systems design.

Figure ES-2. Location of Sites Considered as Alternatives to the Turkey Point Site

Table ES-4. Summary of Environmental Impacts(a) of Construction and Operation of New Nuclear, Coal-Fired, and Natural-Gas–Fired Generating Units and a Combination of Alternatives

Impact Category	Nuclear	Coal(b)	Natural Gas(b)	Combination of Alternatives(b)
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	MODERATE	MODERATE	MODERATE	MODERATE
Waste Management	SMALL	MODERATE	SMALL	SMALL
Socioeconomics	MODERATE Beneficial to MODERATE Adverse	MODERATE Beneficial to MODERATE Adverse	MODERATE Beneficial to SMALL Adverse	MODERATE Beneficial to MODERATE Adverse
Human Health	SMALL	SMALL	SMALL	SMALL
Historic and Cultural Resources	MODERATE	MODERATE	MODERATE	MODERATE
Environmental Justice	NONE(b)	NONE(b)	NONE(b)	NONE(b)

(a) Impact levels for all alternatives are for construction and operation but do not reflect cumulative impacts. Thus, the nuclear impacts identified here may differ from those used to compare the proposed site to the alternative sites, which reflect cumulative impacts.
(b) Impacts taken from EIS Table 9-4. These conclusions for energy alternatives should be compared to NRC-authorized activities reflected in Chapters 4, 5, and Sections 6.1, and 6.2.
(c) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts to minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while there are adverse impacts, those impacts do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

Benefits and Costs

The NRC staff compiled and compared the pertinent analytical conclusions reached in the EIS. It gathered all of the expected impacts from building and operating proposed Turkey Point Units 6 and 7 and aggregated them into two final categories: (1) expected environmental costs and (2) expected benefits to be derived from approval of the proposed action. Although the analysis in Section 10.6 is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the purpose of the section is to identify potential societal benefits of the proposed activities and compare them to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed activities. In general, the purpose is to inform the COL process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed activities outweigh the aggregate costs.

On the basis of the assessments in this EIS, the building and operation of proposed Turkey Point Units 6 and 7, with mitigation measures identified by the review team, would accrue benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (i.e., NRC-authorized construction and operation), the accrued benefits would also outweigh the costs of preconstruction, construction, and operation of proposed Turkey Point Units 6 and 7.

Public Involvement

A 60-day scoping period was held from June 15, 2010, to August 16, 2010. On July 15, 2010, the NRC held two public scoping meetings in Homestead, Florida. The review team received many oral comments during the public meetings and 32 e-mails and 10 letters throughout the rest of the scoping period on numerous topics including energy alternatives, terrestrial ecology, ground and surface water, and socioeconomics. The review team's response to the in-scope public comments can be found in Appendix D. The Scoping Summary Report (Agencywide Documents Access and Management System (ADAMS) Accession No. ML103130609) contains all of the comments, even those considered out-of-scope (e.g., security, safety issues).

During the initial 75-day comment period on the draft EIS, which began on March 6, 2015, the review team held public meetings in Miami, Florida, on April 22, 2015, and in Homestead, Florida, on April 23, 2015. During the course of the comment period, the NRC received requests from members of the public, a Tribal government, and Federal agencies to extend the comment period. In response to these requests, the NRC reopened the comment period on the draft EIS on May 28, 2015, until July 17, 2015, allowing additional time for public comments. In total, approximately 68 people provided oral comments at the public meetings held in April, and the NRC received approximately 11,300 pieces of correspondence during the original and reopened comment period.

Recommendation

The NRC's recommendation to the Commission related to the environmental aspects of the proposed action is that the COL should be issued.

This recommendation is based on the following:

- the application, including the ER, submitted by FPL
- consultation with Federal, State, Tribes, and local agencies
- site audits and alternative sites audits
- consideration of public comments received during the environmental review
- the review team's independent review and assessment summarized in this EIS.

The NRC's determination is independent of the USACE's determination of whether to issue, deny, or issue with modifications the DA permit application for the Turkey Point Units 6 and 7. The USACE will conclude its Clean Water Act Section 404(b)(1) Guidelines and public interest analyses in its Record of Decision.

ABBREVIATIONS/ACRONYMS

AADT	annual average daily traffic
ac	acre(s)
ACC	averted cleanup and decontamination costs
ac-ft	acre (foot) feet
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AD	Anno Domini
ADAMS	Agencywide Documents Access and Management System
AERMOD	American Meteorological Society/U.S. Environmental Protection Agency (AMS/EPA) Regulatory Model
AICUZ	Air Installation Compatible Use Zone
ALARA	as low as reasonably achievable
a.m.	ante meridian
AO	Administrative Order
AP-42	EPA’s Compilation of Air Pollutant Emission Factors document
APE	Area of Potential Effect
APPZ	Avon Park Permeable (or Producing) Zone
AQCR	Air Quality Control Region
ARNI	Aquatic Resources of National Importance
ARRA	American Recovery and Reinvestment Act of 2009
ASE	advanced safety evaluation
ASR	aquifer storage and recovery (system)
ATC	Atlantic Coastal Ridge
BA	Biological Assessment
BACT	Best Available Control Technologies
BBCW	Biscayne Bay Coastal Wetlands
BC	Before Christ
BEBR	University of Florida’s Bureau of Economic and Business Research
BEA	U.S. Bureau of Economic Analysis
BEIR VII	Biological Effects of Ionizing Radiation VII
bgs	below ground surface
BISC	Biscayne Bay
BLS	U.S. Bureau of Labor Statistics
BMP	Best Management Practice
Btu	British thermal unit
°C	degree(s) Celsius
μCi	microcurie(s)

μCi/mL	microcuries per milliliter
CA	Consent Agreement
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CCD	Colony Collapse Disorder
CCR	coal combustion residuals
CCS	cooling-canal system (also known as IWF)
CDF	core damage frequency
CDMP	Comprehensive Development Master Plan
CDNFRM	cost for decontamination of non-farmland
CEC	chemical/contaminant of emerging concern
CEQ	Council on Environmental Quality
CERP	Comprehensive Everglades Restoration Program (also Project, Plan)
CFR	*Code of Federal Regulations*
cfs	cubic foot/feet per second
cm	centimeter(s)
cm^2	square centimeter(s)
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COL	combined construction permit and operating license
CPI	Consumer Price Index
CPUE	catch per unit effort
CSAPR	Cross-State Air Pollution Rule
CTEMISS	cooling-tower emissions processor
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWS	circulating-water system
CZMP	Coastal Zone Management Plan
d	day(s)
D	Directional Distribution Factor
DA	Department of the Army
dB	decibel(s)
dBA	decibel(s) on the A-weighted scale
DBA	design basis accident
DCD	Design Control Document
DEET	*N*,*N*-Diethyl-*meta*-toluamide
DEIS	draft environmental impact statement
DERM	Miami-Dade County Department of Environmental Resources Management
DHS	Department of Homeland Security

DNL	day-night average sound level
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
DOT	U.S. Department of Transportation
DPS	distinct population segment
DSM	demand-side management
DZMW	dual-zone monitoring well
EAB	exclusion area boundary
EAI	Ecological Associates, Inc.
EC10	effective concentration required to induce a 10% effect
EC50	effective concentration required to induce a 50% effect
ECOTOX	EPA Ecotoxicology
EDR	Florida Legislature's Office of Economic and Demographic Research
EEEA	East Everglades Expansion Area
EEL	Environmentally Endangered Lands (Program)
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	environmental impact statement
EJ	environmental justice
ELF	extremely low frequency
ELF-EMF	extremely low frequency-electromagnetic field
EMB	Everglades Mitigation Bank
EMF	electromagnetic field
ENP	Everglades National Park
EPA	U.S. Environmental Protection Agency
EPOC	emerging pollutant of concern
EPRI	Electric Power Research Institute
ER	Environmental Report
ESA	Endangered Species Act of 1973, as amended
ESOC	emerging substance of concern
ESRP	Environmental Standard Review Plan (NUREG-1555, Supplement 1, Operating License Renewal)
EW	exploratory well
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FAC	Florida Administrative Code or Fla. Admin. Code
FDEP	Florida Department of Environmental Protection
FDHR	Florida Division of Historic Resources
FDOH	Florida Department of Health

FDOT	Florida Department of Transportation
FEC	Florida East Coast (Railway)
FEFP	Florida Education Finance Program
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFWCC	Florida Fish and Wildlife Conservation Commission
FIRM	Flood Insurance Rate Map
FKNMS	Florida Keys National Marine Sanctuary
FLUCFCS	Florida Land Use, Cover, and Forms Classification System
FLUM	Future Land Use Map
FMNH	Florida Museum of Natural History
FMP	fishery management plan
FMSF	Florida Master Site File (form)
FNAI	Florida Natural Areas Inventory
FONSI	Findings of No Significant Impact
FPL	Florida Power & Light Company
fps	foot (feet) per second
FPSC	Florida Public Service Commission
FR	*Federal Register*
FRCC	Florida Reliability Coordinating Council
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft^2	square foot/feet
ft/d	foot (feet) per day
ft^2/d	square foot (feet) per day
ft^3	cubic foot (feet)
ft^3/d	cubic foot (feet) per day
ft^3/yr	cubic foot (feet) per year
FTE	full-time equivalent
FWPCA	Federal Water Pollution Control Act (also known as the Clean Water Act of 1977)
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
µg	microgram(s)
µg/L	microgram(s) per liter
µGy	microgray(s)
g	gram(s) or gravity of Earth (g-force)
gal	gallon(s)
gal/yr	gallon(s) per year

GC	gas centrifuge
g/cm^3	gram(s) per cubic centimeter
GCRP	U.S. Global Change Research Program
GEIS	Generic Environmental Impact Statement (for License Renewal of Nuclear Plants, NUREG-1437)
GHG	greenhouse gas
GIS	geographic information system
gpd	gallon per day
gpm	gallon per minute
gpm/ft	gallon(s) per minute per foot
g/s	gram(s) per second
GU	Interim District (zone)
GW	gigawatt(s)
GWh	gigawatt hour(s)
ha	hectare(s)
HAP	hazardous air pollutant
HAPC	habitat area of particular concern
HBB	health-based benchmark
HDR	HDR Engineering, Inc.
HEC-RAS	Hydrologic Engineering Centers River Analysis System
hr	hour
HUD	U.S. Department of Housing and Urban Development
Hz	hertz
I	Interstate
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
ID	identification
IGCC	integrated gasification combined-cycle
in.	inch(es)
IRWST	in-containment refueling water storage tank
ISFSI	independent spent fuel storage installation
IUCN	World Conservation Union
IWF	industrial wastewater facility (also known as CCS)
K	Standard Peak Hour Factor
kg	kilogram(s)
kg/d	kilogram(s) per day
kg/L	kilogram(s) per liter
kg/yr	kilogram(s) per year

kg/ha/mo	kilogram(s)/hectare/month
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
km/hr	kilometer(s) per hour
kt	knot(s)
kV	kilovolt(s)
kV/m	kilovolt(s) per meter
kW	kilowatt(s)
kWh	kilowatt-hour(s)
L	liter(s)
lb	pound(s)
lb/yr	pound(s) per year
L_{dn}	day-night average sound level
LEDPA	least environmentally damaging practicable alternative
L_{eq}	noise level equivalent
LFA	Lower Floridan Aquifer
LLC	Limited Liability Company
LLW	low-level waste
LOEC	lowest-observed effect concentration
LOS	level of service
LPZ	low-population zone
LST	local standard time
LWA	Limited Work Authorization
LWR	light water reactor
μmhos/cm	micromhos per centimeter
m	meter(s)
m/s	meter(s) per second
m^2	square meter(s)
m^3	cubic meter(s)
m^3/d	cubic meters per day
m^3/s	cubic meter(s) per second
mA	milliampere(s)
MACCS	MELCOR Accident Consequence Code System
MCU	Middle Confining Unit
MDC	Miami-Dade County
M-DCPS	Miami-Dade County Public School District
MDWASD	Miami-Dade Water and Sewer Department
MEI	maximally exposed individual

mg	milligram(s)
mG	milliGauss
Mgd	million gallon(s) per day
Mgd/yr	million gallon(s) per day per year
Mgm	million gallons per month
Mg/L	milligram(s) per liter
Mg/m^3	milligram(s) per cubic meter
mg N/L	milligrams of nitrate per liter
mg P/L	milligrams of phosphate per liter
mGy	milligray(s)
mGy/d	milligray(s) per day
MFCMA	Magnuson–Stevens Fishery Conservation and Management Act (or Magnuson–Stevens Act)
MHz	megahertz
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
MIT	Massachusetts Institute of Technology
mL	milliliter(s)
MMBtu	one million British thermal units
MMBtu/hr	one million British thermal units per hour
MMBtu/yr	one million British thermal units per year
mo	month(s)
MOU	Memorandum of Understanding
mph	mile(s) per hour
mrad	millirad
mrem	millirem
msl or MSL	mean sea level
mSv	millisievert(s)
MSW	municipal solid waste
MT	metric ton(nes)
MTU	metric ton uranium
MW	megawatt(s)
MWd/MTU	megawatt-days per metric ton of uranium
MW(e)	megawatt(s) electric
MW(t)	megawatt(s) thermal
MWh	megawatt hour(s)
MWh/yr	megawatt hour(s) per year
N	north or nitrogen
NA	not applicable

NAAQS	National Ambient Air Quality Standard
NAD83	North American Datum of 1983
NARUC	National Association of Regulatory Utility Commissioners
NASCAR	National Association for Stock Car Auto Racing
NAVD88	North American Vertical Datum of 1988
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection and Measurements
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NFC	Natural Forest Community
NGCC	natural-gas combined-cycle
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NNC	Numerical Nutrient Criteria
NO_2	nitrogen dioxide
NO_3+NO_2	nitrate+nitrite
NO_x	nitrogen oxides
NOAA	National Oceanic and Atmospheric Administration
NOEC	no-observed effect concentration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSR	new source review
NUREG	U.S. Nuclear Regulatory Commission technical document
NW	northwest
NWS	National Weather Service
O_2	oxygen
O_3	ozone
ODCM	Offsite Dose Calculation Manual
OFW	Outstanding Florida Water
OIG	Office of the Inspector General
ORV	off-road vehicle
OSHA	Occupational Safety and Health Administration
P	phosphorus
PAH	polycyclic aromatic hydrocarbon

PC	personal computer
PCB	polychlorinated biphenyl
pCi/L	picocurie(s) per Liter
pH	measure of acidity or basicity in solution
PHU	panther habitat units
PHU	panther habitat unit
PFA	Panther Focus Area
P/L	phosphorus per liter
PIR	Public Interest Review or Project Implementation Report
PIRF	Public Interest Review Factor
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
PPSA	Power Plant Siting Act
ppm	part(s) per million
ppt	parts per thousand
PRA	probabilistic risk assessment
PSA	probabilistic safety assessment
PSD	Prevention of Significant Deterioration (Permit)
psu	practical salinity unit
PWR	pressurized water reactor
rad	radiation absorbed dose
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RCW	radial collector well
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
RfC	reference concentration
RFI	Request for Information
RHA	Rivers and Harbors Act of 1899
RIMS II	Regional Input-Output Modeling System
RMS	root mean square
Rn-222	radon-222
ROD	Record of Decision
ROI	region of interest
RPHP	Radiation Public Health Project
RRY	reference reactor year
RSICC	(Oak Ridge) Radiation Safety Information Computational Center

RV	recreational vehicle
RWTF	reclaimed water-treatment facility
Ryr	reactor year
s or sec	second(s)
SAFMC	South Atlantic Fisheries Management Council
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SAV	submerged aquatic vegetation
SBO	Station Blackout
SCA	Site Certification Application
scf	standard cubic feet
SCR	selective catalytic reduction
SDWWTP	South District Wastewater Treatment Plant
sec	second(s)
SECA	State Energy Conversion Alliance
SER	Safety Evaluation Report
SFRPC	South Florida Regional Planning Council
SFWMD	South Florida Water Management District
SGWEA	Southern Glades Wildlife Environmental Area
SHA	seismic hazard analysis
SHPO	State Historic Preservation Office (or Officer)
s/m^3	seconds per cubic meter
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SOR	Save Our Rivers (Program)
SPCC	Spill Prevention, Control, and Countermeasure (Plan)
SR	State Route
SRP	Standard Review Plan
SSC	Species of Concern
SU	Standard Unit(s)
Sv	sievert(s)
SW	southwest
SWPPP	stormwater pollution prevention plan
SWS	service-water system
T	ton(s) or tonne(s)
T/B	Tug/Barge
TB_q	terrabequerel
TCP	traditional cultural property
T&E	threatened and endangered

TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Officer
TIMDEC	decontamination time
TKN	total Kjeldahl nitrogen
TLD	thermoluminescent dosimeter
TLF	Treasured Lands Foundation
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus
TRC	total reportable cases
TVA	Tennessee Valley Authority
UDB	urban development boundary
UF_6	uranium hexafluoride
UIC	underground injection control
UMAM	Uniform Mitigation Assessment Method
UMTRI	University of Michigan Transportation Research Institute
UNESCO	United National Educational, Scientific and Cultural Organization
UO_2	uranium dioxide
US	U.S. (State Highway)
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDW	underground source of drinking water
USGS	U.S. Geological Survey
VOC	volatile organic compound
W	west
W.A.T.E.R.	Wetland Assessment Technique for Environmental Review
WCA	water conservation area
Westinghouse	Westinghouse Electric Company, LLC
WHO	World Health Organization
wk	week(s)
WOTUS	waters of the United States
WRDA	Water Resources Development Act
WTP	water treatment plant
WWTP	wastewater treatment plant

χ/Q	atmospheric dispersion factor(s); annual average normalized air concentration value(s)
yd^3	cubic yards
yr	year(s)

1.0 INTRODUCTION

By letter dated June 30, 2009 (FPL 2009-TN1229), as supplemented by a letter dated August 7, 2009 (FPL 2009-TN1230), the Florida Power & Light Company (FPL) applied to the U.S. Nuclear Regulatory Commission (NRC or the Commission) for two combined construction permits and operating licenses (combined licenses or COLs) for the proposed Turkey Point Units 6 and 7 (COL application). The NRC review team's evaluation of the environmental impacts of the proposed action is based on the October 29, 2014 revision of the COL application (FPL 2014-TN4102), including the Environmental Report (ER) (FPL 2014-TN4058), responses to requests for additional information, and supplemental information. Documents supporting the review team's evaluation are listed as references where appropriate.

The site proposed by FPL for the two new nuclear units is the Turkey Point site in southeastern Miami-Dade County, Florida. The Turkey Point site is an approximately 9,460 ac site that includes five existing power plants. Units 1 and 2 have been operated as natural-gas/oil steam-generating units. Unit 2 has been converted to operate in synchronous condenser mode. Unit 1 will be converted to operate in synchronous condenser mode in late 2016 (FPL 2016-TN4579). In the synchronous condenser mode, the generators help stabilize and optimize grid performance but do not generate power. Units 3 and 4 are nuclear pressurized water reactors (PWRs), and Unit 5 is a natural-gas combined-cycle steam-generating unit. The proposed plant area is south of Turkey Point Units 3 and 4 on approximately 218 ac of the Turkey Point site property (FPL 2014-TN4058). The proposed Turkey Point Units 6 and 7 would be owned by FPL (2014-TN4058). With the exception of the transmission systems needed to route power from the proposed units, and the pipelines needed to bring reclaimed water to the Turkey Point site, all of the construction and operation related to proposed Turkey Point Units 6 and 7 would be completely within the confines of the Turkey Point site (FPL 2014-TN4058).

On June 30, 2009, the U.S. Army Corps of Engineers (USACE or Corps) received a Department of the Army (DA) permit application number SAJ-2009-02417 (SP-MLC) from FPL in connection with the proposed Turkey Point Units 6 and 7 and associated structures, including a reclaimed water facility, access roads, radial collector wells, pipelines, transmission lines, and other related infrastructure. The proposed work would result in the alteration of waters of the United States,[(1)] including wetlands. The USACE is participating as a cooperating agency with the NRC in preparing this environmental impact statement (EIS). As part of the USACE public comment process, USACE published a public notice on March 13, 2015, to solicit comments from the public regarding FPL's DA permit application for proposed work at the Turkey Point site. The Corps' consideration of public comments received in response to this public notice will be reflected in the public interest review and CWA Section 404(b)(1) analysis in the Corps' Record of Decision.

(1) "Waters of the United States" is used to include both "waters of the United States" as defined by 33 CFR Part 328 (TN1683) defining the extent of USACE geographic jurisdiction pursuant to Section 404 of the Clean Water Act and "navigable waters of the United States" as defined by 33 CFR Part 329 (TN4770) defining the extent of USACE geographic jurisdiction pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768).

On June 30, 2009, FPL submitted a Site Certification Application (SCA) to the State of Florida Department of Environmental Protection for the proposed Turkey Point Units 6 and 7 and ancillary facilities (FPL 2010-TN1231). The SCA process provides a Certification that encompasses all licenses and permits needed for affected Florida State, regional, and local agencies. It also includes any regulatory activity that would be applicable under these agencies' regulations for proposed Turkey Point Units 6 and 7 (FDEP 2013-TN2629). On May 19, 2014, the State of Florida issued final Conditions of Certification to FPL authorizing construction, operation, and maintenance of proposed Turkey Point Units 6 and 7 and associated facilities (State of Florida 2014-TN3637). The final Conditions of Certification issued are binding and subject to the requirements listed in State of Florida 2014(TN3637). The NRC staff is aware that on April 20, 2016, a Florida court issued an opinion in which it ruled that the Florida Siting Board should have considered whether to require FPL to bury a portion of the transmission lines, and that the record was inadequate to support certain mitigation measures associated with transmission lines in the East Everglades. [State of Florida 2016-TN4781] Although the opinion remands the Conditions of Certification to the Florida Siting Board for consideration of the possibility of burying a portion of the transmission lines and reconsideration of the specified mitigation measures, the NRC staff understands that the court's opinion is not yet final as of this writing (October 3, 2016). Accordingly, for the purposes of the FEIS evaluation of impacts, the NRC staff considers the transmission line route and conditions reviewed and approved by the Florida Siting Board as the most current information regarding the transmission line and associated potential mitigation measures. Even if the Conditions of Certification are revisited, the NRC staff considers it reasonable to expect that Conditions of Certification similar to or no less effective than those originally issued will be in place before construction and operation of the proposed units begins.

FPL's applications for proposed Turkey Point Units 6 and 7 seek (1) NRC issuance of COLs for constructing and operating two new nuclear units at the Turkey Point site, and (2) DA authorization pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act), as amended (33 U.S.C. § 1344 et seq.) (TN1019), Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403 (TN4768), and Section 14 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 408 (TN4769). The DA permit application requests authorization to discharge fill into approximately 1,000 ac of jurisdictional wetlands (USACE 2015-TN4627), to construct structures under navigable waters of the United States such as radial collector wells, and to expand the existing barge unloading area in navigable waters of the United States.

1.1 Background

The granting of a COL is Commission approval of the construction and operation of a nuclear power facility. NRC regulations related to COLs are found primarily in Title 10 of the *Code of Federal Regulations* (CFR) Part 52, Subpart C.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4321 et seq.) (TN661) requires the preparation of an EIS for a major Federal action that significantly affects the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51 (TN250). Further, in 10 CFR 51.20 (TN250), the NRC has determined that the issuance of a COL under 10 CFR Part 52 (TN251) is an action that requires an EIS.

According to 10 CFR 52.80(b) (TN251), a COL application must contain an ER. The ER provides the applicant's input to the NRC's EIS. NRC regulations related to ERs and EISs are found in 10 CFR Part 51 (TN250). FPL's ER, which was included as Part 3 of the application, provides a description of the proposed actions related to the application and FPL's analysis of the potential environmental impacts of construction and operation of proposed Units 6 and 7.

1.1.1 Application and Review

The purpose of the FPL COL application is to obtain COLs to construct and operate two baseload nuclear power reactors. In addition to the COLs, FPL must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The purpose of FPL's DA application is to meet the public's need for reliable increased electrical baseload generating capacity in FPL's service territory. Pursuant to the Clean Water Act (33 U.S.C. § 1251 et seq.) (TN662), the Corps has jurisdiction over navigable waters, which are defined as waters of the United States (WOTUS) and the territorial seas. Pursuant to the Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.) (TN660), the Corps has jurisdiction over navigable WOTUS. Throughout the rest of the document, WOTUS will be used to refer to both navigable waters, including certain wetlands, as defined by the Clean Water Act (33 U.S.C. § 1251 et seq.) (TN662) and navigable WOTUS as defined by the Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.) (TN660).

Collectively, the NRC staff (including its contractor staff at Pacific Northwest National Laboratory and Information Systems Laboratory) and the USACE staff who reviewed the environmental aspects of the applications and supporting documentation and decided on impact levels are referred to as the "review team" throughout this EIS. The National Park Service participated in the environmental review as a cooperating agency by providing special expertise for the areas in and around the national parks (Biscayne and Everglades National Parks). Impact determinations made in this EIS should not be attributed to NPS, but only to the NRC and USACE (also referred to as the review team). The NPS's participation in preparing this EIS does not imply NPS concurrence. Individual contributors to this EIS are listed in Appendix A.

1.1.1.1 NRC COL Application Review

FPL's ER focuses on the environmental effects of construction and operation of two Westinghouse AP1000 PWRs (FPL 2014-TN4058) at the proposed site. The NRC regulations setting standards for review of a COL application are listed in 10 CFR 52.81 (TN251). Detailed procedures for conducting the environmental portion of the review are listed in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan* (NRC 2000-TN614) and recent updates. Additional guidance on conducting environmental reviews is provided in NRC Interim Staff Guidance COL/ESP-ISG-026 *Environmental Issues Associated with New Reactors* (NRC 2014-TN3767).

The FPL COL application references Revision 19 of the Westinghouse AP1000 reactor certified design (Westinghouse 2011-TN261), which is incorporated by reference into 10 CFR Part 52, Appendix D. Subpart B of 10 CFR Part 52 (TN251) states NRC regulations related to standard design certification. Revision 19 of the AP1000 design was published on December 30, 2011 (76 FR 82079) (TN248). The NRC staff reviews severe accident mitigation design alternatives in its review of an application for certification of a standard reactor design. Where appropriate, this EIS incorporates results of the review of Revision 19. (Additional information about design certification is discussed in Section 3.2.1).

In this EIS, the review team evaluates the environmental effects of the construction and operation of two Westinghouse AP1000 PWRs at the Turkey Point site, each with thermal power ratings of 3,415 MW(t). In addition to considering the environmental effects of the proposed action, this EIS addresses alternatives to the proposed action, including the no-action alternative and the building and operation of new reactors at alternative sites. The benefits of the proposed action (e.g., meeting an identified need for power) and measures and controls to limit adverse impacts are also evaluated. FPL's proposed action to construct and operate two new nuclear units includes requests for departures (FPL 2013-TN3083) from the AP1000 design certification under 10 CFR 52.93 (TN251). The environmental impacts of the requested departures are addressed in this EIS. The technical analysis for each design certification departure will be included in the NRC's Final Safety Evaluation Report, including a recommendation for approval or denial of each departure.

By letter dated September 4, 2009 (NRC 2009-TN1667), the NRC notified FPL that its application was accepted for docketing. Docket numbers 52-040 and 52-041 were established for proposed Units 6 and 7, respectively. After acceptance of FPL's application, the NRC began the environmental review process by publishing in the *Federal Register* on June 15, 2010 a Notice of Intent to prepare an EIS and conduct scoping (75 FR 33851) (TN511). On July 15, 2010, the NRC held two public scoping meetings in Homestead, Florida, to obtain public input on the scope of the environmental review. The NRC staff also contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A list of the agencies and organizations contacted is provided in Appendix B. Correspondence between NRC and the Federal, State, Tribal, regional, and local agencies is included in Appendix C. The NRC staff reviewed the comments received during scoping and responses were written for each comment. Comments within the scope of the NRC environmental review and their associated responses are included in Appendix D. A complete list of the scoping comments and responses is documented in the *Turkey Point Nuclear Plant Combined License Scoping Summary Report* (NRC 2010-TN515).

To gather information and to become familiar with the Turkey Point site, the entire review team visited the site in June 2010. During the June 2010 visit, the review team also conducted a site audit and met with FPL staff, Federal, Tribal, State and local officials, and members of the public. Members of the review team visited the Martin, Glades, Okeechobee 2, and St. Lucie alternative sites in July 2010. Documents related to the Turkey Point site and alternative sites were reviewed and are listed as references where appropriate.

To guide its assessment of the environmental impacts of the proposed action or alternative actions, the NRC has established a standard of significance for impacts based on Council on Environmental Quality guidance (40 CFR 1508.27) (TN428). Table B-1 of 10 CFR Part 51 (TN250), Subpart A, Appendix B, provides the following definitions of the three significance levels established by the NRC—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.

This EIS presents the review team's analysis, which considers and weighs the environmental impacts of the proposed action at the Turkey Point site, including the environmental impacts associated with constructing and operating proposed Units 6 and 7 at the site, the impacts of constructing and operating reactors at alternative sites, the environmental impacts of alternatives to granting the COLs, and the mitigation measures available for reducing or avoiding adverse environmental effects. This EIS also provides the NRC staff's recommendation to the Commission regarding the issuance of the COLs for proposed Units 6 and 7 at the Turkey Point site.

On March 5, 2015, the NRC and the Corps issued a *Federal Register* notice in which the NRC solicited comments on the draft EIS to support the environmental review of the application. The public comment period closed on May 22, 2015 (80 FR 12043). During the course of the comment period, the NRC received requests from members of the public, a Tribal government, and Federal agencies to extend the comment period. In response to these requests, the NRC reopened the comment period on the draft EIS from May 28, 2015, until July 17, 2015, allowing for additional time for public comments (80 FR 30501) (TN4614). During the public comment period, three public meetings were held, one in Miami, Florida on April 22, 2015 and two in Homestead, Florida on April 23, 2015. These meetings also provided an opportunity for the public to provide comments that may be considered in evaluating a proposed DA permit. Members of the review team described the results of the environmental review, provided members of the public with information to assist them in formulating comments about the EIS, and accepted comments about the EIS. Approximately 350 people attended the three public comment meetings, and sixty-eight attendees provided oral comments, which were transcribed by a court reporter. In addition to comments received at the public meetings, the NRC received a total of approximately 11,300 additional pieces of correspondence. Appendix E outlines the comments received and states the review team's responses to the comments on the draft EIS.

1.1.1.2 USACE Permit Application Review

The USACE is a cooperating agency with the NRC, which is serving as the lead agency in the development of this EIS. The USACE has participated as a member of the review team. In carrying out its regulatory responsibilities, the USACE will complete an independent evaluation of the applicant's DA permit application to determine whether to issue, deny, or issue with modifications a DA permit for this project. This decision will be documented in the USACE's Record of Decision (ROD). The decision whether to issue a DA permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity and its intended effect on the public interest. Evaluation of the probable impacts that the proposed activity may have on the public interest requires a careful weighing of all of the factors relevant in each particular case. A decision by the USACE to authorize this proposal, and if so, the conditions under which it will be allowed to occur, are therefore determined by the outcome of this general balancing process.

By acting as a cooperating agency on the development of the EIS, USACE plans to adopt the EIS in its ROD. USACE will also include any additional information and analyses required to support its decision to issue the DA permit, deny the DA permit, or issue the DA permit with modifications. 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) (TN427); hereafter § 404(b)(1) Guidelines, contains the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into WOTUS. The USACE's Public Interest Review (PIR) (33 CFR § 320.4) (TN424) directs the USACE to consider a number of factors as part of a balanced evaluation process in order to determine whether the proposed project is contrary to the public interest. The USACE's PIR will be part of its ROD and will not be addressed in this EIS. The following general criteria are considered in the evaluation of every application:

- the relative extent of the public and private need for the proposed structure or work;
- where there are unresolved conflicts about resource use, the practicability of using practicable and reasonable alternative locations and methods to accomplish the objective of the proposed structure or work; and
- the extent and permanence of the beneficial and/or detrimental effects that the proposed structure or work is likely to have on the public and private uses to which the area is suited.

As part of the USACE public comment process, USACE published a public notice on March 13, 2015, to solicit comments from the public regarding FPL's DA permit application for proposed work at the Turkey Point site (USACE 2015-TN4627). The Corps' consideration of public comments received in response to this public notice will be reflected in the PIR and CWA Section 404(b)(1) analysis in the Corps' ROD.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorizations for Nuclear Power Plants" (72 FR 57416) (TN260), the Commission limited the definition of "construction" to those activities within its regulatory purview in 10 CFR 51.4 (TN250). Many of the activities required to construct 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, erecting support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for a COL is submitted, during the review of a COL application, or after a COL is granted, or in some cases, concurrently with NRC-regulated construction. Although preconstruction activities are outside the NRC's regulatory authority, many of them are within the regulatory authority of local, State, or other Federal agencies.

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. In addition, certain preconstruction activities that require permits from the USACE are considered to have direct effects related to its Federal permitting decision. Chapter 4 describes the relative magnitude of impacts related to construction and preconstruction activities.

1.1.3 Cooperating Agencies

NEPA (42 U.S.C. § 4321 et seq.) (TN661) lays the groundwork for coordination between the lead agency preparing an EIS and other Federal agencies that may provide special expertise regarding an environmental issue or jurisdiction by law. These other agencies, referred to as “cooperating agencies,” are responsible for assisting the lead agency through early participation in the NEPA process, including scoping, by providing technical input to the environmental analysis and by making staff support available as needed by the lead agency. In addition to a license from the NRC, most proposed nuclear power plants require a permit from the USACE when impacts on WOTUS are proposed. Therefore, the NRC and the USACE concluded that the most effective and efficient use of Federal resources in the review of nuclear power projects would be achieved by a cooperative agreement. On September 12, 2008, the NRC and the USACE signed a Memorandum of Understanding (MOU) regarding the review of nuclear power plant license applications (USACE and NRC 2008-TN637). On November 25, 2009 the NRC formally requested that the USACE become a cooperating agency during the review of the combined license application at Turkey Point to construct proposed Units 6 and 7. Via letter correspondence dated December 10, 2009, the Corps agreed. Therefore, the Jacksonville District of the USACE is a cooperating agency as defined in 10 CFR 51.14 (TN250).

As described in the MOU, the NRC is the lead Federal agency, and the USACE is a cooperating agency in the development of the EIS for proposed Turkey Point Units 6 and 7. Under Federal law, each agency has jurisdiction related to portions of the proposed project as major Federal actions that could significantly affect the quality of the human environment. The goal of this cooperative agreement is to develop one EIS that serves the needs of the NRC environmental review process and the USACE permit decision process. While both agencies must meet the requirements of NEPA, the NRC and the USACE have additional mission requirements that must be met. The NRC makes license decisions under the Atomic Energy Act of 1954, as amended (42 U.S.C. § 2011 et seq.) (TN663), and the USACE makes permit decisions under Section 404 of the Clean Water Act (33 U.S.C. § 1344) (TN427), and Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768). The project will also require an engineering review and approval pursuant to Section 14 of the Rivers and Harbors Act 1899 (33 U.S.C. § 408) (TN4769). The USACE is cooperating with the NRC to ensure that the information presented in the NEPA documentation is adequate to fulfill the requirements of USACE regulations (33 CFR Parts 320–332) (TN4127), the PIR process (33 CFR § 320.4) (TN424), and the § 404(b)(1) Guidelines (40 CFR Part 230) (TN427), which contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into WOTUS.

As a cooperating agency, the USACE is part of the NRC review team and is involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. 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) (TN428).

However, for permit decisions under Section 404 of the Clean Water Act (33 U.S.C. § 1344) (TN427), the USACE can only permit the least environmentally damaging practicable alternative, which must also and a project that is not contrary to the public interest. This EIS is intended to provide information to support the USACE permitting decision, as will be documented in the USACE's ROD. However, it is possible that the USACE will need additional information from the applicant to complete the permit review; for example, information that the applicant could not make available by the time the final EIS is issued. Also, any conditions required by USACE, such as implementation of additional mitigative measures, would be required by a DA permit if issued by the USACE.

On July 1, 2013 the National Park Service (NPS) signed the Memorandum of Agreement and became a cooperating agency for the proposed Turkey Point Units 6 and 7 COL application environmental review (NRC 2013-TN2518). According to the Memorandum of Agreement, the NPS has "special expertise regarding the environment in and around its national parks." Specifically, the NPS has special expertise regarding impacts to park resources and the experience of park visitors at Biscayne National Park, which is located adjacent to the Turkey Point facility. In addition, the NPS has special expertise regarding impacts to park resources and the experience of park visitors from cumulative impacts associated with FPL's proposed western power line corridor near, or potentially through, Everglades National Park. The NPS prepared a separate EIS to evaluate options and potential impacts for acquiring lands owned by FPL within the East Everglades Expansion Area of Everglades National Park (NPS 2015-TN4437). On March 16, 2016, the NPS approved a ROD based on this EIS (NPS 2016-TN4532). The decision resulted in the acquisition of 320 ac of FPL lands in the East Everglades expansion area by the NPS in exchange for 260 ac along the eastern boundary of the Park. The NPS will also provide a 90-foot-wide easement to FPL adjacent to the entire length of the exchange corridor (NPS 2016-TN4532) for use as a portion of FPL's proposed western power line corridor.

The NPS has firm and clear mandates from Congress regarding its mission. The NPS Organic Act of 1916 requires the NPS "…to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Congress reaffirmed the NPS's conservation mandate by amending the Organic Act in 1978. That amendment, known as the "Redwood Amendment," states that the "authorization of activities…shall not be exercised in derogation of the values and purposes for which these various areas have been established."

On March 11, 2011, the NRC formally requested the NPS become a cooperating agency for the proposed Turkey Point Units 6 and 7 COL application environmental review. Via letter correspondence dated April 22, 2011, the NPS agreed. Therefore, the NPS's Southeastern Regional Office, which includes Biscayne National Park and Everglades National Park, is a cooperating agency as defined in 10 CFR 51.14 (TN250). The NPS does not have any specific regulatory actions pending before it in regard to the proposed Units 6 and 7 at this time. However, as a cooperating agency, the NPS did provide input into the NRC impact analysis based on the special expertise described previously. Due to this unique set of circumstances, impact determinations made in this EIS should not be attributed to NPS, but only to the NRC and USACE (also referred to as the review team). The NPS's participation in preparing this EIS does not imply NPS concurrence and was primarily centered on data gathering and information sharing regarding the environment in and around the applicable national parks. The NPS role in regard to this EIS is described in a Memorandum of Agreement between the NRC, USACE, and NPS (NRC 2013-TN2518).

1.1.4 Concurrent NRC Reviews

In a review that is separate but parallel to the EIS process, the NRC staff analyzes the safety aspects of the COL application, including, among other things, the characteristics of the proposed site and emergency planning information. These analyses are documented in a Safety Evaluation Report (SER) issued by NRC. The SER presents the conclusions reached by NRC regarding (1) whether the COL application for Turkey Point meets the applicable requirements in NRC regulations, including among others 10 CFR Part 50 (TN249), 10 CFR Part 52 (TN251), 10 CFR Part 73 (TN423), and 10 CFR Part 100 (TN282); and (2) whether there is reasonable assurance that two AP1000 reactors can be constructed and operated at the Turkey Point site without undue risk to the health and safety of the public. The final SER for the Turkey Point COL application is expected to be published in November 2016 (NRC 2016-TN4619).

The reactor design referenced in FPL's COL application for Turkey Point Units 6 and 7 is Revision 19 of the AP1000 certified design (Westinghouse 2011-TN261), which is incorporated by reference into 10 CFR Part 52, Appendix D. Subpart B of 10 CFR Part 52 (TN251) states NRC regulations related to standard design certification. The final rulemaking certifying the AP1000 standard design, as described in Revision 19 of the AP1000 FSAR was published on December 30, 2011 (76 FR 82079) (TN248). The NRC staff reviewed AP1000 severe accident mitigation design alternatives (SAMDAs) in its review of the application for certification of the AP1000 standard reactor design, and published an Environmental Assessment on those SAMDAs in connection with the final rulemaking certifying the design [(76 FR 82079) (TN248), (71 FR 4464) (TN258)]; where appropriate, this EIS incorporates results of the review of Revision 19.

This EIS provides the NRC and USACE analyses of the environmental impacts that could result from building and operating the two proposed units at the Turkey Point site or at one of the four alternative sites. These impacts are analyzed by the review team to determine whether the proposed site is suitable for the two units and whether any of the alternative sites are considered to be obviously superior to the proposed site.

1.2 The Proposed Federal Actions

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52 (TN251), of COLs that would authorize the construction and operation of two new Westinghouse AP1000 reactors at the Turkey Point site. This EIS provides the NRC staff's analyses of the environmental impacts that could result from building and operating the two proposed units at the Turkey Point site or at one of the four alternative sites. These impacts are analyzed by the NRC to determine whether the proposed site is suitable for the two units and whether any of the alternative sites are considered to be obviously superior to the proposed site. The proposed USACE Federal action is the decision whether to issue, issue with modifications, or deny a DA permit pursuant to the requirements in Section 404 of the Clean Water Act (33 U.S.C. § 1344) (TN427) and Sections 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403 and 408) (TN4768) to authorize certain activities potentially affecting WOTUS based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activities on the public interest. If issued, the USACE permit would authorize the impact on WOTUS, including wetlands, for the construction of the Turkey Point electrical generation facility, and various associated, integral project components, including electrical transmission lines and substations, access roads, expansion of an existing barge slip, a pretreatment facility, and reclaimed wastewater and potable water pipelines. The barge slip, radial collector well makeup-water−intake structures, and some portions of the pipelines or transmission lines would be located in, over, or under navigable WOTUS. The proposed project would also require engineering reviews and approvals pursuant to Section 14 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 408) (TN4769) for proposed modifications of federally authorized projects.

1.3 The Purpose of and Need for the Proposed Actions

The continued growth of residential and commercial development in Florida has created an increased demand for electrical power. The purpose and need of the NRC proposed action—NRC authorization of the construction and operation of two AP1000 units at the Turkey Point site—is to provide additional baseload electrical generation capacity for use in the FPL service territory. The need for additional baseload power is discussed in Chapter 8 of this EIS.

The Atomic Energy Act of 1954, as amended (Act), prohibits construction and operation of proposed Units 6 and 7 without licenses from the NRC, which, in this case would be two COLs. Preconstruction and certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, however, may begin before the COLs are granted. FPL must obtain and maintain permits or authorizations from other Federal, State, and local agencies and permitting authorities prior to undertaking some of these activities. The ultimate decision whether or not to build the new units and the schedule for building are not within the purview of the NRC or the USACE and would be determined by the license holder if the authorizations are granted.

Pursuant to the 404(b)(1) Guidelines (40 CFR Part 230) (TN427), the USACE determines both a basic and an overall project purpose. Defining the basic project purpose enables the USACE to determine whether the activity is water-dependent (40 CFR 230.10(a)(3)) (TN427). The overall project purpose is used to identify and evaluate practicable alternatives (40 CFR 230.10(a)(2)) (TN427).

For this project, the USACE has determined the following purpose and need statements:

- Basic Purpose – To meet the public’s need for electric energy.
- Overall Purpose – To meet the public’s need for reliable increased electrical baseload generating capacity in FPL’s service territory.

For the USACE’s NEPA review, the overall project purpose is consistent with that stated above in this section for the purpose and need for the proposed NRC action.

1.4 Alternatives to the Proposed Actions

Section 102(2)(C)(iii) of NEPA (42 U.S.C. § 4321 et seq.) (TN661) states that EISs are to include a detailed statement analyzing alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including in an EIS a chapter that discusses the environmental impacts of the proposed action and the alternatives [(10 CFR Part 51) (TN250), Subpart A, Appendix A]. Chapter 9 of this EIS addresses the following five categories of alternatives to the proposed action: (1) the no-action alternative, (2) energy source alternatives, (3) alternative sites, and (4) system design alternatives. Appendix K addresses Potential USACE Alternative Transmission Line Routes.

In the no-action alternative, the proposed action would not proceed. The NRC could deny FPL's request for the COLs. If the request was denied, construction and operation of two new units at the Turkey Point site would not occur and any benefits intended by the approved COLs would not be realized. Energy source alternatives focus on alternatives that could generate baseload power. The alternative site selection process to determine alternate site locations for comparison with the Turkey Point site is addressed below. System design alternatives include heat-dissipation and circulating-water systems, intake and discharge structures, and water-use and water-treatment systems.

In its ER (FPL 2014-TN4058), FPL defines a region of interest for use in identifying and evaluating potential sites for power generation. Using this process, FPL reviewed multiple sites and identified 21 potential sites for this project from which the alternative sites were selected (FPL 2011-TN36). The review team evaluated the region of interest, the process by which alternative sites were selected, and the environmental impacts of construction and operation of new power reactors at those sites using reconnaissance-level information in accordance with ESRP 9.3 (NRC 2000-TN614). Reconnaissance-level information is data that are readily available from agencies and other public sources and also can include information obtained through visits to the site area. The alternative sites include two owned by FPL and two others. The FPL-owned sites are the Martin site, on which five fossil-fired power plants currently exist and which is located in Martin County, Florida, and the St. Lucie site, on which a nuclear power-generating station currently exists and which is located on Hutchinson Island in St. Lucie County, Florida. The other sites include the Glades site, an agricultural site in the southwestern region of Glades County, Florida, and the Okeechobee 2 site, an undeveloped site in Okeechobee County, Florida (FPL 2014-TN4058). The objective of the comparison of environmental impacts is to determine whether any alternative site is obviously superior to the preferred the Turkey Point site.

In evaluating permit applications pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768) and Section 404 of the Clean Water Act (33 U.S.C. § 1344) (TN427), the USACE is required to consider alternatives in the context of the applicant's purpose and need for the project, as well as the purpose and need from a public interest perspective. The USACE is required by regulation to apply the criteria set forth in the § 404(b)(1) Guidelines (40 CFR Part 230) (TN427). These guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404. These guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have a less adverse impact on the aquatic ecosystem provided the alternative does not have other significant adverse consequences (40 CFR § 230.10(a)) (TN427).

In evaluating permit applications under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768), the USACE is primarily concerned with obstructions to navigation in navigable WOTUS. USACE must also determine whether the proposed project is contrary to the public interest (33 CFR § Section 320.4).

The USACE must also determine whether to grant approval pursuant to Section 14 of the Rivers and Harbors Act (33 U.S.C. § 408) (TN4769). Any proposed action that modifies, alters, or is built upon or adjacent to a Federal project may require authorization pursuant to Section 408, including any proposed action that modifies, alters, or is constructed within a Federal project right-of-way; any proposed structures within 62.5 of a Federal navigation project; any proposed degradation, relocation, penetration, or work under a Corps levee, dike, dam, or water retaining structure; and any proposed work within 15 ft of the toe of a Corps levee, 15 ft of a Federal canal top of bank, or within 50 ft of a Corps dam. The portions of the proposed project that may fall under this coordination process include potential impacts to the L-31N and L-31E levees, and transmission lines crossing under the Miami River and/or canals in Miami-Dade County.

1.5 Compliance and Consultations

Before building and operating new units, FPL is required to obtain certain Federal, State, and local environmental permits, as well as meet applicable statutory and regulatory requirements. In its ER (FPL 2014-TN4058), FPL provided a list of environmental approvals and consultations associated with proposed Turkey Point Units 6 and 7. Potential authorizations, permits, and certifications relevant to the proposed COLs are included in Appendix H. In the development of this EIS, the NRC contacted the appropriate Federal, State, Tribal, and local agencies to identify any consultation, compliance, permit, or significant environmental issues of concern to the reviewing agencies that may affect the acceptability of the Turkey Point site for building and operating the two proposed AP1000 units. A chronology of the correspondence is provided in Appendix C. A list of the key consultation correspondence is provided in Appendix F, which also contains biological assessments and an essential fish habitat assessment.

1.6 Report Contents

Subsequent chapters of this EIS are organized as follows: Chapter 2 describes the proposed site and discusses the environment that would be affected by building and operating the proposed nuclear reactor units. Chapter 3 describes the power plant layout, structures, and activities related to building and operation that are used as the basis for evaluating the environmental impacts. Chapters 4 and 5 separately examine the respective environmental impacts of building and operating the proposed nuclear reactor units. Chapter 6 analyzes the environmental impacts of the uranium fuel cycle, transportation of radioactive materials, and decommissioning. Chapter 7 examines the cumulative impacts of the proposed action as defined in 40 CFR Part 1508 (TN428). Chapter 8 addresses the need for power. Chapter 9 discusses alternatives to the proposed action; analyzes alternative energy sources, sites and system designs; and compares the proposed action with these alternatives. Chapter 10 summarizes the findings of the preceding chapters and provides a benefit-cost evaluation; it also presents the NRC staff's recommendation with respect to the Commission's decision regarding the proposed site for COLs based on the evaluation of environmental impacts. References for sources cited in the narrative are listed in Chapter 11; Chapter 12 is the index.

The appendices to the EIS provide the following additional information:

- Appendix A – Contributors to the Environmental Impact Statement
- Appendix B – Organizations Contacted
- Appendix C – NRC and USACE Environmental Review Correspondence
- Appendix D – Scoping Comments and Responses
- Appendix E – Draft Environmental Impact Statement Comments and Responses (Reserved)
- Appendix F – Key Consultation Correspondence
- Appendix G – Supporting Documentation
- Appendix H – Authorizations, Permits, and Certifications
- Appendix I – The Effect of Climate Change on the Evaluation of Environmental Impacts
- Appendix J – Greenhouse Gas Footprint Estimates for a Reference 1,000 MW(E) Light-Water Reactor
- Appendix K – Potential USACE Alternative Transmission Line Routes

Appendix references are found in the final sections of the applicable appendices.

2.0 AFFECTED ENVIRONMENT

The site proposed by Florida Power & Light Company (FPL) for two combined construction permits and operating licenses (combined licenses or COLs) and a Department of the Army permit is located in southeast Miami-Dade County, Florida. The proposed Turkey Point Nuclear Power Plant (Turkey Point) site is owned by FPL, and currently includes five other power plants on the site. Units 1 and 2 operated as natural-gas/oil steam-generating units. Unit 2 was converted to operate in synchronous condenser mode. Unit 1 will be converted to operate in synchronous condenser mode in December 2016 (FPL 2016-TN4579). In the synchronous condenser mode, the generators help stabilize and optimize grid performance but do not generate power. Units 3 and 4 are nuclear pressurized water reactors, and Unit 5 is a natural-gas combined-cycle steam-generating unit (FPL 2014-TN4058). The location of proposed Turkey Point Units 6 and 7 is described in Section 2.1 followed by descriptions of the land, water, ecology, socioeconomics, environmental justice, historic and cultural resources, geology, meteorology and air quality, nonradiological health, and the radiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects and consultations.

2.1 Site Location

The geographic position of proposed Turkey Point Units 6 and 7 in relationship to the counties, cities, and towns within a 50 mi radius is shown in Figure 2-1. Figure 2-2 shows additional details within a 6 mi radius of the proposed units. The power blocks and most support facilities for proposed Units 6 and 7 would be built on a 218 ac plant area surrounded by man-made cooling canals (referred to from here on as the plant area) situated within the approximately 9,460 ac Turkey Point site (FPL 2014-TN4058). Other project-related facilities would be built on the Turkey Point site. The total area of these facilities, with the exception of the portions of the transmission lines located on the Turkey Point site, is referred to as the project area. The location of proposed Units 6 and 7 within the Turkey Point site and in relation to the existing units is shown in Figure 2-2.

The Turkey Point site is located on the southeastern coast of Florida in unincorporated southeast Miami-Dade County. The site borders Biscayne Bay and Card Sound and is approximately 25 mi south of Miami (as measured from the center point between the proposed Units 6 and 7 power blocks). Homestead and Florida City are the closest incorporated communities. Florida City is 8 mi west of the site and the municipal limits of Homestead are 4.5 mi west of the site. Homestead is also the location of the Homestead Bayfront Park and the Homestead Air Reserve Base.

The location for the proposed Units 6 and 7 is within portions of Sections 33 and 34 of Township 57S Range 40E (FPL 2014-TN4058). The coordinates for the proposed Units 6 and 7 containment buildings are listed in Table 2-1.

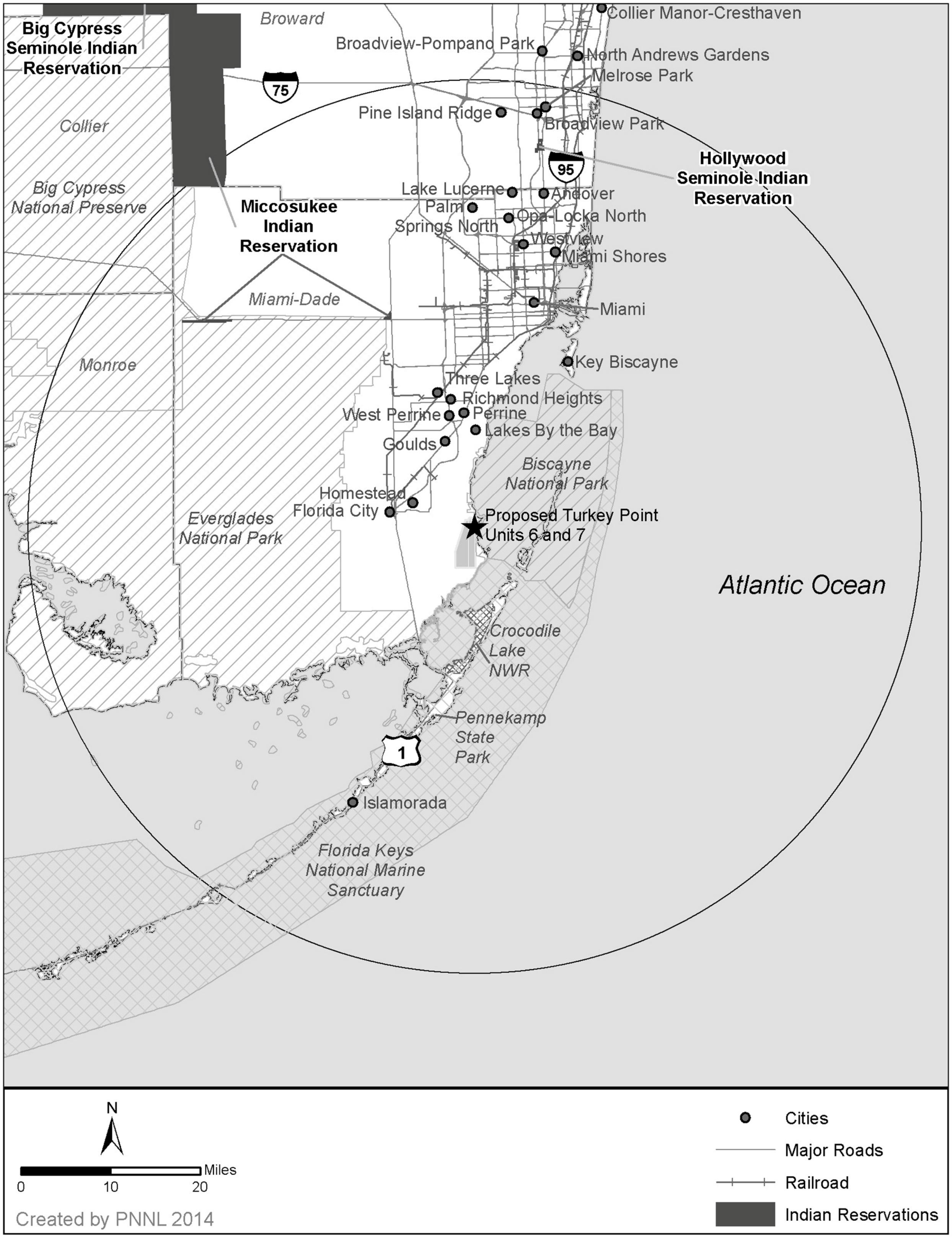


Figure 2-1. Proposed Units 6 and 7 Plant Area and 50-Mile Region

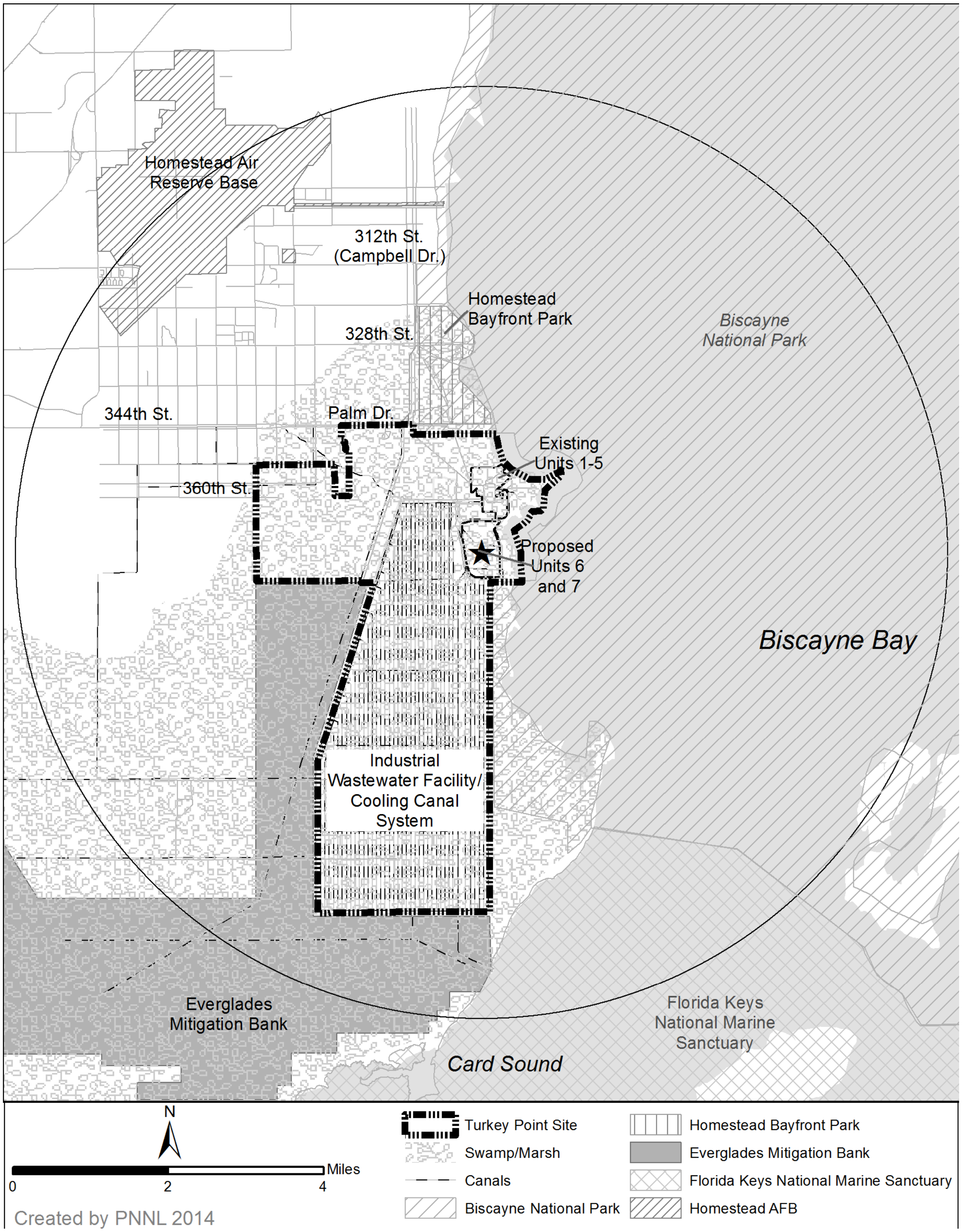


Figure 2-2. Proposed Units 6 and 7 Plant Area and 6-Mile Vicinity

Table 2-1. Proposed Coordinates for the Units 6 and 7 Containment Buildings

Coordinate System	Unit	Coordinates	
Geographic, Decimal Degrees, North American Datum of 1983 (NAD83) (NOAA 1986-TN1163)	Unit 6	25.424186 N	-80.331961 W
	Unit 7	25.424186 N	-80.334536 W
Universal Transverse Mercator Zone 17, Meters, NAD83	Unit 6	2812086.79	N 567179.31 E
	Unit 7	2812086.79	N 566920.31 E
Florida State Plane East, U.S. Feet, NAD83	Unit 6	396968	N 876646 E
	Unit 7	396968	N 875796 E

Source: FPL 2014-TN4058

2.2 Land Use

This section discusses existing land uses on and in the vicinity of the Turkey Point site, as well as in the region. Section 2.2.1 describes the site and vicinity (i.e., the area encompassed within a radius of 6 mi of the plant area, measured from the center point between proposed Units 6 and 7). Section 2.2.2 discusses land use within the existing and proposed transmission line corridors. Section 2.2.3 discusses land use in the region, defined as the area within 50 mi of the plant area, also as measured from the center point between proposed Units 6 and 7.

2.2.1 The Site and Vicinity

As shown in Figure 2-2 and Figure 2-3, the proposed Units 6 and 7 plant area would be located on an island of land surrounded by existing canals. The plant area is adjacent to waters that are part of Biscayne National Park and approximately 2 mi south of the Biscayne National Park Visitors Center. The site is within 3 mi of the Model Lands Basin, a South Florida Water Management District (SFWMD) conservation area. A portion of the Biscayne Bay Aquatic Preserve is located adjacent to the coastal boundary of the Turkey Point site. The Homestead Bayfront Park, a city park, is approximately 1.5 mi north of the proposed Units 6 and 7 plant area. The SFWMD L-31E Canal runs along Biscayne Bay past the Turkey Point site. The site is also located just east of the 13,000 ac Everglades Mitigation Bank (EMB)—an FPL-owned and operated wetland restoration project.

2.2.1.1 Mineral Resources

No oil or gas wells or mines are located within the Turkey Point site boundaries. The most important mineral resource in the vicinity is limestone (USGS 2004-TN678). Limestone is found at or near the land surface throughout the vicinity and is used as a base material for roads and airport runways, as construction aggregate, and in the manufacture of cement (USGS 2004-TN678). Other minerals are not commercially mined in the area (USGS 2004-TN680).

FPL states that it owns the land contained within the Turkey Point site, subject to certain encumbrances (FPL 2014-TN4058). Specifically, the Trustees of the Internal Improvement Fund of the State of Florida hold canal, drainage, reclamation, oil, gas, and mineral rights reservations, and Miami-Dade County holds a canal reservation (FPL 2014-TN4058).

Figure 2-3. Oblique Aerial Photograph of the Proposed Units 6 and 7 Plant Area and Surrounding Area (Adapted from FPL 2014-TN4058)

2.2.1.2 Nearby Population Centers, Schools, and Hospitals

Figure 2-2 provides a map of the vicinity within 6 mi of the plant area. The City of Homestead, in Miami-Dade County, is the nearest population center to the proposed plant site. Other land uses nearby that attract substantial numbers of people include the Homestead/Miami Speedway 5 mi to the northwest and Homestead Air Reserve Base, which contains both civilian and military operations, 4.5 mi northwest. The nearest public school is the Keys Gate Charter School, which is approximately 6 mi away. No hospitals or prisons are located within 6 mi of the proposed Units 6 and 7 project area.

2.2.1.3 Rail and Ports

There are no ports or rail systems located within 6 mi of the Turkey Point site. Biscayne Bay, which lies directly east of the site, is the nearest navigable waterway.

2.2.1.4 Comprehensive Plans and Zoning

Florida’s growth management system includes an adopted State Comprehensive Plan (Fla. Stat. 8-187 2011-TN1503) and requirements for regional planning councils to prepare and adopt comprehensive regional policy plans consistent with that plan. The South Florida Regional Planning Council (SFRPC), which includes Miami-Dade, Broward, and Monroe Counties, has adopted the Strategic Regional Policy Plan for South Florida (SFRPC 2004-TN1151), the policy document that guides all of the SFRPC's activities (Local Government Comprehensive Planning and Land Development Regulation Act) (Fla. Stat. 11-163.3164-TN1240).

Florida also requires counties and municipalities to adopt local government comprehensive plans that guide future growth and development. The comprehensive plans must contain chapters or “elements” that address future land use, housing, transportation, infrastructure, coastal management, conservation, recreation and open space, intergovernmental coordination, and capital improvements. State law (Fla. Stat. 8-187 2011-TN1503) requires that facilities be constructed and services be provided so as to be available concurrent with demand and the impacts of development. Local comprehensive plans must identify specific level-of-service standards for traffic, mass transit, parks, water, sewer, solid waste, and drainage. No development orders can be issued in accordance with State law, if they would cause adopted levels of service to not be met. Local plans, the applicable regional plan, and the State Comprehensive Plan are required by State law to be mutually consistent, and all development regulations and orders must be consistent with the adopted local comprehensive plan.

The Turkey Point site is within the area covered by the Miami-Dade County Comprehensive Development Master Plan (CDMP; Miami-Dade County 2013-TN4563). The CDMP addresses both incorporated and unincorporated areas but focuses land-use regulation on unincorporated areas. Local municipalities’ own comprehensive plans address land use in the incorporated areas. According to the CDMP, nearly 500 mi^2 of the more than 2,000 mi^2 of land in Miami-Dade County have already been developed for urban uses. The land-use diagram in the CDMP identifies recommended future land uses by major categories, each of which is interpreted locally through compatible zoning designations.

The Miami-Dade County CDMP designates the Turkey Point site as Environmental Protection Subarea F (Coastal Wetlands and Hammocks). These areas are low-lying, flood-prone, and characterized predominantly by coastal wetland communities. Electrical generation and transmission facilities are permitted uses under this designation.

The Miami-Dade County zoning for the location of existing Units 1−5, I U-3, Industrial District, Unlimited Manufacturing, allows a full range of institutions, communications, and utilities. The proposed Units 6 and 7 plant area is zoned as Interim Use District (GU) (Miami-Dade Code of Ordinances 33-196-TN1241). The Interim Use District (GU) is applied countywide and used for areas where there is predominately one classification of use (Miami-Dade Code of Ordinances 33-196-TN1241). Nuclear reactors are a permitted use in this district with the approval of an Unusual Use application by Miami-Dade County, as described below (Miami-Dade County 2012-TN1150).

In 2007, Miami-Dade County approved an Unusual Use application submitted by FPL to build two new nuclear power plants and associated facilities. The approval was issued by the Miami-Dade County Board of County Commissioners as Resolution Z-56-07 (Miami-Dade County 2007-TN1085) and included specific conditions of approval for environmental protection.

The Turkey Point site is within the Florida coastal zone (Fla. Stat. 28-380-TN1147). The U.S. Nuclear Regulatory Commission (NRC) has issued guidance (NRC 2009-TN1242) regarding compliance with the Federal Coastal Zone Management Act (16 U.S.C. § 1451 et seq.)

(TN1243). This guidance acknowledges that Florida has an approved Coastal Management Program (Fla. Stat. 28-380-TN1147). Activities of Federal agencies, including issuing licenses or permits, that are reasonably likely to affect coastal zones are required to be consistent with the approved Coastal Zone Management Plan (CZMP) of the State or territory to the maximum extent practical (16 U.S.C. § 1451 et seq.) (TN1243). Applicants for Federal licenses that are likely to affect a State's coastal zone must document the consistency of planned Federal agency activities with the State's or territory's CZMP in a Federal consistency certification, which must be submitted to the State or Federal licensing agency. Pursuant to Sections 373.428 and 403.511, F.S., State certification of power-generation facilities constitutes the State's concurrence that the facilities are consistent with the Federally approved program under the Florida Coastal Management Act.

2.2.1.5 Site Access

Existing public access to the Turkey Point site is provided via SW 344th Street/Palm Drive. Existing barge access to the site is provided by a channel across Biscayne Bay for the delivery of heavy equipment and fuel oil (FPL 2014-TN4058).

2.2.1.6 Existing Land Uses on the Turkey Point Site and in the Vicinity

This section describes the existing land uses on the site, focusing on areas that would be occupied by the proposed new Units 6 and 7 facilities (i.e., the project area, including the plant area), and in the vicinity of the site.

Land-Use/Land-Cover Data

Table 2-2 and Table 2-3 identify the current Florida Land Use, Cover, and Forms Classification System (FLUCFCS) land-use/land-cover classifications within the Turkey Point site and vicinity as provided by FPL (2014-TN4058). The classification data were generated as part of the Land Cover/Land Use 2004/5 Mapping Update Project by the SFWMD (FPL 2014-TN4058).

Developed land on the Turkey Point site is used for power-generation and supporting facilities and activities, including environmental mitigation and compensation activities required as conditions of ongoing permits associated with existing power-generation facilities. The Turkey Point site presently includes two natural-gas/oil steam electric generating units (Units 1 and 2), two pressurized water reactor nuclear units (Units 3 and 4), and one natural-gas combined-cycle steam electric generating unit (Unit 5). As proposed, Units 6 and 7 would be built in an area south of Units 1 through 5 (Figure 2-2) that is previously undeveloped (Figure 2-4). The 5,900 ac industrial wastewater facility (IWF), located south and southwest of the existing power-generation units, includes approximately 4,370 ac of cooling canals (Table 2-2 and Figure 2-2).

Land surrounding the Turkey Point site consists mostly of undeveloped land and protected natural areas; some agricultural lands lie to the west and northwest (Figure 2-4) (FPL 2014-TN4058). Most nearby land in the area outside of Turkey Point site is undeveloped or in agriculture. On the Turkey Point site, most areas adjacent to the proposed Units 6 and 7 plant area are currently undeveloped land. Other land near the plant area is used for the existing generating units and associated infrastructure.

Table 2-2. Major Land-Use Acreages on the Turkey Point Site (FPL 2014-TN4058)

Level 3	FLUCFCS Land-Use Category	Acres
100	Urban and Built-Up	13.8
400	Upland Forest	28.6
500	Water[(b)]	512.2
600	Wetlands	2,706.5
700	Barren Land	492.8
800	Transportation, Communications, and Utilities[(b)]	5,706.0
	Total[(a)]	**9,460.0**

(a) Due to rounding, table values may not exactly sum to the total acres and percentages.
(b) A portion of the IWF was characterized as electrical power facilities and a portion was characterized as streams/waterways/canals (Figure 2.2-2 of FPL 2014-TN4058).

Source: Adapted from FPL 2014-TN4058, Table 2.2-1.

Table 2-3. Major Land-Use Acreages within the 6-Mile Vicinity

Level 3	FLUCFCS Land-Use Category	Acres	% of Total
100	Urban and Built-Up	747.9	1.2
200	Agriculture	2,857.5	4.5
300	Rangeland	1,100.4	1.8
400	Upland Forest	2,248.9	3.6
500	Water	26,044.9	41.4
600	Wetlands	22,336.5	35.5
700	Barren Land	708.9	1.1
800	Transportation, Communications, and Utilities	6,896.2	11.0
	Total[(a)]	**62,941.1**	**100.0**

(a) Due to rounding, table values may not exactly sum to the total acres and percentages.

Source: Adapted from FPL 2014-TN4058, Table 2.2-2.

The FPL Turkey Point site is adjacent to Biscayne Bay and the Intracoastal Waterway, a 3,000 mi waterway along the Atlantic and Gulf Coasts of the United States. Portions of the coastline consist of natural inlets, saltwater rivers, bays, and sounds. Other portions include man-made canals. The City of Homestead is located 4.5 mi west of Turkey Point site (Figure 2-1).

Residential Uses

No residences are located adjacent to the Turkey Point site. The closest residence is approximately 2.7 mi from the proposed Units 6 and 7 plant area (FPL 2014-TN4058).

Parks and Preserves

Parks and preserves in the vicinity include a State-managed aquatic preserve, a wetlands habitat preserve, two national parks, and a national wildlife refuge, as described below.

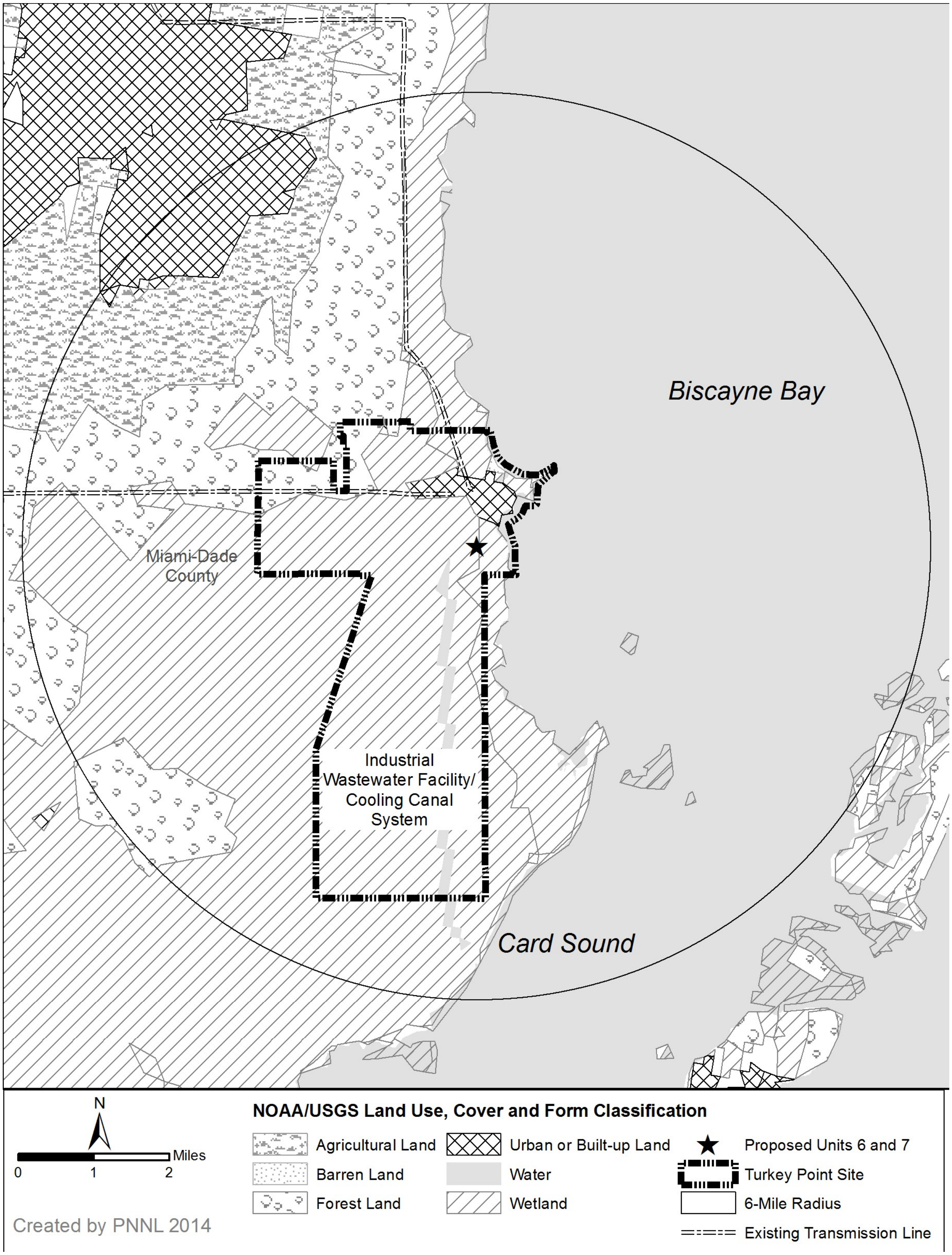


Figure 2-4. Principal Land Uses in the 6-Mile Vicinity of the Turkey Point Site (Adapted from FPL 2014-TN4058)

Biscayne Bay Aquatic Preserve

Biscayne Bay Aquatic Preserve consists of approximately 67,000 ac of submerged State land that has been designated as an Outstanding Florida Water, Class III, and is managed by the Florida Department of Environmental Protection (FDEP), Office of Coastal and Aquatic Managed Areas. Activities at the preserve include recreational and commercial water-related activities, such as boating, water sports, and fishing (FDEP 2010-TN156).

South Dade Wetlands

The South Dade Wetlands is a collective project consisting of the Model Lands Basin, much of the Model Lands Addition, and Southern Glades Addition projects. This project is a collaborative endeavor by the Environmentally Endangered Lands Program of Miami-Dade County (County) and the Save Our Rivers (SOR) Program of the SFWMD (District). The project consists of a broad zone of wetlands located in Miami-Dade County, south of Palm Drive (SW 344th Street) between the boundaries of Everglades National Park, the Southern Glades Wildlife Environmental Area, and the Turkey Point power plant facility. The Model Lands Basin, parts of the Model Lands Addition, and the Southern Glades Addition are being combined into the South Dade Wetlands for management purposes because both agencies own land within the collective project area. These lands are subject to the South Dade Wetlands Conceptual Land Management Plan (SFWMD 2005-TN217).

Biscayne National Park

Biscayne National Park is adjacent to Turkey Point site—to the north and east (Figure 2-1 and Figure 2-2). The waters adjacent to the proposed Units 6 and 7 plant area are within the boundary of Biscayne National Park. The park headquarters building is approximately 2.3 mi north of the proposed Units 6 and 7 plant area (NPS 2012-TN1284). Biscayne National Park was established in 1968 as a national monument and was expanded in 1980 to encompass approximately 173,000 ac of water, coastal lands, and 42 keys (islands). Activities at the multi-use park include boating, recreational and commercial fishing, snorkeling, diving, camping, picnicking, and hiking (NPS 2012-TN1284).

Biscayne National Park was first designated a national monument in 1968 before being expanded and re-designated a national park in 1980. The park was established “to preserve and protect for the education, inspiration, recreation and enjoyment of present and future generations a rare combination of terrestrial, marine, and amphibious life in a tropical setting of great natural beauty.” Biscayne National Park is home to a large segment of the Florida reef tract (the only living coral reef tract in the continental United States), contains the majority of Biscayne Bay, and is an Outstanding Florida Water (OFW). The park supports an incredible array of wildlife, including more than 600 species of fishes, many of which are commercially and recreationally used, over 200 species of birds, and 21 Federally threatened or endangered species. Biscayne National Park is home to the longest protected stretch of mangrove shoreline and protects the finest examples of coastal hardwood hammock on the east coast of the United States.

Everglades National Park

Everglades National Park was created in 1934 as a "public park for the benefit of the people. It is set aside as a permanent wilderness, preserving essential primitive conditions including the natural abundance, diversity, behavior, and ecological integrity of the unique flora and fauna."

Public concern for the Everglades unique flora and fauna, which the wading birds epitomize, were the primary motivation for the establishment of Everglades National Park, as well as the addition of Northeast Shark River Slough and the East Everglades to the Park in 1989 (Everglades National Park Protection and Expansion Act of 1989 [16 U.S.C. § 410r-5 et seq.] [TN4096]). Through these Acts, Congress intended to improve the protection of these resources and the ecosystems upon which they depend. The park's unique ecosystems support 34 native species that are listed as Federally threatened or endangered, or are candidates for listing. Seven of these species are currently considered to be extirpated from the park, and the remaining 27 species may occur in the park today. In addition, critical habitat is designated within Everglades National Park for 10 of these species, and well over half of the park is designated critical habitat for one or more species. Everglades National Park supports the entire range of the endangered Florida leafwing butterfly and nearly all of the remaining population of Cape Sable seaside sparrows. Everglades National Park's rich biodiversity has been recognized by United National Educational, Scientific and Cultural Organization (UNESCO) as a World Heritage Site and an International Biosphere Reserve. Because of alterations of the hydrological regime (quantity, timing, and distribution of Shark Slough inflows); adjacent urban and agricultural growth (flood-protection and water-supply requirements that affect the property's resources by lowering water levels); and increased nutrient pollution from upstream agricultural activities, UNESCO added the park to its list of World Heritage Sites in Danger in 2014. The park is also designated a Ramsar Wetland of International Importance, Specially Protected Area under the Cartagena Convention, an OFW, and includes the Marjorie Stoneman Douglas Wilderness, the largest wilderness area east of the Rocky Mountains. Miami-Dade County has designated a 242 mi^2 area west of the urbanized part of the County contiguous to the Everglades National Park as an area of critical environmental concern (Miami-Dade Code of Ordinances 33B-TN4570).

The broader Everglades ecosystem, which includes Biscayne National Park, has been in decline and many of the species found in the two park's fragile ecosystems are in danger of extinction or regional extirpation. The Comprehensive Everglades Restoration Plan (CERP) is a major restoration initiative that will restore the quantity, quality, timing, and distribution of fresh water in an effort to reverse decades of unintended environmental decline. The Biscayne Bay Coastal Wetlands (BBCW) project is an effort under CERP that will rehydrate wetlands and reduce point-source discharge to Biscayne Bay. CERP is vital to revitalizing habitat within Everglades and Biscayne National Parks and is a major initiative of the Department of Interior and a wide range of other agencies, including the U.S. Army Corps of Engineers (USACE). At a cost of more than $10.5 billion and with over a 35-year timeline, it is the largest hydrologic restoration project ever undertaken in the United States.

Homestead Bayfront Park

The nearest local park is Homestead Bayfront Park—a 97 ac public park. It is 1.5 mi from the proposed Units 6 and 7 plant area south of the North Canal on Biscayne Bay and adjacent to Biscayne National Park (Figure 2-2). The park has a marina and a public swimming area (FPL 2014-TN4058; NRC 2010-TN1457).

Everglades Mitigation Bank

FPL owns the 13,000 ac EMB (Figure 2-2), which is a preserve that is also operated as a mitigation bank, and not a recreational facility (FPL 2014-TN4112). It contains relatively undisturbed freshwater and estuarine wetlands (FPL 2014-TN4058).

Commercial Uses

The 2,938 ac Homestead Air Reserve Base (approximately 4.5 mi northwest of the proposed Units 6 and 7 plant area) (Figure 2-2) is the nearest airport and is primarily devoted to military uses. U.S. Air Force plans provide for future mixed economic uses that could include commercial development as well as residential or recreational uses, but would not include use as a civilian commercial airport (HAFRC 2007-TN1427).

The Homestead-Miami Speedway is 5 mi northwest of the proposed Units 6 and 7 plant area. The speedway has the capacity to seat 65,000 people in grandstands and accommodate more people in other areas of the facility (FPL 2014-TN4058). The City of Homestead recently approved expansion of the speedway (Miami-Dade County 2011-TN1504).

Industrial Uses

Nearby industrial uses include the RMC Florida Group Ltd. active limestone mine (6 mi west), and an abandoned quarry (6 mi north) of the Turkey Point site (FPL 2014-TN4058).

Agriculture – Prime and Unique Farmland

Agricultural land composes approximately 4.5 percent (2,857.5 ac) of land use within the 6 mi vicinity of the Turkey Point site (Figure 2-4; Table 2-2). The land acreage with a use/cover designation of agricultural in the vicinity is concentrated in an area adjacent to the west-northwest corner of the Turkey Point site within Miami-Dade County. No prime farmland or unique farmland, or other special status farmlands as defined in the Farmland Protection Act (7 U.S.C. § 4201(b)) (TN708), occur on the Turkey Point site or in the vicinity (USDA 2012-TN1314).

2.2.2 Transmission Line Corridors and Offsite Areas

The existing Turkey Point power-generation units are currently connected to the transmission system by eight 230 kV transmission lines in two corridors, one going north and one west (FPL 2014-TN4058). The existing transmission lines are shown in Figure 2-5. According to FPL (FPL 2014-TN4058), two 230 kV substations exist on the Turkey Point site, the 1 ac McGregor substation and the approximately 6 ac Turkey Point substation. Existing transmission line corridors connecting the existing generation facilities at the Turkey Point site to the power grid occupy approximately 1,111 ac of land, all within Miami-Dade County (FPL 2014-TN4058).

2.2.2.1 Transmission Line Corridors

To connect proposed Units 6 and 7 to the power grid, two new 500 kV circuits and three new 230 kV circuits are proposed. FPL proposes to build the new transmission lines originating from a proposed new onsite substation (Clear Sky substation) and connecting to the existing Levee substation (500 kV circuits), and to the existing Turkey Point, Davis, and Pennsuco substations (230 kV circuits) (Table 2-4 and Figure 2-5). Two major corridors are proposed—the West and the East corridors—and multiple transmission lines are proposed within each corridor.

As FPL described in Section 2.2.2.2 of its Environmental Report (ER) (FPL 2014-TN4058), existing linear features would generally be followed where available, within two proposed corridors, the West corridor and the East corridor—from the Units 6 and 7 plant area to existing substations (Figure 2-5). These corridors feature several land uses (listed in Table 2-5) (FPL 2014-TN4058). FPL has outlined two options for the West corridor that differ primarily with respect to where the corridor would pass near Everglades National Park (even though no part of the corridor would actually extend inside the perimeter of the park). The first option, termed the West Preferred corridor, passes along a segment of the eastern perimeter of the park. The second option, termed the West Consensus corridor, avoids the park perimeter by passing through lands to the east used mostly for limerock mining. Details regarding the proposed alignment of new transmission lines in each of the corridors (and for the West corridor, each of the options) are presented below.

Table 2-4. Existing and Proposed Transmission Line Corridors

Corridor	Number of Lines/kV	Length (mi)	Total Acres
Existing Corridor			
Turkey Point – Davis	Three 230 kV double circuit lines One 230 kV single circuit	19	NA
Turkey Point – Levee	One 230 kV single circuit	23	NA
West Preferred Corridor			
Clear Sky – Levee	Two 500 kV lines, one 230 kV line	45	3,030.6
Levee – Pennsuco	One 230 kV line	8	312.3
Total		53	3,342.9
East Corridor			
Clear Sky – Davis	One 230 kV line	19	634.9
Davis – Miami	One 230 kV line	18	1,000.0
Total		37	1,634.9
West Consensus Corridor			
Clear Sky – Levee	Two 500 kV lines, one 230 kV line	43.8	3,695.3
Levee – Pennsuco	One 230 kV line	8	312.3
Total		51.8	4,007.6

Source: FPL 2014-TN4058; Note: only one of the West Preferred or West Consensus corridors would be utilized.

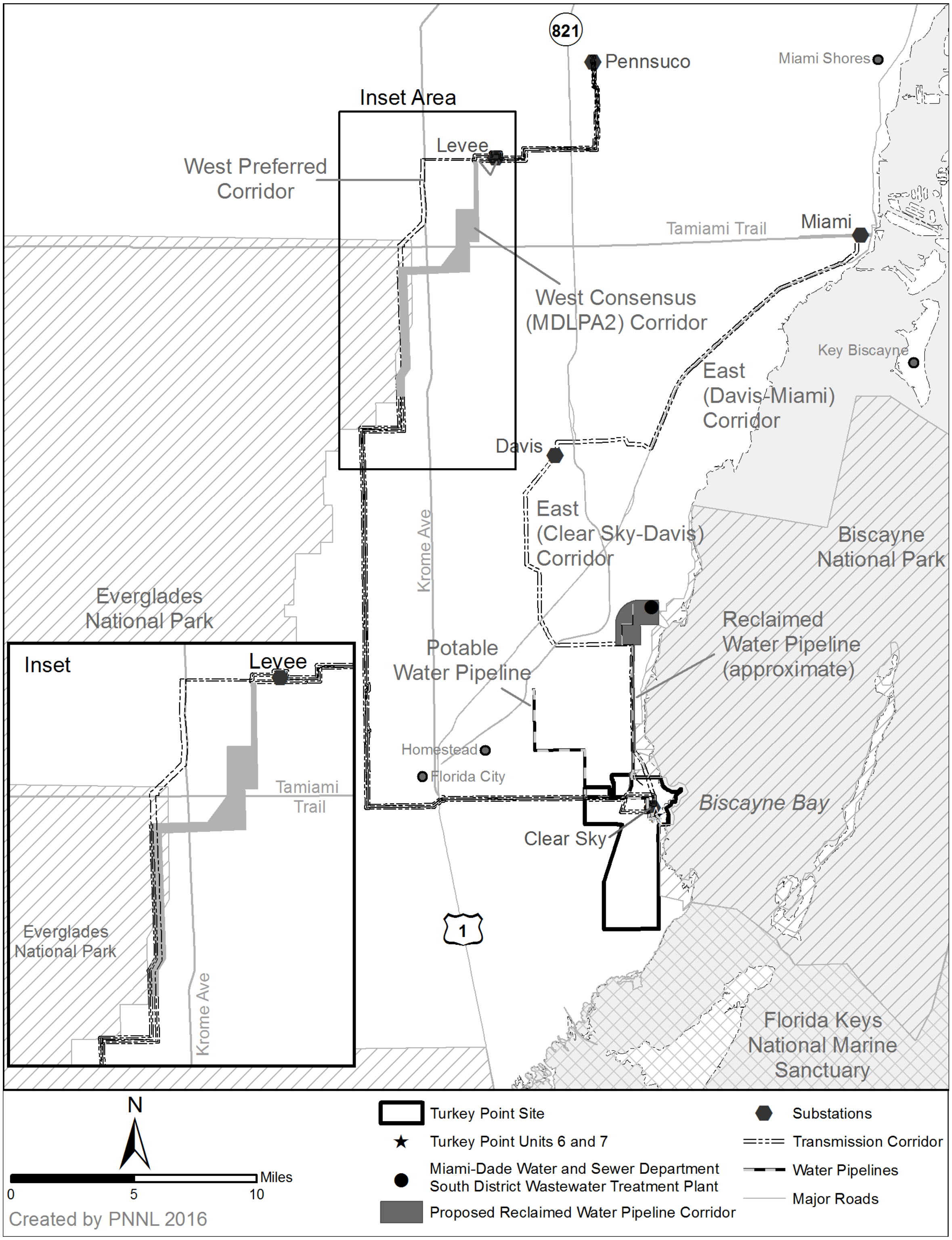


Figure 2-5. Locations of Proposed Transmission Line Corridors and Water Pipelines at the Turkey Point Site (FPL 2013-TN2941)

- West Preferred corridor: The West Preferred corridor, as described in the FPL's ER (FPL 2014-TN4058), consists of a corridor from the proposed new Clear Sky substation to the existing Levee 500 kV substation and then to the existing Pennsuco substation. The segment connecting the Clear Sky and Levee substations would be built in three segments (legs). The first leg passes just south of Homestead and Florida City, then travels north to SW 120th St. Major land use includes fields, pastures, row crops, tree nurseries, and citrus groves. The second and third legs traverse a landscape just east of Everglades National Park characterized by wetlands and disturbed wetlands with some agricultural land, limerock quarries, and scattered urban development. Part of the second leg would abut the eastern perimeter of the park. The segment between the Levee and Pennsuco substations also traverses a landscape characterized by mostly agricultural land, sawgrass wetlands, existing limerock quarries, and scattered urban development.
- West Consensus corridor: FPL describes the West Consensus corridor in a letter dated November 5, 2013 (FPL 2013-TN2941). It differs from the West Preferred corridor only in that portions of the second and third legs of the segment between the Clear Sky and Levee substations have been shifted to the east to avoid abutting the eastern perimeter of Everglades National Park. This corridor still crosses a landscape consisting mostly of wetlands and disturbed wetlands, but FPL states that its use would reduce the potential for adverse impacts on multiple Federally endangered species (FPL 2013-TN2941).
- East corridor: The East corridor is also described in the ER (FPL 2014-TN4058). A new, 230 kV, approximately 19 mi long, transmission line would be constructed to connect the proposed new Clear Sky substation to the existing Davis substation, and a new, approximately 18 mi long, 230 kV line would be constructed to connect the Davis substation to a new 230 kV bay position at the Miami substation. FPL stated (FPL 2014-TN4058) that these transmission lines would be largely collocated in an existing right-of-way or other linear/transportation corridors. FPL also stated that installation of these lines would require acquisition of additional easements. The existing land uses traversed by the East corridor are listed by segment in Table 2-5. The segment connecting the Clear Sky and Davis substations traverses a mostly rural landscape consisting predominantly of agricultural land interspersed with wetlands and rangeland and with widely scattered urban areas and forests. A small (less than 1 mi) portion of the Clear Sky to Davis segment would traverse the end of the APZ II zone of the Air Installation Compatible Use Zone adopted by the Homestead Air Reserve Base. The line would be collocated with an existing transmission line in this location. The segment between the Davis and Miami substations would traverse a mostly urban landscape but would be built mostly along existing roadways.

In addition to the transmission lines built within the corridors noted above, a new underground transmission line would be built within the plant area to connect Units 6 and 7 to the proposed new Clear Sky substation. As proposed, this underground transmission line would be built entirely within the 218 ac island comprising the plant area. The existing land use of the plant area is described above.

Transmission line siting in Florida is regulated under the Florida Power Plant Siting Act (PPSA) (Fla. Stat. 29-403.501 2011-TN1068), and Chapter 62-17 of the Florida Administrative Code (Fla. Admin. Code 62-17-TN1247). FPL obtained certification through the Florida PPSA Site

Certification Application (SCA) process for the new 500 kV and 230 kV transmission lines. FPL undertook a route-selection process to select the transmission line corridors that was submitted for approval under the Florida PPSA (Fla. Stat. 29-403.501 2011-TN1068).

On May 19, 2014, Florida's Governor and Cabinet, sitting as the Siting Board, issued a Final Order of Certification that approved FPL's application to construct and operate two new nuclear generating units at Turkey Point, as well as new electrical transmission lines and other offsite facilities. The West Consensus corridor was certified as the primary corridor for the location, construction, and operation of electrical transmission lines, and the West Preferred corridor as the backup location. The NRC staff is aware that on April 20, 2016, a Florida court issued an opinion in which it ruled that the Florida Siting Board should have considered whether to require FPL to bury a portion of the transmission lines, and that the record was inadequate to support certain mitigation measures associated with transmission lines in the East Everglades (State of Florida 2016-TN478). Although the opinion remands the Conditions of Certification to the Florida Siting Board for consideration of the possibility of burying a portion of the transmission lines and reconsideration of the specified mitigation measures, the NRC staff understands that the court's opinion is not yet final as of this writing (October 3, 2016). Accordingly, for the purposes of the FEIS evaluation of impacts, the NRC staff considers the transmission line route and conditions reviewed and approved by the Florida Siting Board as the most current information regarding the transmission line and associated potential mitigation measures. Even if the Conditions of Certification are revisited, the NRC staff considers it reasonable to expect that Conditions of Certification similar to or no less effective than those originally issued will be in place before construction and operation of the proposed units begins.

On March 16, 2016, the National Park Service (NPS) approved acquisition of 320 ac of FPL lands in the East Everglades expansion area of Everglades National Park in exchange for 260 ac along approximately 6.5 mi of the park's eastern boundary (NPS 2016-TN4532). The NPS will also provide a 90-ft-wide easement to FPL adjacent to the entire length of the exchange corridor. The 260 ac that FPL would acquire through the land swap, plus the easement, forms part of FPL's West Preferred and Consensus corridors. Table 2-5 summarizes the major land uses along each corridor/option.

As part of the West Preferred and West Consensus corridor alignments, multiple access roads would be built to provide vehicular access to the transmission lines. Two proposed access road corridors for the West Preferred corridor have been designated as the Tamiami Trail corridor and the Krome Avenue corridor. Four proposed access road corridors for the West Consensus corridor have been designated as the NW 12th Street, Tamiami Trail, L-31 Canal and Levee, and SW 88th Street corridors. Land uses in these corridors are primarily waterways, marshes, rock quarries, roads and highways, and other open lands with vegetation indicative of disturbed areas.

Table 2-5. FLUCFCS Land-Cover Acreage within Proposed Transmission Line Corridors and Transmission Access Roads

Segment	100	200	300	400	500	600	700	800	Total
West Corridor									
Clear Sky - Levee Preferred	8.5	848.9	89.3	67.3	401.3	1,346.6	69.9	198.9	3,030.6
Clear Sky - Levee Consensus		835.4	67.1	18.4	15.1	2,700.0	59.3		3,695.3
Levee – Pennsuco (Preferred or Consensus)	86.9				1.8	169.4	19.4	34.8	312.3
East Corridor									
Clear Sky - Davis	9.4	418.3	76.1	1.1	17.7	71.7	1.6	38.9	634.9
Davis-Miami	483.0	13.6	19.2	2.1	16.7			465.4	1,000.0
West Preferred Access Roads									
Krome Ave.					85.3	200.2		79.2	364.7
Tamiami Trail					2.7	3.1		4.7	10.5
West Consensus Access Roads									
88th St.	2.1		0.8	12.0	0.01	18.3	0.3		33.5
L-31 Canal					11.4	4.2	21.0		37.1
NW 12th St.	13.3	6.5	0.1	0.4					20.2
Tamiami Trail						19.6			19.6

Source: Adapted from Tables 2.2-4 of FPL 2014-TN4058 and FPL 2013-TN2941

2.2.2.2 Transmission Substation Improvements

Proposed substation improvements include building one new substation (Clear Sky), and upgrading and expanding the existing Turkey Point, Miami, Levee, Davis, and Pennsuco substations (Figure 2-5). Improvements at the Turkey Point, Levee, and Davis substations would require site expansions. In its ER (FPL 2014-TN4058), FPL stated that site expansions at these substations would take place on existing FPL property in previously disturbed areas, except that the improvements proposed at the Pennsuco substation would require acquisition of additional property. Existing land uses for the areas of substation expansion are summarized below.

- Turkey Point substation: The Turkey Point substation would be expanded by approximately 0.9 ac to accommodate proposed new facilities. In its ER (FPL 2014-TN4058), FPL stated that the expansion area is already fully occupied by uses associated with the existing operation. Areas adjacent to the existing substation are currently used for parking lots or are unused but surrounded by electrical power-generation facilities.
- Levee substation: The existing Levee substation, at NW 41st Street and NW 147th Avenue, would be expanded by 2.3 ac to accommodate proposed new facilities. Existing land use in the expansion area for the Levee substation comprises approximately 1.81 ac of hardwoods and 0.52 ac of electric power facilities (FPL 2014-TN4058).

- Pennsuco substation: The existing Pennsuco substation, at 10800 NW 107th Avenue, would be expanded by 2.42 ac to accommodate proposed new facilities. The expansion area for the Pennsuco substation is currently used for rock quarrying (FPL 2014-TN4058).
- Davis substation: The existing Davis substation, at 12701 SW 136th Street would be expanded by 1.12 ac to accommodate new installations. Existing land in the expansion area for the Davis substation is used for tree nurseries (FPL 2014-TN4058).
- Miami substation: The proposed improvements at the Miami substation, at 122 SW 3rd Street, would take place entirely within the existing fence line of the facility (FPL 2014-TN4058).

2.2.2.3 Makeup and Potable Water System Pipelines

As described in Chapter 3, approximately 9 mi of new reclaimed water pipelines would be installed between the FPL reclaimed water-treatment facility (RWTF) on the Turkey Point site and the Miami-Dade Water and Sewer Department (MDSAWD) South District Wastewater-Treatment Plant (SDWWTP) to the north (Figure 2-5). For about 6.5 mi, the pipelines would be collocated with the existing Clear Sky to Davis transmission line right-of-way. At the northern end, FPL has identified a pipeline corridor approximately one mile wide as it approachs the SDWWTP. This width provides for flexibility in the precise corridor location ultimately selected and does not reflect the anticipated width of the corridor. At the southern end it follows the L-31E Canal as it approaches the RWTF. Existing land uses along this route include mostly wetland, agricultural, and electrical power transmission line uses. A new 2.5 mi right-of-way would be located adjacent to a new pipeline corridor. The reclaimed water pipelines from the FPL RWTF (FPL 2014-TN4058) would be routed south along the eastern side of the cooling canals to the makeup-water reservoir (Figure 2-5).

Potable water pipelines, approximately 10 mi long, would be constructed to deliver potable water from the MDSAWD potable water source facility to the Units 6 and 7 plant area as shown in Figure 2-5. Potable water pipelines would be constructed within the rights-of-way for other construction activities and would not result in additional land disturbance (FPL 2015-TN4442).

Makeup-water pipelines would be installed within the site in areas currently used for power-generation purposes, and therefore would not require new land disturbance (FPL 2014-TN4058).

2.2.2.4 Fill Material Source Site

FPL proposes to obtain the offsite fill from established regional sources. A number of fill sources in the region could meet the needs of FPL at the Turkey Point site.

To provide context for the potential impacts of fill mining, the review team considered the Atlantic Civil, Inc. mine located about 10 mi west of the Turkey Point site as a viable commercial fill source (USACE 2013-TN3473). The review team also considered a rock mine in the Lake Belt region as another viable commercial source of fill. This allowed the review team to consider a nearby location with limited capacity and a more distant site with extensive capacity.

The Atlantic Civil rock mine is located about 10 mi west of the FPL site; it is a complex of quarries, fill areas, and mitigation areas occupying approximately 3,200 ac (SFWMD 2010-TN3553; SFWMD 2014-TN3554).

The rock mines in the Lake Belt region in northwest Miami-Dade County are located approximately 40 road miles northwest of the Turkey Point site. The USACE issued project-specific permits to several companies including to Cemex Construction Materials Florida for its FEC Quarry, named for the Florida East Coast (FEC) Railway that serves the quarry. The FEC Quarry and rail center are located near the intersection of the Florida Turnpike and Okeechobee Road (USACE 2010-TN3555; SFWMD 2010-TN3556). Other permitted quarries in the Lake Belt region include White Rock Quarries (North and South), Tarmac America, Florida Rock Industries, and APAC Southeast, Inc. (USACE 2010-TN3559; USACE 2010-TN3560; USACE 2010-TN3561).

2.2.2.5 Emergency Operations Facility

FPL states that the existing facility for Units 3 and 4 would also be used for Units 6 and 7. This facility is located offsite at the intersection of West Flagler Street and SW 92nd Avenue. FPL further states that it proposes no changes to this facility (FPL 2014-TN4058).

2.2.2.6 Roads and Highways

The major area roads and highways, shown in Figure 2-6, are as follows:

- U.S. highways
  - US-1
  - Interstate 75
  - Interstate 95
- State highways
  - Florida’s Turnpike (Homestead Extension, SR-821)
  - SR-997

Local roadways serving the project site (Figure 2-2) are as follows:

- SW 344th Street/Palm Drive. SW 344th Street/Palm Drive intersects with US-1 and SR-997.
- SW 328th Street/North Canal Drive, paralleling SW 344th Street/Palm Drive to the north, connecting to US-1.
- From Florida’s Turnpike, via the exit at SW 312th Street/Campbell Drive or via the Turnpike terminus at US-1.

Existing land uses in the areas to be used for the proposed access road improvements largely include roadways, urban and built-up land, marshes, mangroves, and agriculture (FPL 2014-TN4058).

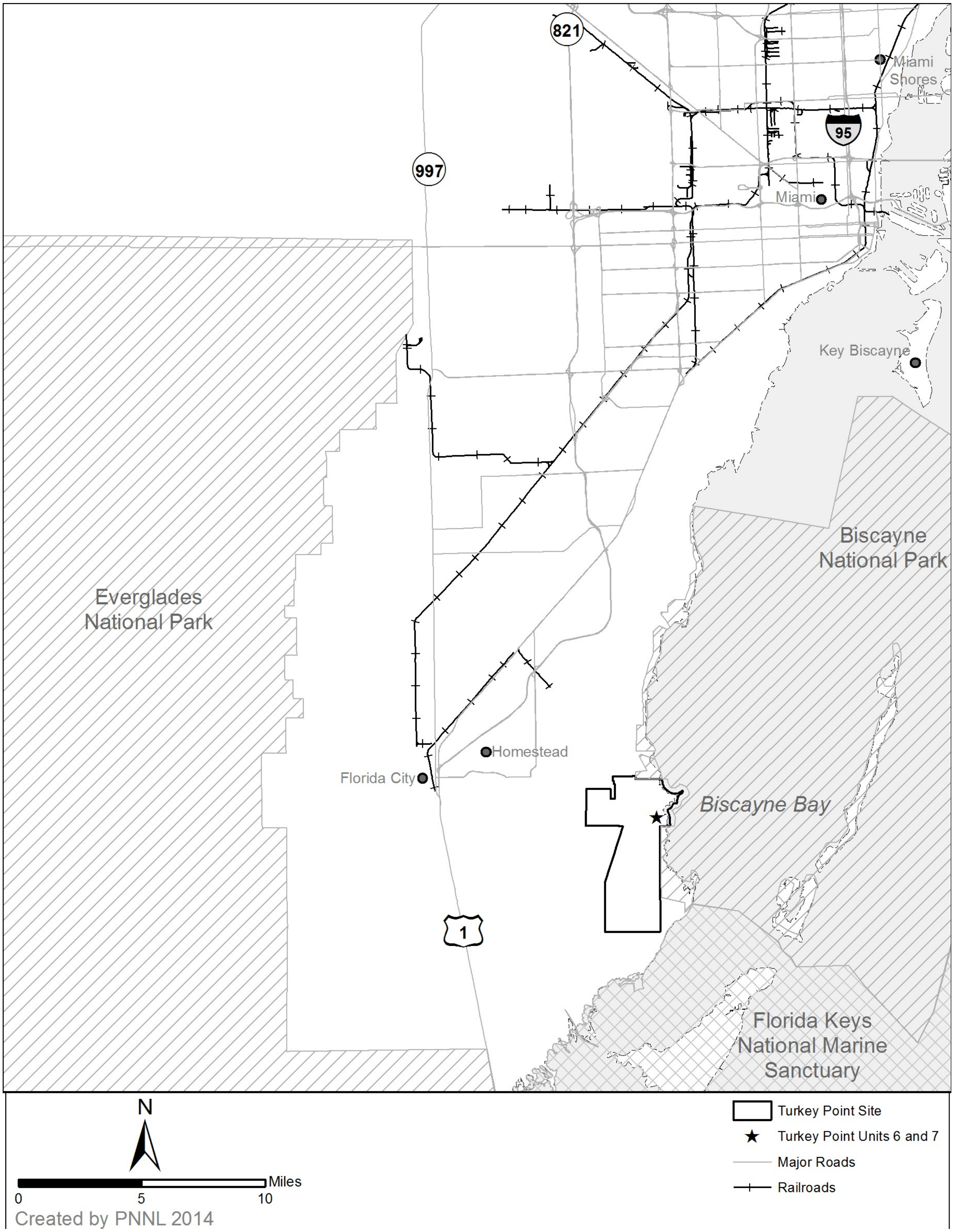


Figure 2-6. Map Showing Major Roads, Highways, and Rail Lines within the Turkey Point Site Vicinity (FPL 2014-TN4058)

2.2.3 The Region

Land within 50 mi falls into four counties: Broward, Collier, Miami-Dade, and Monroe. Existing major land-use classifications and waterways in the region are listed in Table 2-6 and shown in Figure 2-7. Major highways and rail lines are shown in Figure 2-6.

Table 2-6. Regional Land Use

FLUCFCS Code		Acres
100	Urban and Built-Up Land	353,440
200	Agriculture	83,286
300	Rangeland	21,369
400	Upland Forest	23,729
500	Water	690,568
600	Wetlands	1,416,931
700	Barren Land	3,030
800	Transportation, Communications, and Utilities	42,588

Source: FPL 2014-TN4058

All four counties within the region have adopted comprehensive land-use plans (Broward County 2010-TN1505; Collier County 2012-TN1506; Miami-Dade County 2012-TN1150; Monroe County 2012-TN1507). Because the project area, transmission line corridors, and offsite areas are all located in Miami-Dade County, the Miami-Dade CDMP is the relevant land-use planning document for the proposed project.

2.2.3.1 Rail and Ports

The nearest rail line is located 10 mi west of the proposed Units 6 and 7 plant area (Figure 2-1), (DOI 2012-TN1335). The rail line is part of the FEC Railway. The Port of Miami is located approximately 26 mi from the site.

2.2.3.2 Regional Land Uses and Jurisdictions

Land Uses

As described in ER Table 2.2-8 (FPL 2014-TN4058), the region within 50 mi of the proposed Units 6 and 7 plant area encompasses 2,634,939 ac of land (mostly excluding the Atlantic Ocean, Gulf of Mexico, Biscayne Bay, Card Sound, and Florida Bay). Most of this land is wetland (approximately 54 percent) and water (approximately 26 percent); urban or built-up lands account for approximately 15 percent (FPL 2014-TN4058). The remaining lands are agricultural land (approximately 3 percent), forestland (less than 1 percent), rangeland (less than 1 percent), and less than 1 percent barren land.

Public Lands

Federal, State, County, and city public lands account for much of the land in the region. Specific parks and other public lands are described below.

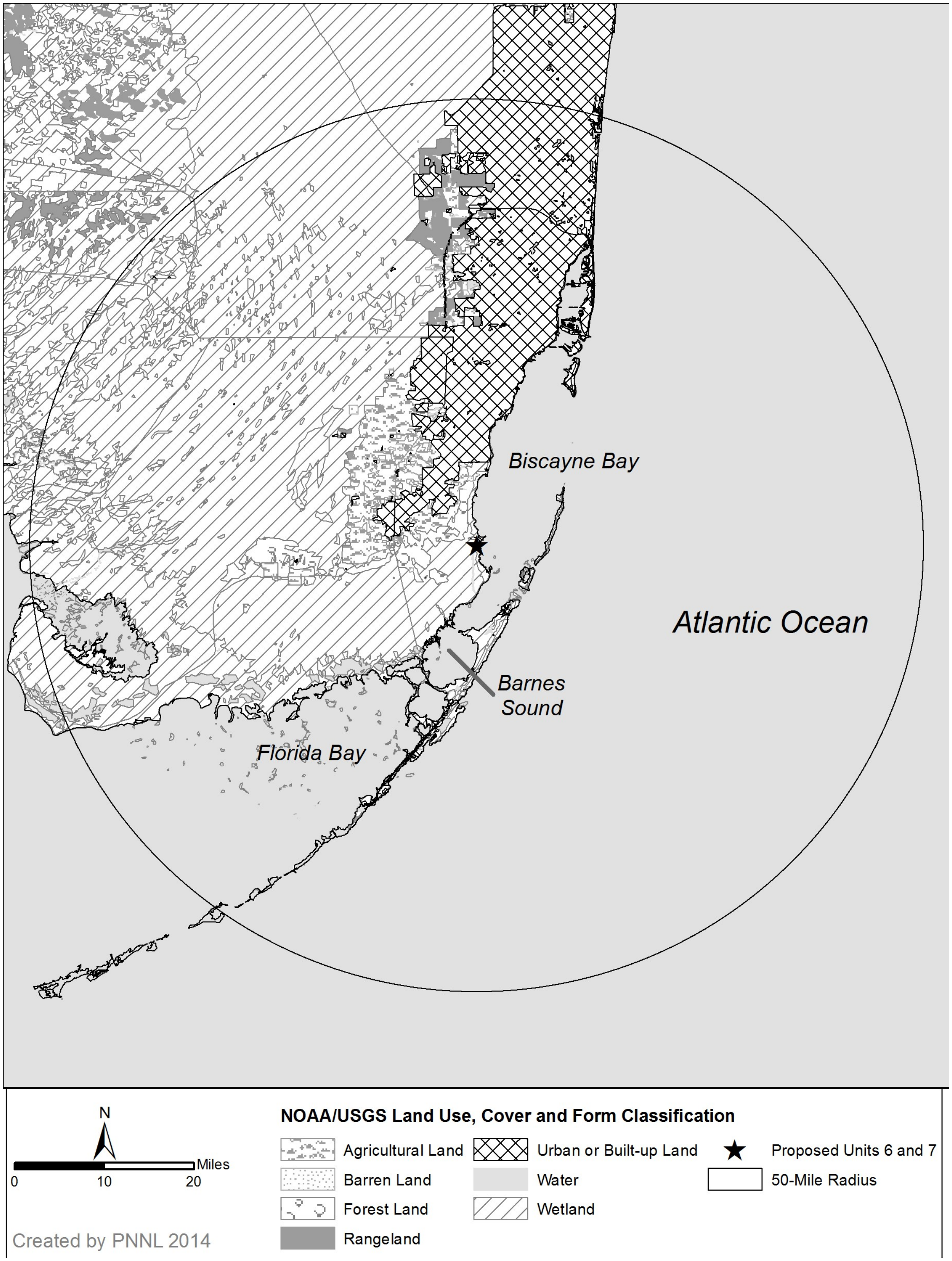


Figure 2-7. Land Use within the 50-Mile Radius of the Turkey Point Site (FPL 2014-TN4058)

Everglades National Park

Everglades National Park, 10 mi southwest of Turkey Point site (Figure 2-1), encompasses approximately 1,509,000 ac, including most of Florida Bay and its uninhabited islands. Ernest Coe Visitors Center is located approximately 16 mi southwest of the proposed Units 6 and 7 plant area (NPS 2010-TN192).

Crocodile Lake National Wildlife Refuge

The Crocodile Lake National Wildlife Refuge is located approximately 10 mi south of the Turkey Point site in the northern part of Key Largo. The refuge is not open to the public except for the interpretive butterfly garden at the refuge headquarters (FWS 2012-TN706).

Big Cypress National Preserve

Big Cypress National Preserve, located approximately 35 mi northwest of the Turkey Point site, consists of 729,000 ac of freshwater swamp and other inland habitats, which support the rich marine estuaries along Florida's southwest coast, including parts of Everglades National Park. The preserve contains a mixture of tropical and temperate plant communities that are home to a diversity of wildlife, including the endangered Florida panther (*Puma concolor coryi*). Activities at the preserve include a wide variety of recreational pursuits, including camping (NPS 2012-TN707).

Indian Reservations

Indian reservations in the region include the Miccosukee Indian Reservation (approximately 50 mi northwest) and the Seminole Tribe of Florida, Hollywood Reservation (approximately 50 mi north) (Figure 2-1).

Agriculture

Information about principal agricultural products, crop areas, and average annual yields is presented in Table 2-7 and was taken from the AgCensus, which is conducted every 5 years; the most recent data available were from 2007 (USDA 2009-TN1669).

Table 2-7. Agriculture in the Region

County	Total Agricultural Land (ac)	Harvested Cropland (ac)		Pastureland (ac)		Major Agricultural Products
Broward	8,737	2,577	(29%)	4,141	(41%)	Cattle, orchard crops, vegetables, poultry, hogs and pigs, and hay
Collier	109,934	35,288	(32%)	63,612	(58%)	Cattle and calves, poultry, orchards crops, vegetables, hogs and pigs, and hay
Miami-Dade	67,050	49,065	(73%)	9,108	(14%)	Cattle and calves, poultry, orchards crops, vegetables, hogs and pigs, sheep and lambs, sweet potatoes, and hay
Monroe	187	156	(83%)	12	(6%)	Not disclosed in 2007

Source: USDA 2009-TN1669.

2.3 Water

This section describes the hydrologic processes and waterbodies in and around the Turkey Point site, the existing water use, and the quality of water in the environment of proposed Turkey Point Units 6 and 7. The description is limited to the parts of the hydrosphere that may affect or be affected by building and operating the proposed units. For plant operations, there would be two independent sources of makeup water for nonsafety-related circulating-water system cooling. Each source would be capable of supplying 100 percent of the makeup-water demand. The primary source would be reclaimed water from the MDWASD, and the alternative source would be saltwater supplied from horizontal radial collector wells installed in the Biscayne aquifer between 25 and 40 ft beneath the bed of Biscayne Bay and adjacent to Biscayne National Park (FPL 2014-TN4058).

The reclaimed water, prior to being used in the circulating-water system, would receive further treatment at the FPL RWTF. The alternative source supplied by the radial collector wells would only be used when needed to supplement makeup-water demand when reclaimed water is not available in sufficient quantity or quality, and would be limited to a maximum of 60 days per year by the Florida State Conditions of Certification (State of Florida 2014-TN3637).

The blowdown from the cooling towers and other plant discharge effluents from proposed Units 6 and 7 would be collected in a sump and would be injected to the Boulder Zone—a cavernous, high-permeability South Florida geologic horizon within the Lower Floridan aquifer system. As such, the surrounding surface waterbodies would neither be directly used for the primary water supply, nor for a heat sink for proposed Units 6 and 7. However, if the radial collector wells are used, the water would be pumped directly from the Biscayne aquifer beneath the bay and most of this water would be drawn downward from Biscayne Bay in an area adjacent to Biscayne National Park. No waste effluent from proposed Units 6 and 7 would be discharged directly to the surrounding surface waterbodies. As described in Chapter 3, new pipelines would convey potable water from an existing MDSAWD water supply line. The original source of this water is the Biscayne aquifer in Miami-Dade County. Therefore, the affected environment described in this section includes surface-water resources such as the following:

- Biscayne Bay, BBCW (Biscayne Bay Coastal Wetlands), and adjacent marine waters (Card and Barnes Sound)
- Everglades hydrologic system including Shark River Slough and Taylor Slough
- South Florida canal system
- the FPL IWF.

The following groundwater resources are also described:

- the Biscayne aquifer
- the Upper Floridan aquifer
- the Boulder Zone of the Lower Floridan aquifer.

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features that could be affected by building and operation of proposed Turkey Point Units 6 and 7. The hydrologic conditions at the Turkey Point site are described in Section 2.4 of the Final Safety Analysis Report (FSAR) (FPL 2015-TN4502). A summary of the hydrologic conditions of the Turkey Point site is provided in Section 2.3 of the ER (FPL 2014-TN4058). The following descriptions are based on information from the FSAR (FPL 2015-TN4502), the ER (FPL 2014-TN4058), and sources of publicly available hydrological data referenced below.

2.3.1.1 Surface-Water Hydrology

Topographic and geologic features over a range of spatial scales influence the surface-water hydrology at the Turkey Point site. The largest of these features is the South Florida Hydrologic System, within which the regional hydrology of the Biscayne Bay and Turkey Point hydrologic systems function. These are described in the following subsections.

South Florida Hydrologic System

South Florida is characterized by low topographic relief; the elevations south of Lake Okeechobee are mostly below 20 ft NAVD88 (Zilkoski et al. 1992-TN1232). Along the eastern portion of South Florida lies the Atlantic Coastal Ridge (ACR); its elevations are nearly 20 ft NAVD88 at the northern end and around 10 ft NAVD88 at the southern end (Figure 2-8). Extending southward from Lake Okeechobee is a relatively low trough (Everglades trough), which includes Shark River Slough draining to the south into Everglades National Park (Figure 2-8). Shark River Slough is more than 30 mi wide and has an elevation of around 8 ft NAVD88 north of Miami and around 4 ft NAVD88 west of Miami. Historically, it was inundated much of the time and remains subject to seasonal flooding (Renken et al. 2005-TN110). While the ACR generally forms a barrier to flows from Shark River Slough, historically natural swales (relatively low areas locally referred to as "glades") traverse the coastal ridge, which allowed conveyance of flows toward the Atlantic Coast as hydrologic conditions allowed (Renken et al. 2005-TN110). Taylor Slough flows eastward south of the ACR providing potential freshwater flows to the southeastern region of South Florida, including Barnes and Card Sounds and southern Biscayne Bay. Limestone bedrock underlies the region, while layers of muck and peat cover the bedrock in the Everglades trough with historical thicknesses ranging from 24 ft near Lake Okeechobee to 2.5 ft in the southern Everglades (Renken et al. 2005-TN110).

In the early twentieth century, canal construction began in Southeast Florida to support agricultural land development (Renken et al. 2005-TN110; Cantillo et al. 2000-TN108). Increases in population and changes in land use led to modifications of the hydrologic system to reduce flooding associated with conversion of wetlands to agricultural uses (Renken et al. 2005-TN110; Cantillo et al. 2000-TN108). The first canals to drain the Everglades were constructed in 1903 (Cantillo et al. 2000-TN108). Figure 2-9(a) shows the extent of the canal network by 1920, when the canals primarily provided drainage from the area south of Lake Okeechobee. Increased population in Southeast Florida led to the need for additional dry land so that the canal network was greatly expanded by 1990 (Figure 2-9(b)). In general, the construction of the canal network had its intended effect of controlling the hydrologic system of Southeast Florida

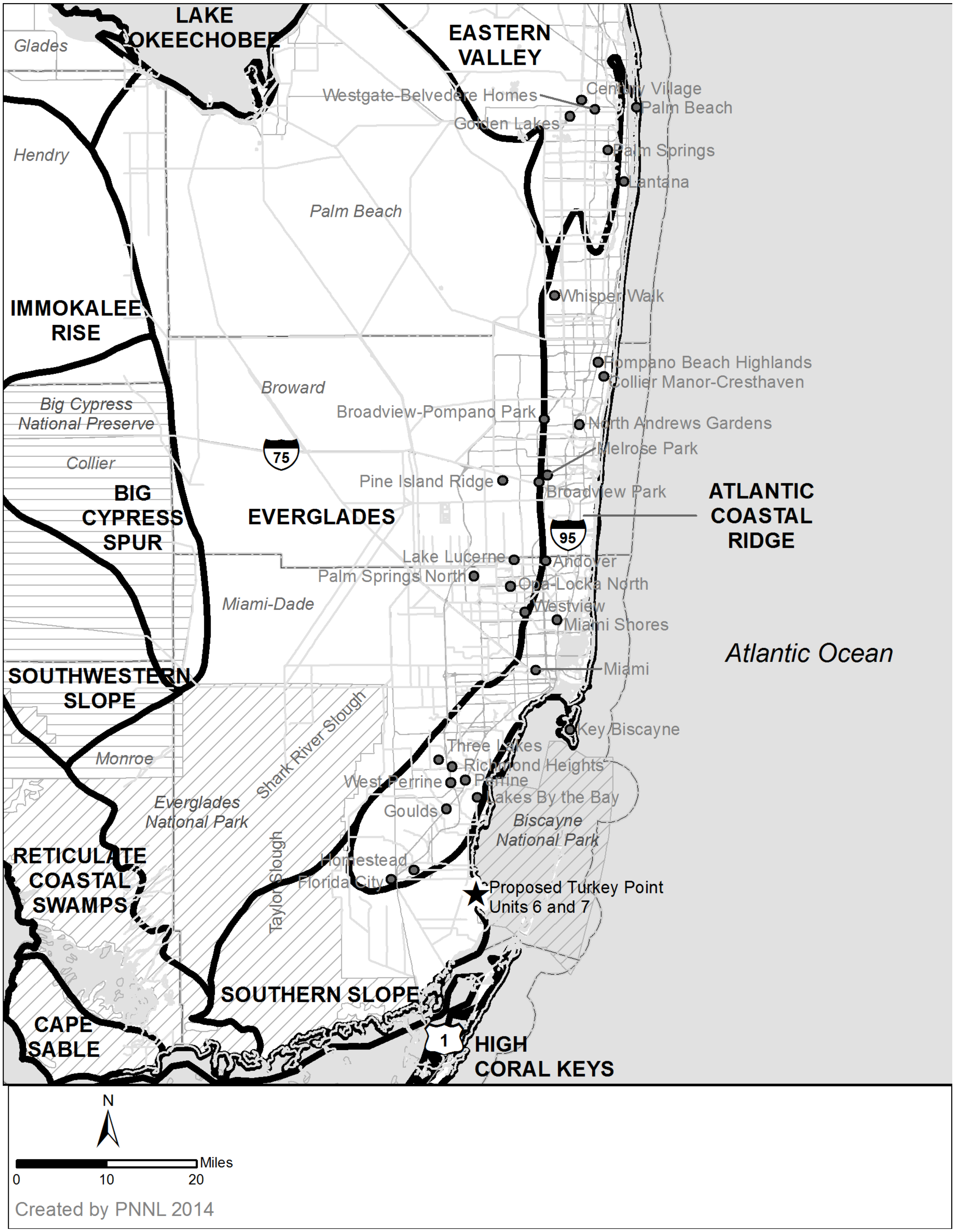


Figure 2-8. Physiographic Provinces in Southeast Florida

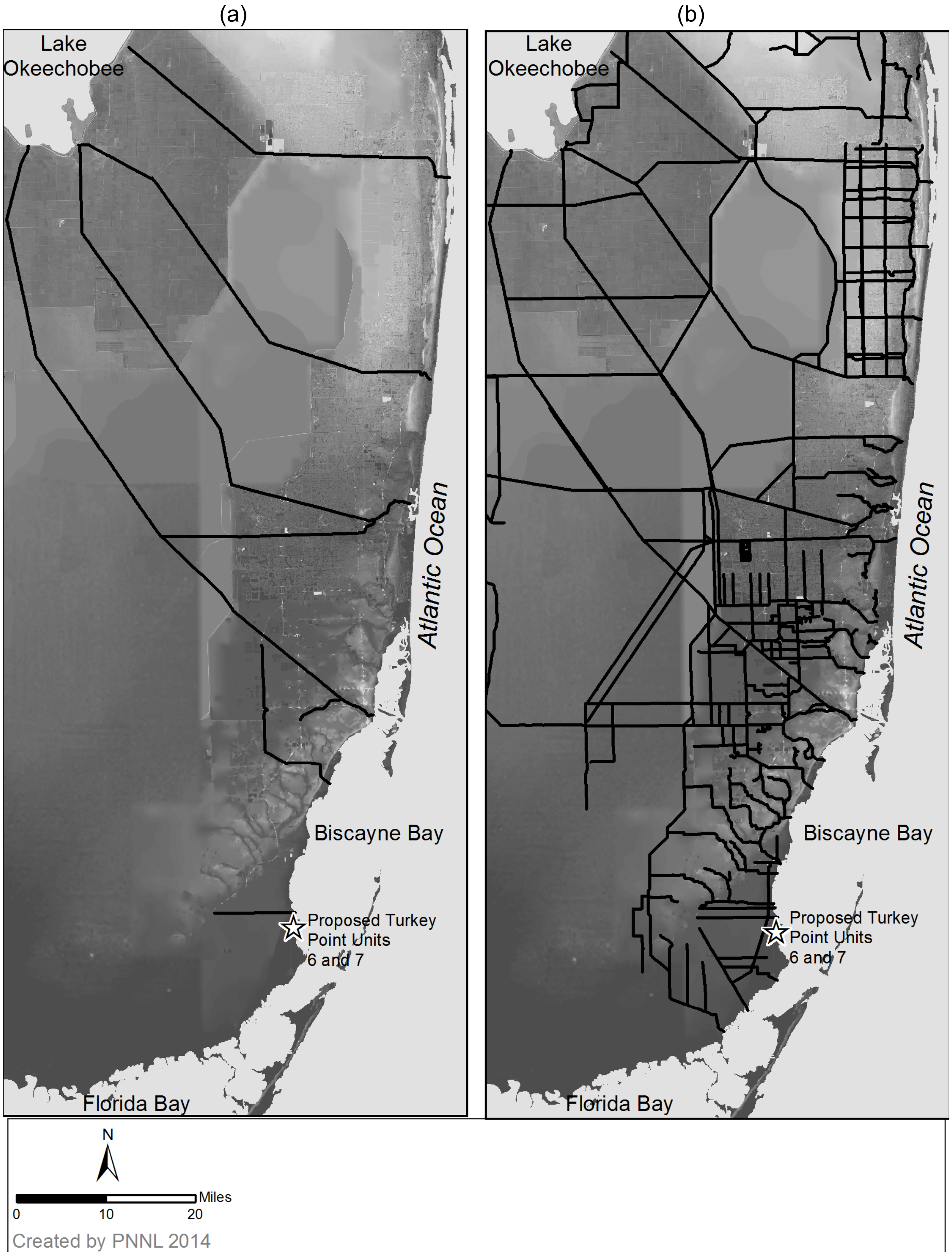


Figure 2-9. South Florida Canal System (a) 1920 and (b) 1990

including flood control and land drainage. As illustrated in Figure 2-10, the surface-water hydrologic system went from one characterized by sheet flow down the Everglades trough (Figure 2-10(a)) to one characterized by channel flow through the canal network (Figure 2-10(b)). Under the channelized flow regime, most of the freshwater was discharged to Biscayne Bay, Card Sound, Barnes Sound, and Florida Bay, which greatly reduced sheet flow into the southernmost section of the Everglades (now established as Everglades National Park). Smith et al. (1989-TN122) estimated the reduction in freshwater flow from the Everglades into Florida Bay to be as much as 59 percent between pre- and post-canal building periods; the estimated annual flows into Shark River Slough during the period 1881–1939 were 1,145,777 ± 96,700 ac-ft, while the estimated annual flow during the period 1940–1986 was 471,610 ± 62,829 ac-ft. The rate of sheet flow down the poorly defined channel of Shark River Slough is estimated to be 80.5 km/yr during high-flow conditions, while during low-flow conditions the rate may drop to zero and have an average rate of 32 km/yr (Smith et al. 1989-TN122).

Comprehensive Everglades Restoration Program

In 1992 and 1996, Congress authorized feasibility studies of structural and operational modifications that could restore the Everglades and the South Florida ecosystem (USACE/SFWMD 1999-TN116). In 2000, Congress approved as part of the Water Resources Development Act the development of the CERP—a long-term effort to capture, store, and redirect freshwater for environmental restoration of the entire Everglades ecosystem (USACE 2010-TN113). The work accomplished for the 2005 reporting period included projects with relatively rapid implementation schedules and included studies and reports for planning additional actions and managing the restoration of the Everglades.

The 2010 report to Congress summarizes the progress over the previous 5 years and briefly discusses progress since the inception of the project. The work accomplished for the 2010 reporting period included implementation of restoration actions to re-establish flows into the Everglades and important environments to the east, particularly the BBCW. The 2010 report also identifies anticipated projects through 2020. As identified in Figure 2-11, these projects include the following:

- WCA3 Decompartmentalization and Sheetflow Enhancement
- L-31N (L-30) Seepage Management Pilot
- West Miami-Dade Reuse
- South Miami-Dade Reuse
- Wastewater Reuse Technology Pilot
- BBCW (Biscayne Bay Coastal Wetlands)
- Restoration of Pineland and Hardwood Hammocks in C-111 Basin
- C-111 Spreader Canal.

The goal of the South Miami-Dade Reuse project is to supply additional water to South Biscayne Bay and the Coastal Wetlands restoration projects after advanced treatment of the wastewater. The West Miami-Dade Reuse project is to supply additional water for recharge to Shark River Slough after advanced treatment of the wastewater. One of the goals of the Wastewater Reuse Technology Pilot project was to determine the ecological effects of reuse of

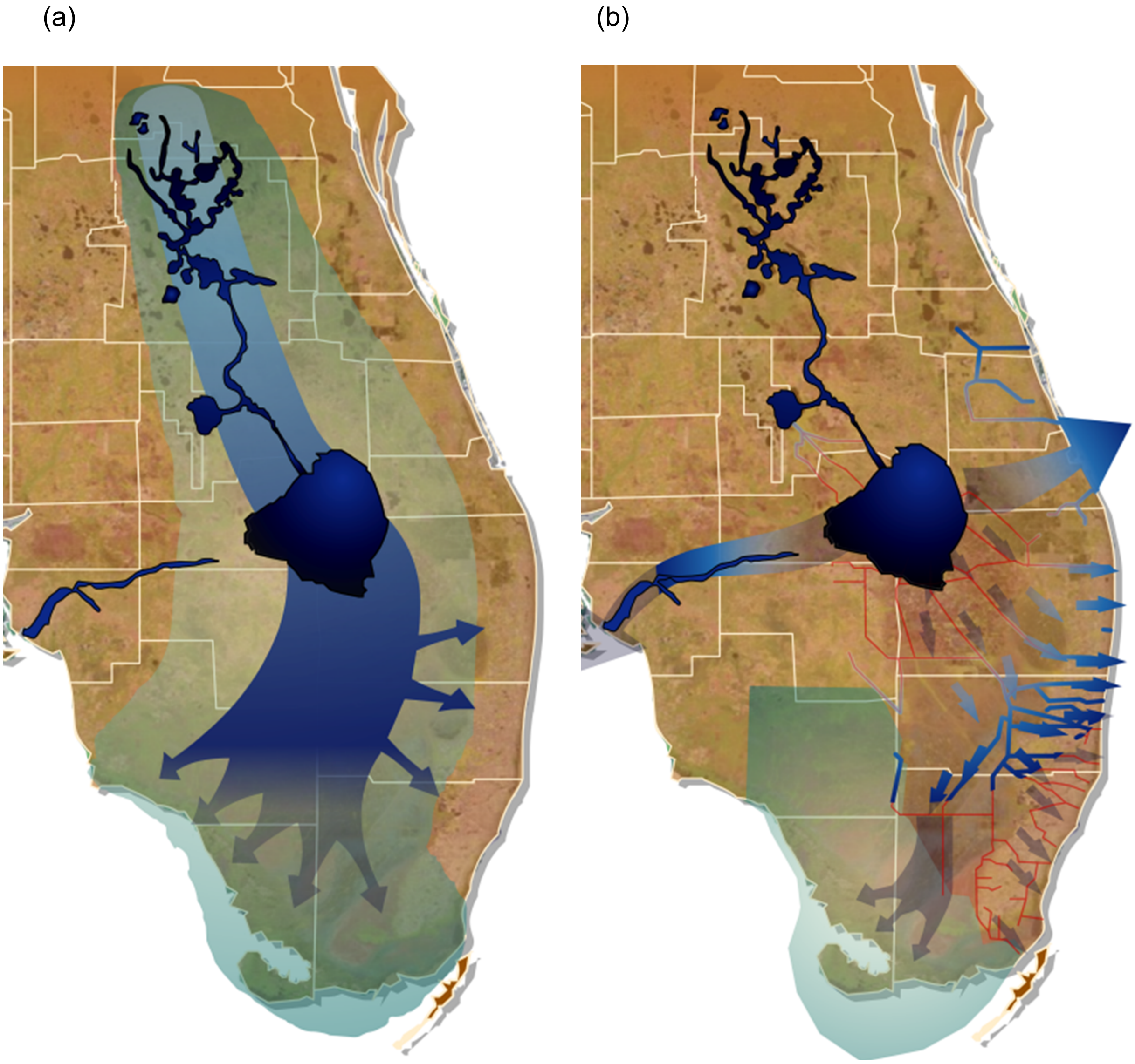


Figure 2-10. South Florida Typical Surface Hydrologic Flows (a) Historic and (b) Present. (Adapted from the Comprehensive Everglades Restoration Program [USACE 2010-TN113])

wastewater after advanced treatment. The hydrologic modifications implemented and planned by CERP will have an effect on the regional-scale hydrology near the Turkey Point site, particularly those modifications that increase sheet flow to the nearshore coastal waters around the Turkey Point site, as well as potential modifications of the freshwater groundwater hydrology. Future CERP projects that are discussed in the 2010 report (USACE 2010-TN113) are included in the cumulative effects analysis discussed in Chapter 7.

In the vicinity of Turkey Point, the role of CERP is limited to the Model Lands. The Model Lands are described in Section 2.2.1.6 and include FPL's 13,367 ac South Dade Mitigation Bank (USACE/SFWMD 2011-TN1330), which is targeted for restoration through CERP. The CERP project BBCW is discussed below in the Biscayne Bay System subsection.

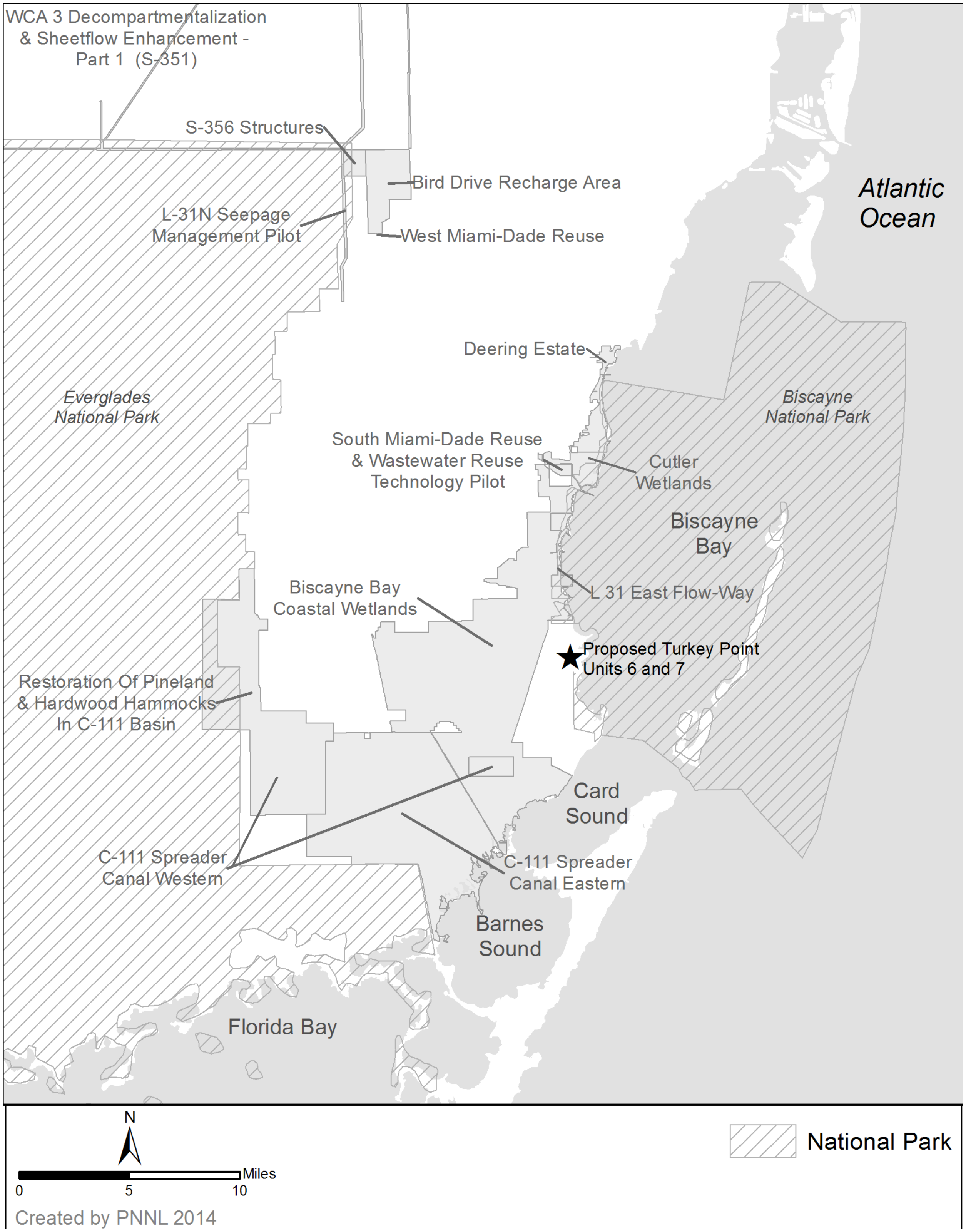


Figure 2-11. Comprehensive Everglades Restoration Plan Projects in Southeastern Florida that Are Planned through 2020 (USACE 2010-TN113)

Regional Hydrologic System

For surface water, the regional hydrologic system is considered to encompass the area east and south of the section of the ACR near Biscayne Bay (Figure 2-12). As described in the subsection on the South Florida Hydrologic System, the ACR has swales that connect Shark River Slough to the coastal areas west of Biscayne Bay. At the southern end of the ACR, Taylor Slough heads southward from Shark River Slough and connects to the coastal wetlands to the south and east. These areas include those west of the Turkey Point site such as the Model Lands. Under historical conditions and during higher flow periods, freshwater could be conveyed eastward through the various swales or glades and sloughs to the coastal wetlands (Figure 2-10(a) and Figure 2-12).

Under current conditions, canals crisscross the landscape and discharge into Biscayne Bay and Card Sound. As seen in Figure 2-12, the canals are routed through the transverse swales or glades to drain interior regions. The following are the major canals in the region, particularly those near the Turkey Point site:

- L-31E Canal extends southward along Biscayne Bay past Turkey Point site and the cooling canals.
- Florida City, North, and Mowry Canals extend from the ACR to Biscayne Bay north of Turkey Point site.
- Model Land, Model Land S, and Card Sound Canals are west and south of Turkey Point site and extend from the Model Lands Area eastward; the Card Sound Canal extends to the Card Sound.
- The C-111 Canal is the southernmost canal of the system, which ultimately discharges into Manatee Bay (Figure 2-12).
- Aerojet Canal is west of Turkey Point site and on the west and south sides of the ACR, extending to Manatee Bay and Barnes Sound via the C-111 Canal (Figure 2-12).
- Princeton, Goulds, Black Creek, Cutler Drain, Snapper Creek, and Coral Gables Canals are north of Turkey Point site, are placed in swales crossing the ACR, and extend to Biscayne Bay.

As discussed in the CERP section above, several projects have been or are being implemented in the region near the Turkey Point site. Of these, the ones that are designed to enhance sheet flow into Everglades National Park via Shark River Slough (Figure 2-12), including increased sheet flow into Taylor Slough (Figure 2-12), are expected to increase the hydroperiod of the regional wetlands by exceeding the hydroperiod observed prior to restoration. The projects for the restoration of BBCW are discussed in the Biscayne Bay System subsection below.

The implementation of the C-111 spreader canal system is intended to create a hydraulic ridge along the east side of Everglades National Park, which in turn will improve the quantity, timing, and distribution of flows through Taylor Slough into Florida Bay (USACE/SFWMD 2011-TN1330). Improvements in hydroperiod and distribution are anticipated in the Model Lands and Southern Glades. Reduction of salinities in Florida Bay and adjacent waterbodies is also expected.

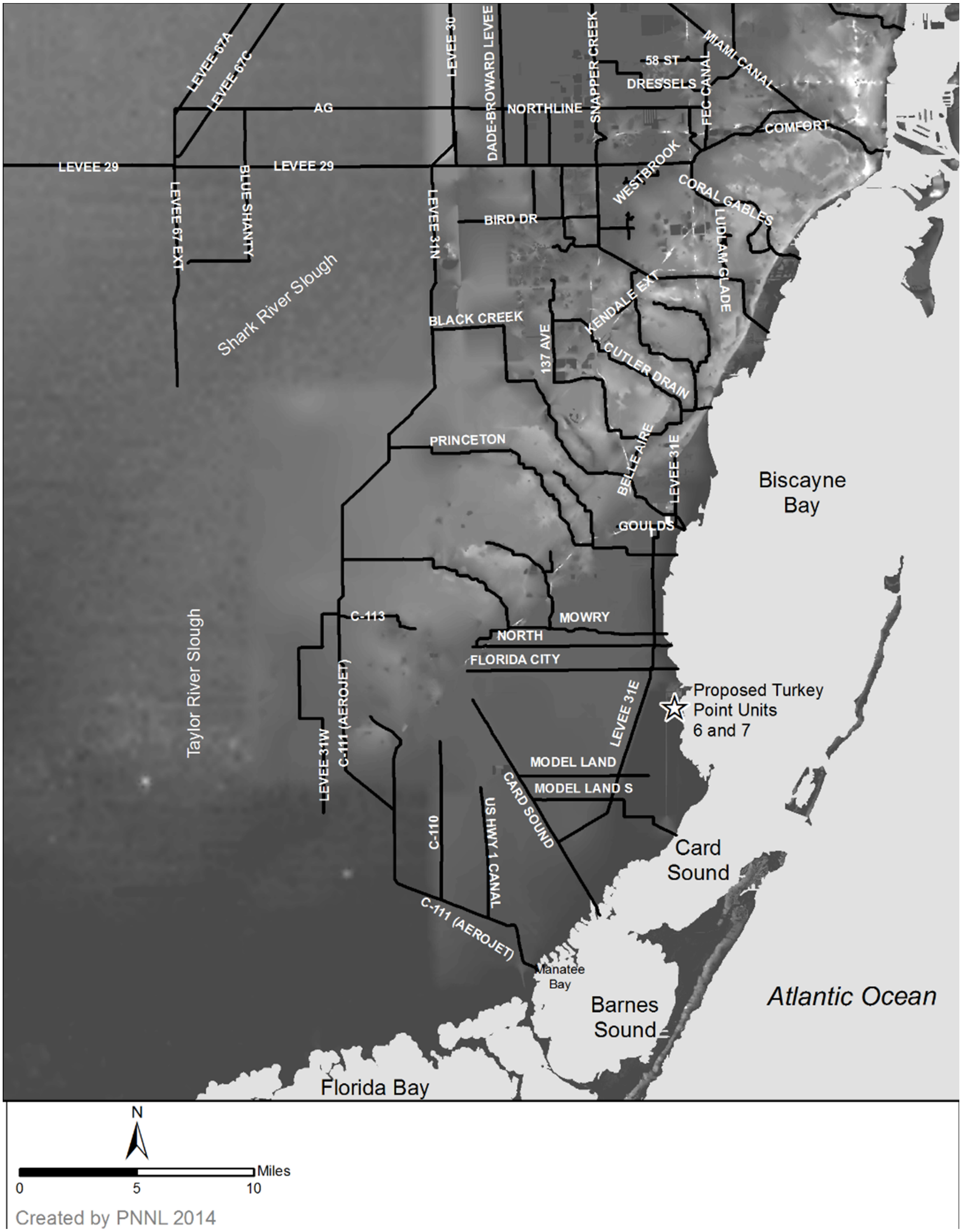


Figure 2-12. Regional Hydrologic System Showing the Canals, Glades, etc. (Adapted from Renken et al. 2005-TN110). ***The 1990 canal system is shown, as are the transverse swales through the Atlantic Coastal Ridge.***

Biscayne Bay System

The hydrology and hydrodynamics of Biscayne Bay are influenced by several factors: tidal exchange with the marine waters of the Atlantic Ocean, surface and groundwater inflows of freshwater, precipitation, and evaporation.

Tidal exchange occurs through the channels and openings between the keys that define the east margin of Biscayne Bay (Figure 2-13). Tidal exchange with the Atlantic Ocean influences both the tidal elevations and the salinity of Biscayne Bay. Along the western margin, the salinity of the coastal region of Biscayne Bay is affected by freshwater inflows, which historically entered via sheet flow and creek flows across the landscape, but which at present enter via the many canals that discharge to Biscayne Bay. In addition, historical reports of freshwater springs bubbling up through the saltwater in Biscayne Bay appear in the literature (Cantillo et al. 2000-TN108). Bellmund et al. (2008-TN123) supporting the assertion that there is continued influx of freshwater to the bay from groundwater, although it is reduced from historical levels. Rainfall is another significant source of freshwater entering Biscayne Bay. Evaporation from the surface of Biscayne Bay during warmer periods tends to increase salinity to concentrations greater than those present in the nearby Atlantic Ocean, especially if freshwater inflows are at a minimum.

The development of South Florida and the construction of canals throughout southern Florida have altered the quality, quantity, timing, and distribution of freshwater flow into Biscayne Bay. The modified hydrology can produce hypersaline (with salinity greater than marine waters) conditions during the dry season (November to June) in Biscayne Bay and a coastal region of low productivity (USACE/SFWMD 2011-TN1038). The addition of canals that discharge into Biscayne Bay has increased freshwater flows into the bay but at discrete locations rather than as widespread sheet flow.

Stalker et al. (2009-TN124) used isotope tracer analysis to estimate the fraction of freshwater inflows from available sources using monthly samples collected from 2004 to 2006. They found the respective bay-wide percentages of canal, precipitation, and groundwater input to Biscayne Bay to be 37 percent, 53 percent, and 10 percent during the wet season and 40 percent, 55 percent, and 5 percent during the dry season. The largest groundwater fractions were found at stations near the western coastline of Biscayne Bay, but overall freshwater groundwater inflows accounted for less than 2 percent of the total input of marine waters and freshwaters (Stalker et al. 2009-TN124). Drainage canal inflows accounted for the greatest variability of salinity in the western areas of Biscayne Bay of the three freshwater sources, while precipitation accounted for the greatest salinity variation in the eastern portion of Biscayne Bay (Stalker et al. 2009-TN124). The review team's examination of Stalker et al.'s Figure 7 (Stalker et al. 2009-TN124) indicates that the areal extent of groundwater influence on salinity variation in the western portion of Biscayne Bay was greatest during the wet season.

The CERP-related restoration plans for the Biscayne Bay System are summarized in the Environmental Impact Statement (EIS) Regional Hydrologic System subsection of the Final Integrated Project Implementation Report and EIS (USACE/SFWMD 2011-TN1038). The

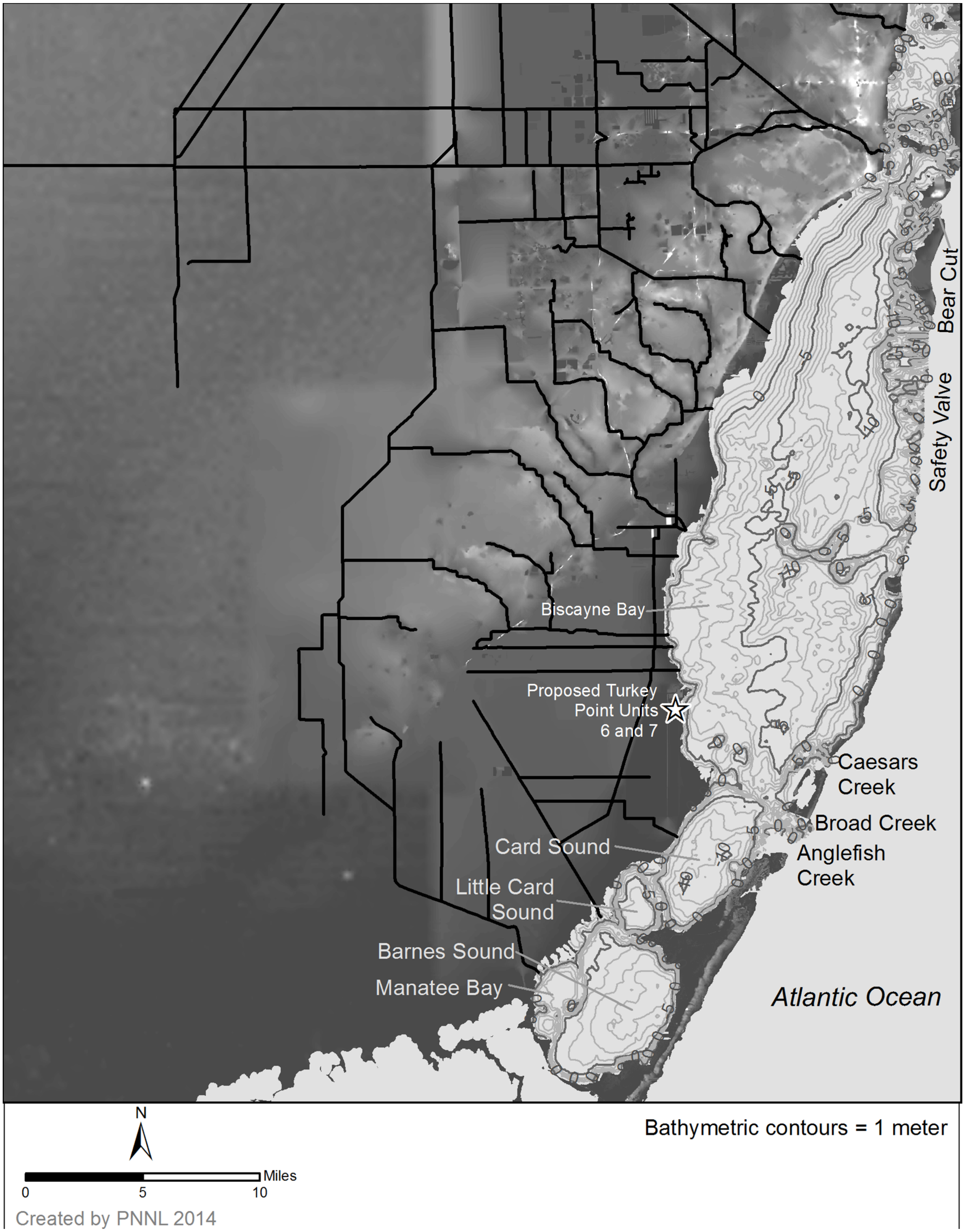


Figure 2-13. Biscayne Bay Bathymetry and Features (major canals, openings to the Atlantic Ocean)

restoration plan for Biscayne Bay uses a phased approach. Phase 1 encompasses 3,761 ac in three hydrologically distinct regions. The three regions include the following:

- Deering Estate – construction of a freshwater wetland and delivery of freshwater to the coastal wetlands via the Cutler Drain Canal
- Cutler Wetlands – conveyance of freshwater via a lined canal to a spreader canal in a saltwater wetlands
- L-31 East Flow Way – isolation of the L-31E Canal from the major discharge canals and allowing freshwater flow through the L-31E Levee into saltwater marsh. Pump stations and culverts are to be added to facilitate freshwater discharges.

A fourth region included in the overall restoration plan is the Model Lands west of Turkey Point site, but it is not part of the Phase 1 effort.

Phase 1 is anticipated to divert 59 percent of the freshwater discharges from the current direct discharges to Biscayne Bay and add them to the freshwater and saltwater wetlands along the coast (USACE/SFWMD 2011-TN1038). The Phase I effort is expected to also reduce nitrogen and phosphorus loading to Biscayne Bay by 50 percent (USACE/SFWMD 2011-TN1038).

Bellmund (2011-TN1317) presents the results of a salinity study of Biscayne Bay through 2008 from 34 stations largely found in the western portion of the bay. Several surface-water sampling stations are near Turkey Point site, and the review team used the measurements to examine salinity variability under the existing conditions. Bellmund (2011-TN1317) designates the months of June through October as the wet season and November through May as the dry season; the review team used these same periods to define wet and dry seasons.

To analyze the salinity results, the review team considered several factors: average ocean salinity, evaporative losses, and freshwater inflows. Average ocean salinity provides the baseline around which salinities vary. Evaporation varies seasonally; the highest rates of evaporation occur during the summer (the wet season), which tends to increase salinity. Freshwater inflows (canal discharges and precipitation) vary seasonally; the highest rates occur in the summer to early fall (wet season), which tends to decrease the salinity. The review team analysis considered available measurements at four stations near Turkey Point site (Figure 2-14). These samples were collected from the bottom of the water column.

The salinity time series (at 15-minute intervals) for these stations are shown in Figure 2-15. Salinities vary seasonally with the wet and dry season due to freshwater inflows and evaporation. The lowest salinities typically appear in late summer through the end of the calendar year, while the highest salinities occur in spring to early summer, which corresponds with the generally accepted dry period of November through May. The seasonal range is greater for the nearshore stations than for the mid-bay stations. A statistical summary of the salinity data for the nearshore stations (BISCA6 and BBCW10) and the mid-bay stations (BISC12 and BISC18) is provided in Table 2-8. The nearshore stations have larger ranges and standard deviations than the mid-bay stations (Table 2-8), indicating higher salinity variability at the nearshore stations. The minimum salinities at the nearshore stations are less than 10 psu, while the minimum salinities at the mid-bay stations are just below 20 psu. The maximum

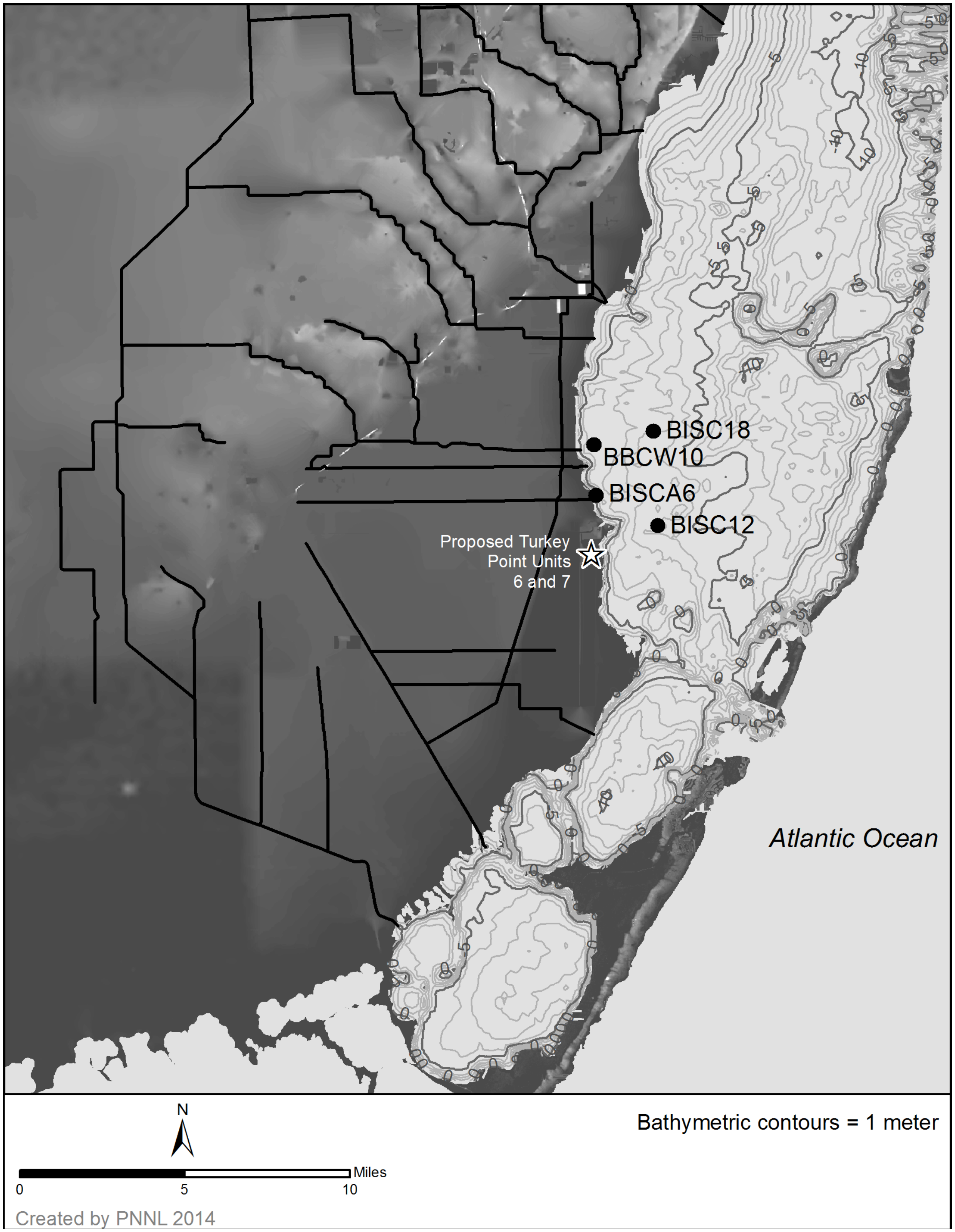
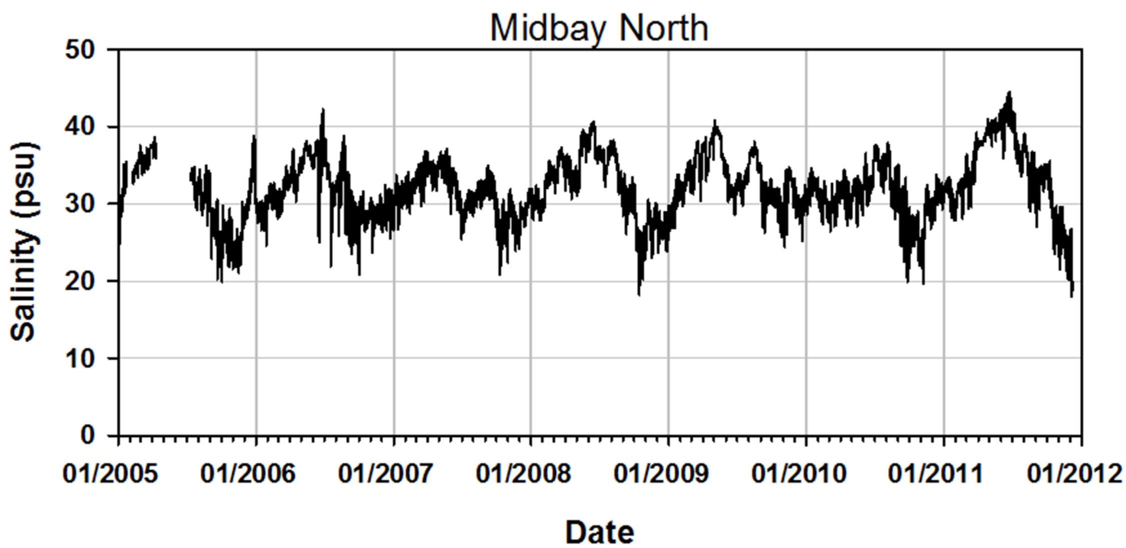


Figure 2-14. Salinity Station Locations in Biscayne Bay. ***Stations BISC12 and BISC18 are mid-bay stations, while stations BISCA6 and BBCW10 are nearshore stations (*****Bellmund 2012-TN4118*****).***



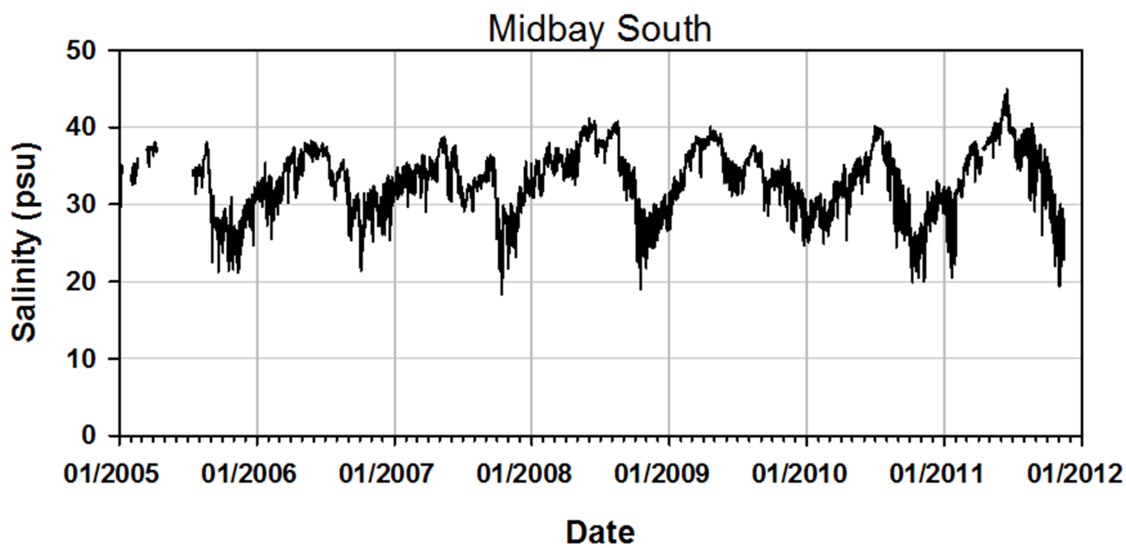
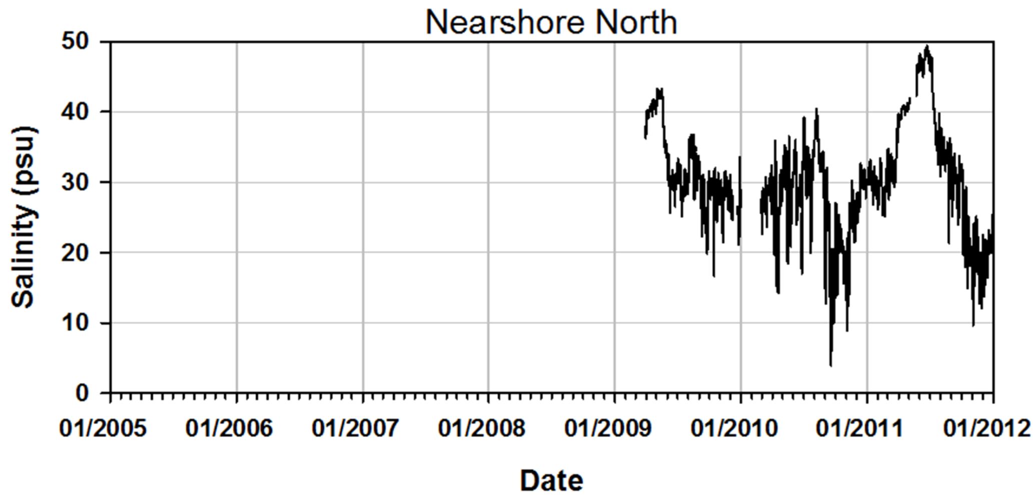


Figure 2-15. Salinity Time Series from 2005 through 2012 for the Four Stations near the Turkey Point Site (Bellmund 2012-TN4118)



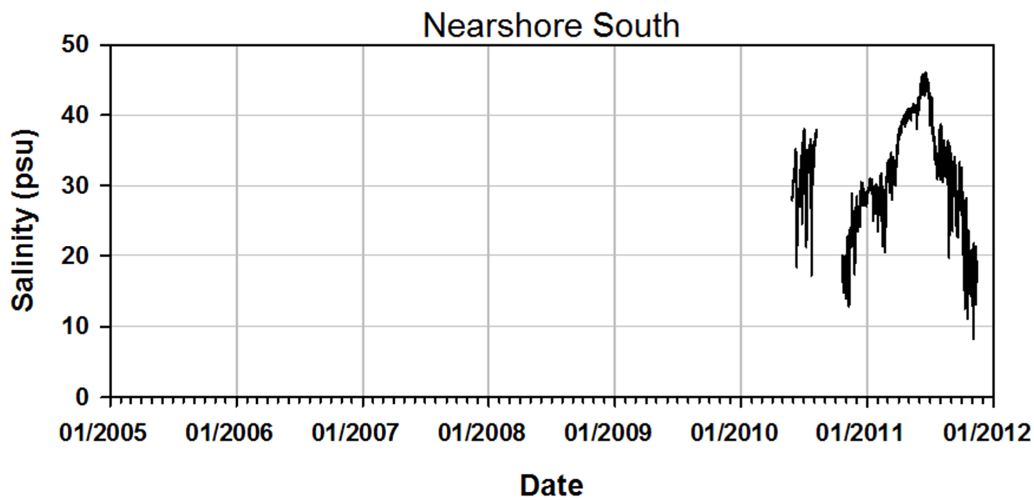


Figure 2-15. (contd)

Table 2-8. Summary Statistics of Salinity at the Four Measurement Stations near the Turkey Point Site

Station	Number of Sample	Mean (psu)	Standard Deviation (psu)	Minimum (psu)	Median (psu)	Maximum (psu)
Nearshore North	86,371	30.2	7.6	4.0	30.1	49.4
Midbay North	232,583	32.1	4.0	17.9	32.0	44.5
Nearshore South	44,233	31.1	7. 7	8.2	31.6	46.1
Midbay South	226,683	33.1	4.1	18.3	33.5	44.9

psu = practical salinity units

salinities at the nearshore stations are between 45 and 50 psu, while the mid-bay stations have maximum salinities just below 45 psu. The nearshore stations have a larger range and standard deviation because they are influenced by freshwater inflows and evaporation in the nearshore (evaporation from a smaller depth and volume increases the salinity more than evaporation from a greater depth).

Local (Site) Hydrologic System

Local drainage areas include the proposed Units 6 and 7 plant area, the RWTF, and the facilities for the radial collector wells. In addition, natural hydrologic features that are near the Turkey Point site include the Model Lands to the west and south and the immediate coastal areas of Biscayne Bay to the east. Another important local hydrologic feature is the cooling canals, which have a water-surface area of 4,370 ac south of the Turkey Point site (Figure 2-2). The cooling canals are part of the 5,900 ac IWF; they are not considered a natural waterbody and are not subject to State and Federal (Environmental Protection Agency) water-quality standards. Releases of industrial wastewater to the IWF and eventual infiltration into groundwater are authorized by State Industrial Wastewater Facility Permit No. FL0001562 (FPL 2014-TN4058).

Site Drainage

To estimate a water budget for the environmental review, the review team estimated average and maximum annual runoff from the facilities of proposed Units 6 and 7 using the areas reported in FPL's stormwater management plan (FPL 2011-TN303). Within the 507 ac Units 6 and 7 project area, the sub-basin areas considered by FPL (2011-TN303) for the existing condition include the following (Figure 2-16):

- Units 6 and 7 power block including the area of the proposed makeup-water reservoir (198.3 ac) and laydown areas (46.0 ac west of the plant site across the west-return canal of the cooling-canal system [CCS]). Both the plant area and laydown areas drain into the IWF.
- The proposed locations for east and west administration and training buildings and parking area (31.8 ac). There is currently no stormwater discharge from these areas because they are surrounded by berms, and stormwater is retained within the berms and infiltrates into the ground.
- The proposed location for the RWTF (43.5 ac) is west-northwest of the plant area. The location currently is undeveloped with drainage to the surrounding wetlands.

The review team located the nearest continuous precipitation gage at Homestead General Aviation (Coop ID 084095) (NOAA 2012-TN1316), which is about 15 mi northwest of the site. The review team estimated an average annual precipitation of 57.10 in. and maximum annual precipitation of 71.53 in. during the period from 2001 through 2010. USDA (2012-TN1314) reports that the soil type at the proposed RWTF location, from which stormwater discharge is anticipated to discharge to the local area, is largely Pennsuco marl with some Terra Ceia muck. Both of these soil types are described as being poorly drained, having water tables very near (within 6 in.) or at the surface, and being subject to frequent flooding. Because the water table is so close to the surface the soil has almost no capability to absorb precipitation. Hence, the review team conservatively assumed 100 percent of precipitation runs off the areas. As stated above, the proposed locations for east and west administration and training buildings and parking area are enclosed by berms, but for the other areas, the review team again conservatively assumed that all precipitation runs off because of the shallow water table. Using the average precipitation rate and conservatively assuming 100 percent runoff with no losses to groundwater or evaporation, the review team computed the annual average runoff from the proposed RWTF area to be approximately 207 ac-ft (Table 2-9), which discharges to its

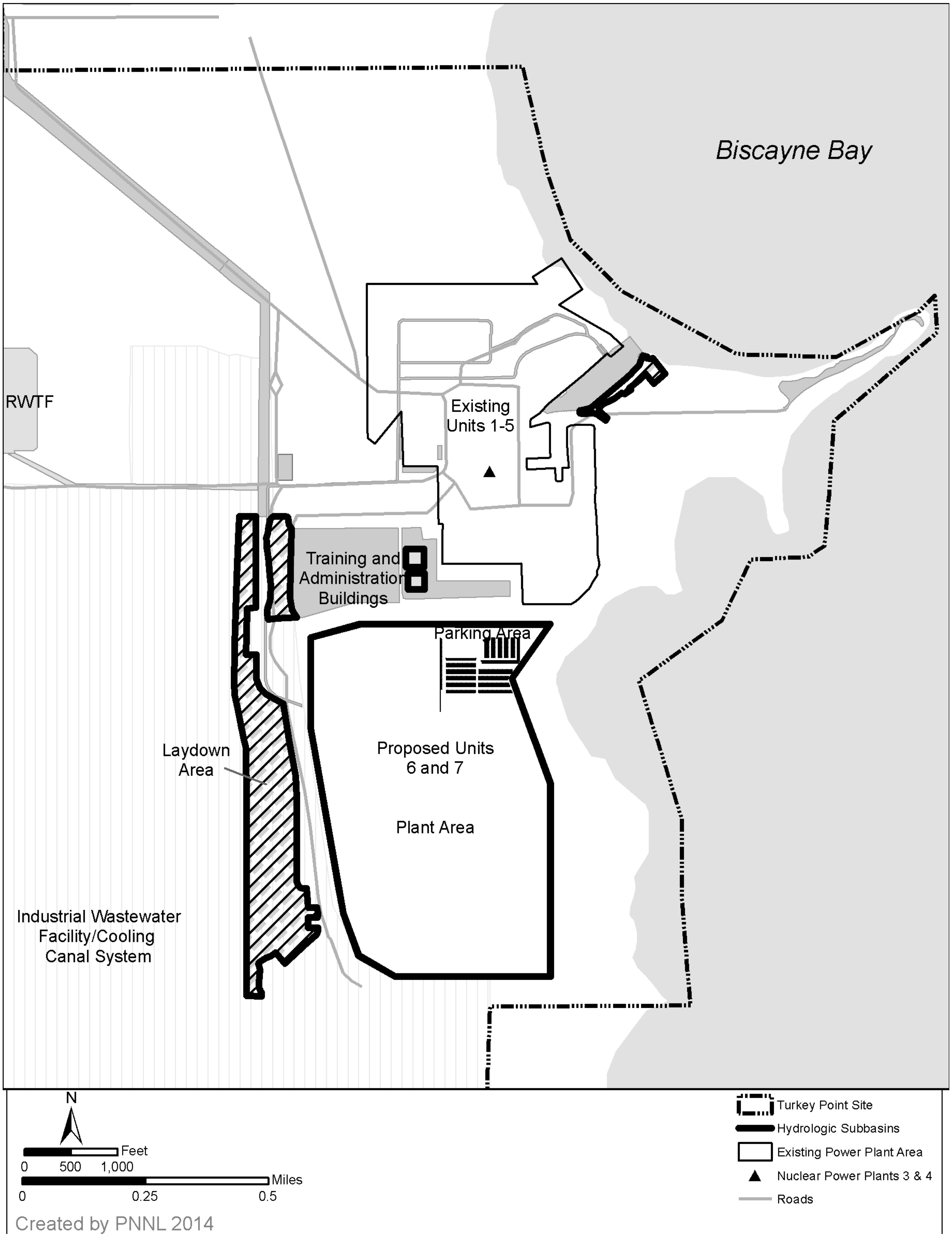


Figure 2-16. Site Drainage Sub-Basins for the Existing Condition (FPL 2011-TN303)

Table 2-9. The Review Team Estimates of Average and Maximum Annual Runoff under the Existing Condition from Sub-Basins on FPL Property at the Turkey Point Site

Sub-Basin	Area (ac)	Average Annual Runoff (ac-ft)[(a)]	Maximum Annual Runoff (ac-ft)[(b)]
Units 6 and 7 Power Block and Laydown Areas	244.3	1,163	1,456
Proposed Admin Buildings and Parking Areas	31.8	No Runoff[(c)]	No Runoff[(c)]
Subtotal	276.1	1,163	1,456
Proposed RWTF	43.5	207	259
Total	319.6	1,307	1,715

(a) Based on review-team-computed runoff for 2001 through 2010. Assumes 100 percent runoff from the average annual rainfall for the period.
(b) Assumes 100 percent runoff from the maximum annual rainfall for the period.
(c) Area is surrounded by berms so there is no surface drainage (FPL 2014-TN4058)

surrounding wetland area. With maximum annual precipitation, the review team computed the maximum annual runoff to be 259 ac-ft from the proposed RWTF area. For the combined Units 6 and 7 power block and laydown areas, which drain into the IWF, the review team computed the annual average runoff to be 1,163 ac-ft and the maximum annual runoff to be 1,456 ac-ft. Because the proposed locations of the east and west administration and training buildings and parking area are enclosed by berms, they do not drain to the Biscayne Bay or the IWF but infiltrate into the surficial aquifer.

Nearby Hydrologic Features

The natural surface-water hydrologic systems near the Turkey Point site include the Model Lands to the west (which function as wetlands) and the nearshore of Biscayne Bay to the east. The Model Lands include FPL's 13,367 ac South Dade Mitigation Bank (USACE/SFWMD 2011-TN1330). At present, the Model Lands are hydrologically isolated from Everglades's flows due the presence of roads and drainage canals (USACE/SFWMD 2011-TN1330). Currently, the area is composed of wetlands that can experience extreme hydroperiod events (periods without inundation) (USACE/SFWMD 2011-TN1330). Biscayne Bay to the east is a shallow saline estuary in a limestone depression (USACE/SFWMD 2011-TN1038). The Biscayne Bay coast near the Turkey Point site is lined by mangrove wetlands, particularly north of the site (USACE/SFWMD 2011-TN1038). An existing barge-turning basin was dredged from the shoreline of the Turkey Point site in 1979 to provide for oil and equipment delivery (FPL 2014-TN4058) to the existing site.

Industrial Wastewater Facility

Biscayne Bay is the most important and most visible natural hydrologic feature in the vicinity of the proposed site and the IWF is by far the most important and most visible anthropogenic feature in the vicinity of the proposed site. The IWF covers an area running approximately 5 mi along the Biscayne Bay shoreline and covering an area of about 5,900 ac (FPL 2014-TN4058).

The initial cooling system design for the existing power-generation facilities at the Turkey Point site was a once-through design that withdrew water from and discharged water to the Biscayne Bay through intake and discharge structures. In a consent decree entered in 1971 by the

Federal District Court for the Southern District of Florida (United States of America v. Florida Power & Light Company 1971-TN4726), FPL built the IWF and substituted it for the original once-through cooling system. The decree included a requirement that all cooling water used at the Turkey Point facilities must be discharged into a closed-cycle cooling canal system and, except in limited circumstances, all discharges from the cooling system into Biscayne Bay be stopped. The IWF does not rely on intake and discharge structures with a direct connection to the Biscayne Bay.

The IWF is a closed-cycle cooling system, but is not a closed hydrologic system. Instead of rejecting heat to nearby waterbodies, the IWF closed-cycle cooling system was designed to reject waste heat to the atmosphere. Heat exchange to the atmosphere occurs through a variety of processes including evaporation. Evaporation results in an overall net loss of water in the cooling canals. However, water from the cooling canals also infiltrates the underlying Biscayne aquifer in some areas (FPL 2012-TN3439).

The design of the IWF uses gravity to force the cooling water to follow a long and slow trajectory through a series of parallel canals from where the heated water leaves plants to where it returns to the plant after having lost heat to the atmosphere. Pumping the water from the return side of the IWF closest to Biscayne Bay to a higher elevation on the inland side of the existing units causes the water to circulate.

The water in the IWF is designed to circulate from north to south and then return from the south to the north along the east side of the IWF cooling canals. During normal operation of the existing nuclear power Units 3 and 4, this results in lower overall water surfaces along the eastern berm with the lowest water surface at the north end along the eastern berm because of the drawdown created by the existing plant cooling-water intake (FPL 2015-TN4502).

Evaporation from the IWF causes freshwater to enter the atmosphere causing the concentration of remaining solutes in the IWF to increase proportionally. Salinity in the IWF can exceed the typical value of ocean salinity by a factor of two or more. The increase in salinity results in an increase in the density of the water in the cooling canals (FPL 2012-TN3439).

The temperature of the water discharged from the existing plant's cooling systems is elevated by the rejected heat. The increase in temperature results in a slight decrease in density of the water in the cooling canals. However, density increase associated with the increase in salinity dominates. The water in the IWF cooling canals is more dense than either seawater or freshwater.

The normal operation of the existing nuclear power Units 3 and 4, results in the release of tritium to the IWF. Unlike other constituents in the water (e.g., salt), evaporation results in tritium being released to the atmosphere. Radioactive decay also reduces tritium concentrations so that they do not continue to build up in the cooling canals.

The water quality in the canals varies inter-annually and intra-annually in response to plant operation and meteorological conditions. Rainfall will cause the salinity in the canals to decrease. Evaporation from induced evaporation and hot, dry meteorological conditions will cause salinity to increase over time. Temperatures in the cooling canal will decrease during the winter (FPL 2012-TN3439).

The construction of the IWF and the canals outside the IWF has prevented freshwater sheet flow from inland areas from reaching Biscayne Bay adjacent the cooling canals. Given the vast extent of the canals this has likely further increased the hypersalinity in poorly mixed shallow coastal areas subject to natural evaporation, although, the exact magnitude of this alteration is unknown.

While the IWF is appropriately called a closed-cycle cooling system, this does not mean it is a closed hydrologic system. The unlined canals allow the water in the IWF to exchange with adjacent surface waterbodies and groundwater aquifers beneath the site. The rates of water exchange are determined by the potentiometric head gradients between the various waterbodies. These potentiometric head gradients change spatially and temporally (FPL 2012-TN3439).

Water can seep through the unlined berms surrounding the IWF. Based on the potentiometric gradient at a given time, water can move either into or out of the IWF from the adjacent waterbodies. Given the length of the berms and the proximity to waterbodies, seepage through the western berm into the interceptor ditch and eastern berm into Biscayne Bay are the largest and most significant exchanges.

The interceptor ditch was installed to create a hydraulic barrier outside the western berm to prevent migration of hypersaline seepage westward. Water seeping into the interceptor ditch is pumped back into the IWF (FPL 2014-TN4058).

The potentiometric gradient along the eastern berm is controlled by the tidal elevation in Biscayne Bay, the water-surface elevation in the IWF along the eastern berm, and the density of the water in the IWF. During low tide conditions the potentiometric gradient could cause water to seep from the IWF into Biscayne Bay along the entire length of the eastern berm. During high tide conditions the potentiometric gradient could cause water to seep into the IWF from Biscayne Bay along the entire length of the eastern berm. Since water-surface elevation in the cooling canals decreases from south to north along the eastern berm during operation, there will be times when water may seep out of the IWF at the south end of the berm and into the IWF at the north end of the berm. Actual seepage will be attenuated by the tidal cycle relative to the travel time through the berm. The volume of the IWF and this attenuation masks any response between the IWF and Biscayne Bay to daily tidal fluctuations. The review team does acknowledge that some degree of hydraulic connection related to the tidal cycle exists.

Water from the IWF also can move into and out of the aquifer beneath the IWF. The downward movement of water is impelled by the increased density because of the elevated salinity of the water in the IWF. Observations of water quality beneath the IWF suggest a hypersaline plume extending down to the base of the Biscayne aquifer that may increase in size because of the continued presence of hypersaline water in the IWF. While the overall general movement is from the IWF downward, during certain conditions water from the aquifer can also move upward. High potentiometric heads in the regional groundwater system possibly associated with high tides and wet conditions can cause water from the aquifers to move back up into the IWF (FPL 2012-TN3439).

Change in IWF Condition in Summer of 2014

During the summer of 2014, between the time that the review team completed most of the writing on the draft EIS and early 2015, when the draft EIS was published, the IWF experienced record high salinity and temperature levels and algae abundance. These algae, salinity concentrations, and temperature levels were significantly outside the range observed over the entire history of the cooling canals and were outside the IWF conditions discussed above in the draft EIS (NRC 2015-TN4444). FPL implemented measures approved by FDEP to mitigate the record high salinity, temperature, and algae abundance in the IWF. FPL has proposed further mitigation measures to address these conditions. Because of the timing of the implementation and proposal of these mitigations measures, the review team did not consider any of the mitigation measures directed to these conditions in the draft EIS. Inasmuch as the cooling canals and Biscayne aquifer are part of the affected environment of the proposed action, the review team determined that an updated discussion of this portion of the affected environment was warranted. This section provides this update.

The review team observed that during the summer of 2014, the canal water was clear enough for the staff to make out details on the bottoms of the canals and to see schools of fish in the water, but abruptly changed to being fully opaque. FPL reported algae counts historically at 50,000 cell/ml had increased in the summer of 2014 to as high as 1,800,000 cell/ml.

In October 2014, the review team conducted a supplemental site audit (NRC 2014-TN4115) to determine if the changes in the IWF operation made during the summer of 2014 would alter conclusions drawn in the draft EIS (NRC 2015-TN4444). In January 2016, the review team conducted another supplemental site audit to determine if the actions, including mitigation measures, proposed in response to the Administrative Order (FDEP 2014-TN4144) and the Consent Agreement (Miami Dade County v. Florida Power & Light 2015-TN4505) would alter conclusions drawn in the draft EIS (NRC 2015-TN4444). Information obtained during these audits was considered in assessing the impacts described in this EIS.

Until the spring of 2014, the temperature and salinity in the IWF at the intake to Units 1, 2, 3, and 4, where the temperatures are the lowest in the canals at any specific time, had typically remained below 92°F and 70 psu, respectively. Beginning in spring 2013 the canals began to experience higher than average temperatures and increasing salinities. The temperature at the intake to Units 1, 2, 3, and 4 exceeded 100°F for brief periods of time. However, as shown in Figure 2-17 and Figure 2-18, the temperature at the discharge to Units 1, 2, 3, and 4, where the temperatures are the highest, exhibits a persistent period of higher than average temperatures for the period from the spring of 2013 through the summer of 2014 with a maximum temperature in excess of 115°F. Salinity during this period shows a steady increase eventually exceeding 100 psu by the summer of 2014

In response to the increase in temperature observed in the canals, FPL requested permission from the State of Florida in June 2014 to add water to the cooling canals from onsite wells to help reduce the temperature of water in the canals (FPL 2014-TN4565). FPL received approval for this action from the State on June 27, 2014 (FDEP 2014-TN4144). From September 2014 through September 2015, FPL pumped over 6,000 million gallons from the Biscayne aquifer and over 800 million gallons from the Upper Floridan aquifer into the IWF.

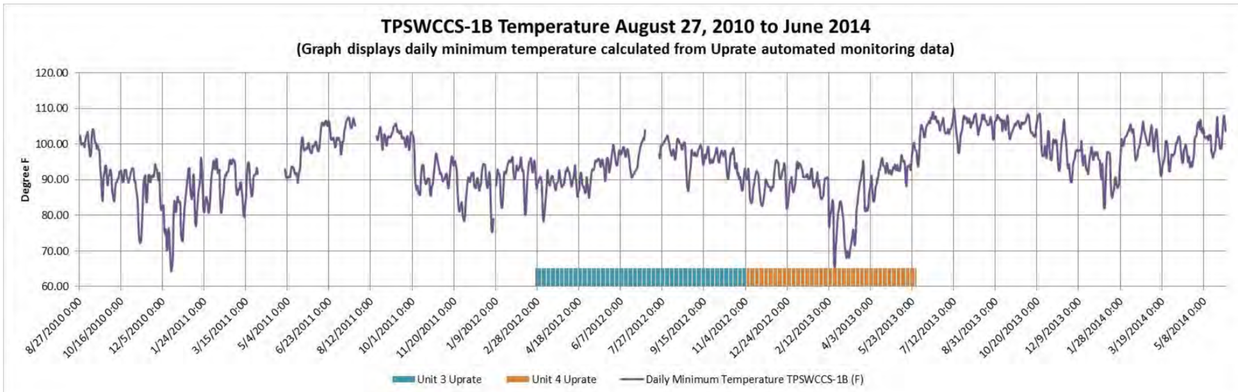


Figure 2-17. Temperature in Cooling Canals

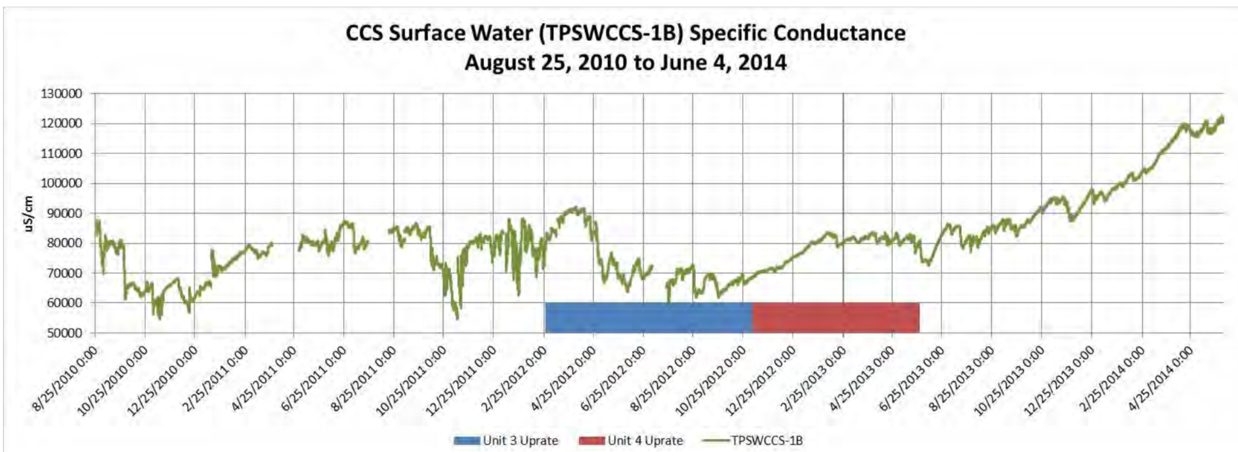


Figure 2-18. Salinity (Specific Conductance) in Cooling Canals

In July 2014, FPL began chemical treatment of the cooling canals to control algae in the waters of the CCS. FPL reported that while algae concentrations declined, the temperature in the IWF remained elevated.

In August of 2014, FPL requested permission from the SFWMD to divert water from the L-31E Canal to aid in salinity reduction within the cooling canals. The SFWMD approved FPL's request on August, 28 2014. From September 2014 through October 2015 FPL pumped about 3,000 million gallons from the L-31E Canal into the IWF.

Subsequent to these additions of about 10,000 million gallons, the IWF had a large rainfall event that refreshened the canals. For reference, 12 inches of rainfall over the surface of the IWF results in an addition of 1,700 million gallons in the IWF. In response to these additions of water, the IWF water temperatures and salinities returned to pre-summer 2014 levels. The algae level in the canals and the biological function of the canals, however, has remained substantially altered.

In December 2014, the FDEP issued an Administrative Order (FDEP 2014-TN4144) requiring FPL to submit to the FDEP a salinity management plan to describe how FPL would reduce and maintain the average annual salinity in the CCS at or below 34 psu. The proposed plan includes the addition of water from the L-31E Canal in the near term and water from the Upper Floridan aquifer in the long term to the CCS to achieve the objective of the Order (this information is from the 2015 Consent Agreement [Miami Dade County v. Florida Power & Light 2015-TN4505]).

In addition to these actions, on October 2, 2015 Miami-Dade County issued a Notice of Violation to FPL indicating that groundwater originating from the CCS exceeded the allowable chlorinity limit (19,000 mg/L) beyond the boundaries of the FPL property (Miami-Dade County 2015-TN4575). In response to this Notice of Violation, FPL and the County entered into a Consent Agreement on October 6, 2015 (Miami Dade County v. Florida Power & Light 2015-TN4505). The Consent Agreement, identified the steps FPL will take to remediate the hypersaline plume in groundwater such that groundwater with a chlorinity greater than 19,000 mg/L would be limited to the area within the FPL property boundary. FPL proposes to install remediation wells to withdraw hypersaline groundwater. The water will be disposed of through an existing underground injection control well that is completed in the Boulder Zone. The amount of water removed from the hypersaline plume to implement this remediation will range up to 12 Mgd.

The review team considered the report prepared by Dr. David A. Chin of the University of Miami (Chin 2016-TN4529) for the Miami-Dade County Department of Environmental Resource Management and the subsequent comments on the report provided by FPL (2016-TN4530). Dr. Chin developed a water and energy balance model for the IWF. The review team analyzed the Chin report and the associated FPL response and determined that it did not alter our understanding of the IWF behavior.

Uprate Monitoring Plan

In connection with the amendment of the Units 3 and 4 licenses to allow an increase in each unit's maximum power (called a "power uprate") the FDEP, the SWFMD, Miami-Dade County, and FPL developed a monitoring plan in 2009 that requires the collection of groundwater, surface water, meteorological, flow, and ecological data in and around the plant to assess Pre-uprate and Post-uprate conditions in, around, and beneath the IWF (FPL 2016-TN4615). Monitoring conducted under this program has shown that water from the cooling canals is entering Biscayne Bay via the groundwater pathway. Miami-Dade County reported tritium concentrations of over 4,000 pCi/L in samples collected at the bottom of the bay adjacent to the cooling canals (Miami-Dade County 2016-TN4510). The sampling site is located in a deep excavation in the bay bottom that was once part of a canal that is now isolated from the CCS. While the County measurement is well below the EPA drinking water standard of 20,000 pCi/L, the observed concentrations confirm the review team's conceptual model that the IWF is hydraulicly connected to the Biscayne Bay via the groundwater pathway. Recent additions of water to reduce the salinity in the CCS and the related increases in water level in the CCS, as well as above average rainfall, increased the force impelling water to move from the CCS toward the bay. Although the 4,000 pCi/L value was identified on or about December 28, 2015, the monitoring station was relocated nearer the IWF (Miami-Dade County 2016-TN4510), and periods of high water-surface levels in the CCS have also happened in the past, and therefore the review team cannot presume that the elevated tritium level is just a recent occurrence.

On June 20, 2016 FPL and FDEP signed a Consent Order that supercedes the Administrative Order of December 2014. It includes many of the provisions of the Administrative Order and the 2014 Consent Agreement for reducing salinity in the CCS and remediating the hypersaline plume beneath the canals. In addition, the 2016 Consent Order requires FPL to perform restoration projects on Turtle Point Canal and the Barge Basin to "prevent releases of groundwater from the CCS to surface waters connected to Biscayne Bay that result in exceedances of surface-water quality standards in Biscayne Bay" (FDEP 2016-TN4625).

2.3.1.2 Groundwater Hydrology

Groundwater aquifers in the region and the vicinity of the Turkey Point site are described in Section 2.3 of the ER (FPL 2014-TN4058). Additional information about the site groundwater and geology is also provided in Sections 2.4.12 and 2.5 of the FSAR (FPL 2015-TN4502). Geohydrologic descriptions provided in these documents are consistent with regional descriptions for Southeast Florida provided in the U.S. Geological Survey (USGS) Ground Water Atlas of the United States, Chapter 6 (Miller 1990-TN550).

The two major aquifer systems found at Turkey Point are the surficial aquifer system and the deeper Floridan aquifer system. The uppermost surficial aquifer system in the vicinity of Turkey Point site is called the Biscayne aquifer. Low-permeability confining units separate the Biscayne aquifer and the underlying Floridan aquifer system and limit exchange of groundwater between these aquifer systems (Miller 1990-TN550). Figure 2-19 shows the sequence of aquifer systems and their relative depths and thicknesses at the site. The review team compiled this information based on local site investigations presented in the FSAR (FPL 2015-TN4502), results from FPL's exploratory well 1 (EW-1) presented in FPL 2012 (TN1577), and information from Reese and Richardson (2008-TN3436).

Biscayne Aquifer

The Biscayne aquifer has an area of about 4,000 mi^2 and underlies nearly all of Dade and Broward Counties. It varies from 0 ft thick in the south-central part of Florida to more than 240 ft thick north of Fort Lauderdale (Miller 1990-TN550) and is approximately 80 to 115 ft thick in the vicinity of the Turkey Point site (FPL 2014-TN4058).

Regionally, the Biscayne aquifer is primarily under unconfined conditions. However, stratification caused by beds of lower and higher permeability may cause semi-confined or locally confined conditions (Fish and Stewart 1991-TN1340). At the Turkey Point site, the Miami Limestone (Miami Oolite) unit of the Biscayne aquifer is overlain by a surficial layer of "organic muck" described as light to dark gray to pale brown with trace amounts of shell fragments, or as black to brown with organic fibers (FPL 2014-TN4058). This organic layer was estimated to vary from 2 to 7 ft thick in the Units 6 and 7 plant area. The water table at the site is found either in the Miami Limestone or in the overlying organic muck (FPL 2014-TN4058). The bottom of the Biscayne aquifer is defined by the top of laterally extensive beds of much lower permeability rock called the Intermediate Confining Unit, which separates it from the underlying Floridan aquifer system (Reese 1994-TN1439). At the plant site, the Intermediate Confining

Unit is about 870 ft thick and contains extensive layers of clay-rich sediments within the lower part of the Tamiami Formation and the underlying Hawthorne Group (Fish and Stewart 1991-TN1340; FPL 2012-TN1264; FPL 2012-TN1577).

Recharge of the Biscayne aquifer from precipitation occurs primarily during the wet season, from June to October with minimal recharge during the dry season, from November to May. However, seepage from freshwater canals usually continues to recharge the aquifer during the dry season (Fish and Stewart 1991-TN1340).

SERIES	STRATIGRAPHIC UNIT	LITHOLOGY	TOP DEPTH (ft)	THICK-NESS (ft)	HYDRO-GEOLOGIC UNIT	TOP DEPTH (ft)
HOLOCENE	organic muck	organic soil and silt	0	3	Biscayne Aquifer	0 - 3
PLEISTOCENE	Miami Formation	sandy, oolitic limestone	3	25		
	Key Largo Limestone	well indurated, vuggy, coraline limestone	28	22		
	Ft Thompson Formation	poor/well indurated fossiliferous limestone	50	65		
PLIOCENE	Tamiami Formation	sand and silt with calcarenite limestone	115	105	Intermediate Confining Unit	140
MIOCENE	Hawthorne Group: Peace River Formation	silty calcareous sand and silt	220	235		
	Hawthorne Group: Arcadia Formaion	calcareous wackestone with indurated limestone, sandstone and sand	455	555		
OLIGO-CENE	Suwannee Limestone	fine-grained limestone and dolomitic limestone	1010	245	Upper Floridan Aquifer (USDW)	1010
EOCENE	Avon Park Formation	fine-grained limestone and dolomite	1255	(~445)	Middle Floridan Confining Unit	1450
		permeable limestone	(~1700)	(~75)	APPZ (?)	(1700)
		fine-grained limestone and dolomite	(1775)	745	Middle Floridan Confining Unit	1930
	Oldsmar Formation	limestone, dolomitic limestone and dolomite	2580	450		
		Boulder Zone	3030	>200	Lower Floridan Aquifer	2915
					Boulder Zone	3030

APPZ (?) denotes uncertainty

Figure 2-19. Geologic Stratigraphy and Major Aquifers beneath the Turkey Point Site (based on information from FPL 2012-TN1577 and FPL 2015-TN4502)

Before development, including construction of canals to drain inland areas, the wet season recharge was greater than it is today, and resulted in higher subsurface flows of groundwater into

Biscayne Bay (Renken et al. 2005-TN110). In a study of groundwater discharge to Biscayne Bay, Langevin (2001-TN1338) used a regional-scale model to estimate that the average rate of fresh groundwater discharge to Biscayne Bay for the 10-year period (1989–1998) was about 53 Mgd over a 100 km length of coastline. He estimated that this simulated discharge rate was about 6 percent of the measured surface-water discharge to Biscayne Bay over the same period, which compares favorably with the 5 percent estimated by Stalker et al. (2009-TN124). Through this same modeling effort, Langevin (2003-TN4568) also determined that nearly all of the groundwater discharge occurs in the northern part of Biscayne Bay with very little occurring south of the S-123 control structure, which is north of Turkey Point. Discharge of groundwater in the southern area was small because the low elevation of the water table reduces the hydraulic gradient toward the coast. This indicates that the freshwater canals are a much larger source of freshwater flow to Biscayne Bay in this area than is flow from the inland Biscayne aquifer. Langevin (2003-TN4568) adds that, while the model was well calibrated to groundwater levels and canal fluxes, it is not calibrated to submarine groundwater discharge, because submarine discharges of groundwater are difficult to measure. As discussed in Section 2.3.1.1 above, efforts are under way through the CERP BBCW Project to restore some of the diminished infiltration into the Biscayne aquifer and the resultant flow of groundwater to Biscayne Bay (USACE 2010-TN113).

Limited groundwater discharge from the aquifer to Biscayne Bay combined with pumping of groundwater for irrigation and water supply has caused saltwater to migrate inland (Klein and Hull 1978-TN1351; Renken et al. 2005-TN110; Prinos et al. 2014-TN4569). Although the EPA has designated the Biscayne aquifer in this area as a “sole-source aquifer,” saltwater intrusion to the aquifer along the coast has made the groundwater too salty to meet drinking water standards over an area from the bay coastline to about 6 to 8 mi inland (Langevin 2001-TN1338; Renken et al. 2005-TN110) near the Turkey Point site, as illustrated in Figure 2-12. Migration of hypersaline water from the IWF into the Biscayne aquifer has also contributed to saltwater intrusion.

<u>Hydraulic Properties of Biscayne Aquifer</u>

The permeable limestones and sandstones forming the Biscayne aquifer are highly heterogeneous with varying hydraulic properties and may form one or more aquifers separated by locally confining units. USGS studies indicate that the Biscayne Bay sediments form a dual-porosity system consisting of (1) unconnected pores and larger vugs (cavities) in the rock matrix; and (2) connected vugs and solution channels (Cunningham and Sukop 2011-TN1339). These secondary porosity features can result in a layered system with very high horizontal permeability and significantly lower vertical permeability. At the Turkey Point site, two relatively thin high-permeability zones were found during geophysical investigations that included the drilling of 20 groundwater monitoring wells and two deeper geotechnical piezometer boreholes (FPL 2015-TN4502). Well MW-1 was drilled on the Turkey Point peninsula near the planned location of the radial collector wells. At this well, an upper high-permeability zone occurred at the base of the Miami Limestone and in the underlying Key Largo Limestone at a depth of about 25 to 34 ft below ground surface; and another potential lower high-permeability zone was identified within the Fort Thompson Formation at a depth of about 66 to 75 ft below ground surface (FPL 2009-TN1263). However, additional recently drilled boreholes showed that this lower zone of increased permeability is not a laterally persistent layer, but consists of more isolated zones at varying depths below the top of the Fort Thompson Formation (FPL 2009-TN1263).

FPL conducted tests to estimate aquifer hydraulic properties for the Biscayne aquifer. Slug tests were conducted at several monitoring wells in both the upper and lower portions of the aquifer. However, the slug test results are not considered valid because of the high hydraulic conductivity of the aquifer and the effects of the well filter pack, which can limit groundwater flow into the well in very high-permeability aquifers. In addition to the slug tests, FPL conducted aquifer performance (pumping) tests at each of the proposed reactor unit locations and on the Turkey Point peninsula near the planned radial collector well locations.

Results of the pumping tests at proposed reactor locations are described in FPL's FSAR (FPL 2015-TN4502). At each of the proposed reactor sites, separate pumping tests were conducted in both a well completed in the upper Biscayne aquifer (Key Largo Limestone) and a well completed in the lower Biscayne aquifer (Fort Thompson Formation). These completion zones were chosen to pump water from the identified high-permeability zones. The upper zone pumping wells were open from about 22 to 45 ft below ground surface. The lower zone pumping wells were open from 67 to 87 ft at the proposed Unit 6 site, and from 66 to 105 ft below ground surface at the proposed Unit 7 site. At each reactor site pumping test location, water-level responses were monitored in four observation well clusters about 10 ft from the pumped well and two additional observation well clusters about 25 ft from the pumped well. Each observation well cluster consisted of two or three wells completed at different depths. Duration of pumping was 24 hours for each test and recovery was monitored for more than 24 hours. Results of these tests indicated averaged horizontal hydraulic conductivity of 9,400 to 12,000 ft/d for the upper interval and 300 to 1,000 ft/d for the lower interval (FPL 2015-TN4502). Although the pumping test analysis results presented in FPL 2015 (TN4502) may be affected by the complexity of the groundwater flow system and assumptions of the Hantush leaky-aquitard analysis technique (Hantush 1967-TN1860), the review team determined that the test results verify the Biscayne aquifer conceptual model of vertically discrete permeable zones separated by less permeable rocks, with the highest permeability in the interval from about 22 to 45 ft below ground surface. Comparison of the results from the different test sites and from different observation wells at the same site also shows that permeability varies laterally within the Biscayne aquifer.

The aquifer performance test conducted on the Turkey Point peninsula is described by FPL (2009-TN1263). The pumping well was open from 22 to 46 ft below ground surface and five observation wells were completed over approximately the same depth interval at radial distances from 80 to about 2,600 ft. However, a measurable response was detected at only the four nearest observation wells, which were within about 2,000 ft of the pumping well. The longest duration pumping test was 7 days at an average rate of 7,097 gpm. Water-level responses at the observation wells were consistent with the conceptual model of a "leaky" aquifer separated from a constant-head water source (Biscayne Bay) by a confining layer.

FPL's analyses of drawdown at the four observation wells resulted in reported aquifer transmissivity ranging from 368,000 to about 1,000,000 ft^2/d based on a water-level drawdown versus time analysis method that accounted for leaky aquifer conditions (Hantush 1964-TN3655). The FPL-calculated transmissivity values appeared to increase with distance from the pumped well and FPL (2009-TN1263) hypothesized that the increase in hydraulic conductivity with distance was related to aquifer heterogeneity. However, the review team determined that the increase in calculated hydraulic conductivity with distance resulted from the analysis methodology. The review team's independent analysis of the drawdown data (described in Appendix G) was consistent with the aquifer transmissivity of 800,000 ft^2/d estimated by FPL (2009-TN1263) using a distance-drawdown analysis (Cooper and Jacob 1953-TN1508) based on the drawdown at four observation wells. This resulting calculated transmissivity equates to an average hydraulic conductivity of 10,000 ft/d for an aquifer thickness of 80 ft.

The confining layer consists of a combination of relatively low-permeability sediment on the bay floor and the moderately permeable upper portion of the Miami Limestone. The vertical permeability of the Miami Limestone is typically lower than the horizontal permeability. FPL estimated the bay floor sediment to have an average vertical hydraulic conductivity of 0.7 ft/d (FPL 2009-TN1263). The review team's independent analysis of the aquifer performance test resulted in an average vertical hydraulic conductivity of 0.6 ft/d for the confining layer above the Biscayne aquifer.

Groundwater Flow Direction

Regional groundwater flow in both the Biscayne and Upper Floridan aquifers is generally west to east toward the coast (Miller 1990-TN550). However, local flow direction in the Biscayne aquifer near the Turkey Point site is affected by tides and canals (Langevin 2001-TN1338). FPL installed 10 monitoring well pairs (20 wells) in 2008 across the proposed plant area for measuring groundwater levels. Each pair included a well completed in the Miami Limestone/Key Largo Limestone at depths ranging from 24 to 28 ft and a well completed in the Fort Thompson Formation at depths ranging from 85 to 110 ft below ground surface. Results showed that water levels and flow directions in the proposed plant area vary for both the shallow and deep Biscayne aquifer wells depending on the tidal influence of Biscayne Bay (FPL 2014-TN4058). At high tide, the groundwater hydraulic gradient was toward the inland aquifer and at low tide the hydraulic gradient was toward the bay.

The presence of the unlined 4,370 ac IWF cooling canals affects groundwater levels in the proposed location of Units 6 and 7. The canals interact with groundwater in the underlying Biscayne aquifer. Because of high rates of evaporation of the heated water in the IWF, there is an average net inflow of groundwater to the cooling canals (FPL 2012-TN3439). However, groundwater movement between the cooling canals and the underlying aquifer varies by location and is affected by several factors including precipitation, IWF discharge rate, air temperature and humidity, and tidal fluctuations. The salinity of the cooling-canal water is greater than that of seawater and about twice the average salinity of Biscayne Bay (FPL 2014-TN4058). The higher density has caused hypersaline water to migrate downward into the aquifer beneath the cooling canals. Movement of cooling-canal water into the aquifer was simulated using a numerical model (Hughes et al. 2010-TN1545), which showed that "finger plumes" of hypersaline water likely form beneath the cooling canals and move downward from the base of the cooling canals to the bottom of the permeable zone in a period of days to several years, depending on density differences and the hydraulic conductivity of the aquifer. The hypersaline water would then mix with water in the aquifer through advective and dispersive processes. Water samples collected during the pre-uprate monitoring for Turkey Point Units 3 and 4 from 2010 to 2012 showed that groundwater beneath the approximate center of the

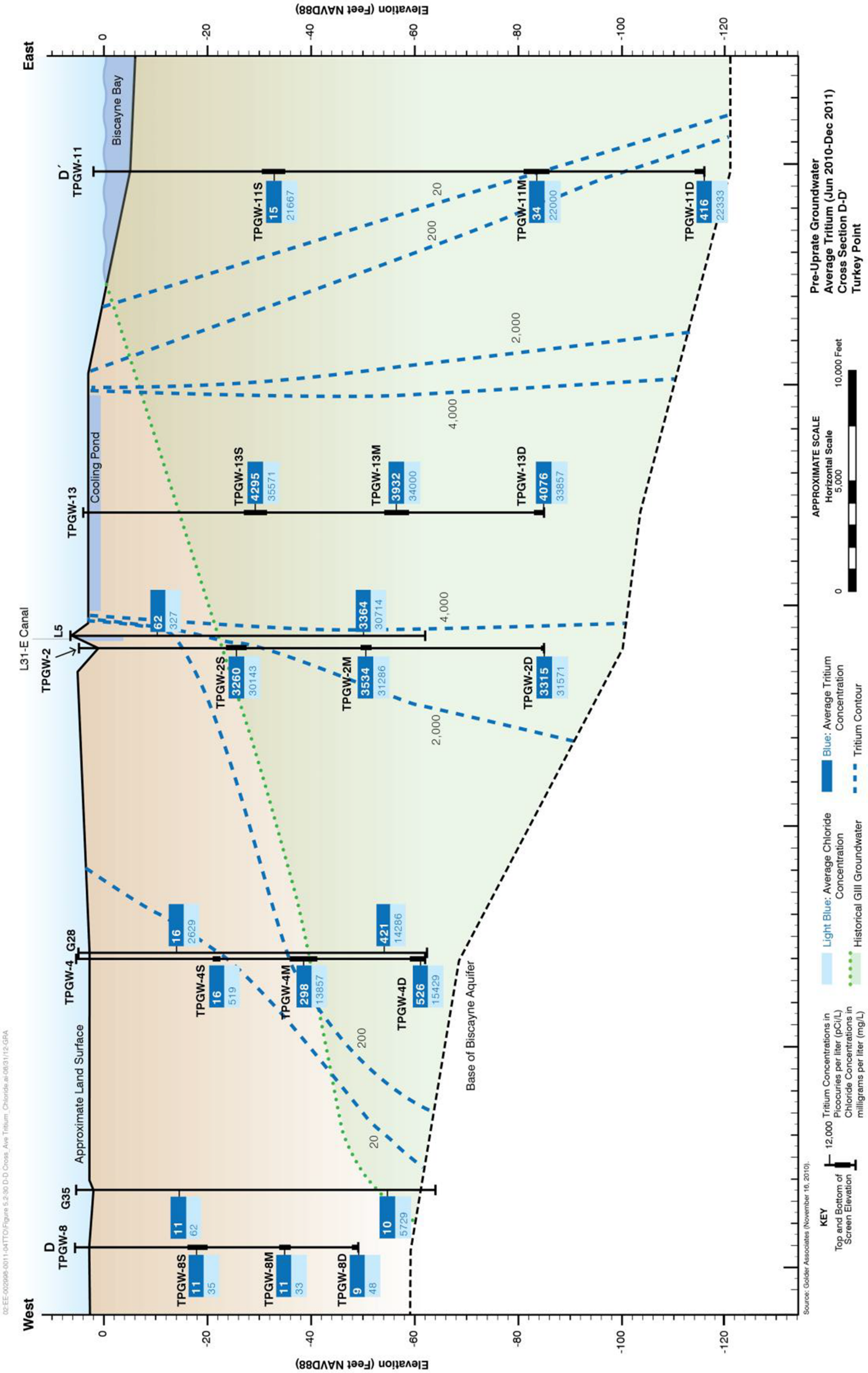


Figure 2-20. Specific Conductance Isopleths along a West-to-East Cross Section through the IWF (FPL 2012-TN3439)

cooling canals had chloride concentrations over 35,000 mg/L (Figure 2-20) and tritium concentrations greater than 4,000 pCi/L compared to about 2,200 mg/L chloride and 15 pCi/L tritium in Biscayne aquifer groundwater under Biscayne Bay (FPL 2012-TN3439). Based on this information, the review team concluded that downward migration of cooling-canal water into the underlying Biscayne aquifer has occurred and is likely still occurring. However, information from the Units 3 and 4 pre-uprate monitoring also shows that interaction between the cooling canals and aquifer varies both spatially and temporally. Precipitation events were shown to have a large impact of water levels in monitoring wells. Tidal effects on well water levels were only observed in wells in or near the bay. Inland wells showed much greater water-level variation between wet and dry seasons than wells near the bay. Increases in operating unit discharges to the IWF could cause increases in both the cooling-canal water level and wetted surface area, which are expected to affect the movement of groundwater between the cooling canals and the aquifer.

Groundwater flow in the Biscayne aquifer is also affected by an interceptor ditch adjacent to the west side of the cooling canals and east of the L-31E Canal. Water is pumped from the interceptor ditch into the IWF cooling canals when needed to maintain a water level in the ditch that is lower than the water level in the L-31E Canal. This is designed to keep groundwater from moving westward from the interceptor ditch toward the L-31E Canal and keep cooling-canal water from affecting groundwater quality to the west (FPL 2015-TN4502). However, because deeper permeable layers within the Biscayne aquifer may be isolated from hydraulic head in the ditch by lower permeability layers, it is possible that some water from the cooling canals could move to the west. As discussed in Section 2.3.3.2 below, monitoring by FPL indicates that hypersaline water from the cooling canals has moved west of the L-31E Canal in the deeper part of the Biscayne aquifer.

Floridan Aquifer System

Below the Biscayne aquifer is the Floridan aquifer system, which is composed of dolomite and limestone (Miller 1990-TN550). The Floridan aquifer system is separated from the shallower Biscayne aquifer by the Intermediate Confining Unit (Figure 2-19), which is composed mainly of rocks from the Tamiami Formation and the deeper Hawthorne Group. At the site, the top of the Intermediate Confining Unit occurs at a depth of about 140 ft and is over 800 ft thick (Figure 2-19). The Floridan aquifer system consists of three units which are, from shallowest to deepest; the Upper Floridan aquifer (also called UFA, a less permeable formation known as the Middle Confining Unit (MCU), and the Lower Floridan aquifer. Studies of the hydrogeology of south Florida indicate that the MCU may be separated into three distinct units, namely; an upper confining zone known as MC1, a permeable zone called the Avon Park Permeable (or Producing) Zone (APPZ) within the Avon Park Formation, and a lower confining zone known as MC2 (Reese and Richardson 2008-TN3436).

Before 2008, the APPZ had not been widely identified in southeastern Florida. In addressing this, Reese and Richardson (2008-TN3436) reported that the APPZ, "…has been identified in previous studies as the…lower part of the Upper Floridan aquifer in…the southern part of southeastern Florida". Because of this, the Upper Floridan aquifer is now recognized as less vertically extensive and the MCU as more vertically extensive than in preceeding studies of the Floridan aquifer, including those at deep well injection sites (McNeill 2002-TN4571; Starr et al

2001-TN1251; EPA 2003-TN3658). As a result, previous hydraulic datasets may not have been truly representative of the units they were used to describe leading researchers to conclude in one case that, "…it can be inferred that the MCU…is a better confining unit than indicated by the hydraulic conductivity dataset" (Starr et al. 2001-TN1251).

The Upper Floridan aquifer is an important source of freshwater in parts of Florida and is designated an underground source of drinking water (USDW) at the Turkey Point site because the total dissolved solids concentration is less than 10,000 mg/L. However, water from the Upper Floridan is too saline (dissolved solid concentrations greater than 2,000 mg/L) in southeastern Florida to be used for drinking water without treatment (Renken et al. 2005-TN110).

Within the Lower Floridan aquifer in southern Florida there is a cavernous, high-permeability geologic horizon called the Boulder Zone, which is the zone identified for deep-well injection of blowdown water from proposed Units 6 and 7. The extremely high permeability is thought to result from horizontal caverns occurring at multiple elevations connected by large vertical tubes (Miller 1990-TN550) within the unit. The water in the Boulder Zone is very similar to modern seawater both in salinity and temperature. It is thought that the Boulder Zone connects to the Atlantic Ocean at a depth of about 2,500 ft about 25 mi off the coast of Miami. The salinity precludes any interest in the Boulder Zone as a supply of freshwater. Based on water quality, hydraulic head, age dating and water temperatures Meyer (1989-TN2255) indicated that natural flow within the Boulder Zone in eastern Florida is generally westward and considered to be very slow- on the order of thousands of years.

The low-permeability dolomite and limestones of the MCU limits the upward migration of water from the Boulder Zone. Because of its isolation and high permeability, the Boulder Zone has been used for injection of municipal and industrial wastewater in Florida (Miller 1990-TN550). At the exploratory well (EW-1) constructed on the Units 6 and 7 plant site, the Upper Floridan aquifer is composed of relatively permeable layers of sediment within the Suwannee Limestone Formation and the upper portion of the Avon Park Formation, as shown in Figure 2-19 (FPL 2012-TN1577). Lower permeability confining layers that impede the vertical mixing of groundwater were also identified within these depth intervals. The bottom of the deepest USDW was determined to be between 1,430 and 1,505 ft below ground surface based on water samples collected during packer testing, and was estimated at 1,450 ft based on specific conductance logging (FPL 2012-TN1577). At the Turkey Point site, the bottom of the USDW is within the Avon Park Formation, and is considered part of the Upper Floridan aquifer because of its relatively low salinity (Figure 2-19).

As shown in Figure 2-19, the uppermost portion of the MCU (MC1), the APPZ, and the lower MCU (MC2) zones are within the Avon Park Formation with the deeper MCU extending into the Oldsmar Formation. The top of the APPZ zone was not explicitly identified by FPL in the report about exploratory well EW-1 or in the report about the dual-zone monitoring well DZMW-1 (FPL 2014-TN4052). Based on information from the EW-1 (FPL 2012-TN1577) and regional information, if it exists at the Turkey Point site, the APPZ is likely within the interval from 1,535 and 1,770 ft below ground surface where FPL documented the presence of both confining and permeable zones at EW-1. While drilling DZMW-1, FPL noted a "significant increase in salinity below a depth of 1,614 feet indicate [sic] the presence of a relatively saline productive interval below this depth." This zone may be part of the APPZ based on its permeability and high salinity. Reese and Richardson (2008-TN3436) show the top of the APPZ at a depth of approximately 1,700 ft at a borehole south of Turkey Point, and missing at a borehole north of Turkey Point. The APPZ is probably less than 100 ft thick based on regional information.

The section of the middle Floridan confining unit between 1,930 and 2,915 ft below ground surface was primarily composed of low-permeability sediments at EW-1. This section includes the lower portion of the Avon Park Formation from 1,930 ft to 2,580 ft and the upper portion of the Oldsmar Formation from 2,580 ft to the top of the Lower Floridan aquifer at about 2,915 ft below ground surface (FPL 2012-TN1577). FPL identified the interval from 1,930 to 2,915 ft as the primary confinement for injectate at the site. The top of the Boulder Zone was identified at a depth of 3,030 ft and extended below the bottom of the EW-1 borehole at 3,230 ft. These depths and thicknesses are consistent with the mapping of statewide information of the Floridan aquifer presented in Reese and Richardson (2008-TN3436).

Seismic-reflection studies performed by the USGS in southeastern Florida have identified both linear tectonic faults and "karst collapse" structures up to about 2 mi in diameter that may result in areas of increased vertical flow through the Floridan aquifer confining units such as the MCU (Cunningham et al. 2012-TN4576; Cunningham 2013-TN4573; Cunningham 2014-TN4051; Cunningham 2015-TN4574). Seismic data have not been collected as the Turkey Point site. Nonetheless, Cunningham (2015-TN4574) suggests that, "other evidence for karst collapse includes borehole geophysical log signatures that indicate highly fractured rock."

Staff evaluated return velocities in sonic logs obtained at EW-1 and found sections of the MCU to have log signatures and transit times consistent with unfractured rock. This is supported by other characterization including geophysical and lithologic log results, hydraulic properties, and injection and pump tests as discussed in greater detail in Section 5.2 (FPL 2014-TN4052). There is currently no evidence of similar features at the Turkey Point site.

<u>Groundwater Flow Directions within the Floridan Aquifer</u>

Regional groundwater flow within the Floridan aquifer system in South Florida has been generally characterized as complex by Meyer (1989-TN2255) who evaluated previous studies, water quality, hydraulic head, age dating and water temperatures. Based on this data Meyer found that a groundwater divide in the Upper Floridan aquifer runs the length of the Floridan Peninsula with groundwater west of this divide flowing west and east of this divide flowing east. Groundwater levels in wells within the Upper Floridan aquifer near the Turkey Point site confirm that groundwater flows eastward.

The FDEP has permitted over 180 Class I injection wells for municipal and industrial wastewater disposal. The wells predominately inject into the Boulder Zone of the Lower Floridan aquifer. As a result a number of site-specific and regional studies have evaluated fluid movement within the MCU and Boulder Zone. Meyer indicates that in eastern Florida, flow from the Boulder Zone is generally lateral (westward) with a component of upward flow into the MCU. However, hydraulic parameters and age dating indicate that this horizontal and vertical flow is driven by temperature differences and may take many thousands of years (Meyer 1989-TN2255) due to the confining nature of the MCU. Other studies, conducted primarily at injection sites, indicate that transit times may be shortened when pathways within the MCU are created through improper well construction or a network of interconnected fractures. This is discussed in more detail below. Evidence from a study by Walsh and Price (2010-TN3656) conducted at the SDWWTP north of the Turkey Point site shows that while flow within MC1 and MC2 is generally vertical, flow within the APPZ is horizontal providing for more rapid flow and mixing of waters entering the APPZ from the underlying MC2 confining unit. This is consistent with findings from a USGS revision of the Floridan Aquifer System, which determined that “in southern Florida, the APPZ is more isolated by thicker lower permeability rocks than elsewhere iin the system and may act as a distinct aquifer within the system” (Williams and Kuniansky 2015-TN4577).

Upward migration of treated municipal wastewater injected into the Boulder Zone has been observed at a minority of injection sites, including 9 mi north of the proposed Turkey Point site at the Miami-Dade SDWWTP, where injection rates are around 97 Mgd. As a result, studies have been performed to evaluate the cause and extent of this migration. Studies have investigated whether this observed migration may have been caused by flow through the matrix of the MCU or through conduits or preferential flow paths provided by either natural geologic features or by a well construction problem.

These studies generally indicate that sections of low permeability limestones and dolostones of the MCU, “appears to act as a competent confining unit” (McNeill 2002-TN4571) and that, “…contaminants are not migrating upward through the Middle Confining Unit across a broad area.” (Starr, et. al. 2001-TN1251). Maliva et al. (2007-TN1483) present evidence from site studies of vertical migration at two water facilities in South Florida as well as variable density transport modeling that shows dolostones with sufficiently low vertical hydraulic conductivities can provide local confinement sufficient to prevent migration into the USDW, even if the underlying rock is fractured.

Improper well construction can create the potential for upward migration across the MCU for several reasons. In the past, a smaller-diameter pilot hole was often drilled first, and then the pilot hole was reamed to a larger diameter. Maliva et al. (2007-TN1483) states that “If the reamed hole for a casing string diverged from the pilot hole, then the pilot hole may become a conduit for vertical fluid migration. However, well construction problems as a cause for vertical fluid migration have not yet been conclusively confirmed at any injection well site.” Despite this, studies by McNeill (2002-TN4571) and Walsh and Price (2010-TN3656) indicate that upwelling at the SDWWTP may be attributed, at least in part, to well construction issues. Such a construction problem is not expected at the Turkey Point site because under newer well construction techniques, the pilot hole is cemented before the actual well is drilled. Also tests would be performed every 5 years to verify well integrity (FPL 2011-TN51).

A 2002 study (McNeill 2002-TN4571) of upwelling of injected fluid at the SDWWTP indicated that upwelling can also occur when wells are improperly completed. This study identified an “important low-permeability interval” which “appears to act as a competent confining unit” between the Boulder Zone and Middle Confining Unit and also indicated that 10 of 17 injection wells were drilled through this unit but completed above it, leaving an open hole and upward pathway for injected effluent. Walsh and Price (2008-TN3657) evaluated water chemistry data from wells at the SDWWTP site and determined that injected wastewater likely migrated upward through a lower section of the MCU and into the APPZ section of the MCU. However, wastewater migration was not apparent in the low-permeability portion of the MCU that lies above the APPZ and below the Upper Floridan aquifer. Additional analysis by Walsh and Price (2010-TN3656) concluded that in three of the four instances of upward migration of injected wastewater at the SDWWTP the plumes moved into the APPZ and in the fourth instance the plume moved into the low-permeability layer below the APPZ. As a result, this report presented a conceptual model that postulates the vertical migration through the MC2 of the MCU is density driven due to salinity or temperature differences between the formation water and injectate. If migration to the APPZ occurred, horizontal flow and mixing would likely diminish the buoyant forces and reduce the impact above the APPZ.

Cunningham (2012-TN4576; Cunningham 2013-TN4573; Cunningham 2014-TN4051; Cunningham 2015-TN4574) has used seismic-reflection data to identify natural vertical "karst collapse" features that could act as conduits for flow across the MCU and identified a municipal wellfield for the City of Sunrise, where upwelling was coincident with a karst collapse feature. However, migration had not occurred above the Lower Floridan aquifer (LFA).

An EPA study of 93 deep-well injection facilities in South Florida also indicates that fluid movement underground is influenced by buoyancy created by temperature and density differences between native and injected waters. Injection pressures, which are influenced by the geology and injection rates, can also induce upward migration (68 FR 23673) (TN3658). As mentioned above, injection rates at the SDWWTP site, where upward migration has occurred, are around 97 Mgd. As discussed above, FPL evaluated the confining ability of the MCU during the drilling and completion of EW-1 through geophysical logging, core analysis and pressure testing (FPL 2012-TN1577) and concluded that there was "no indication of vertically extensive or significant fracturing at several intervals throughout the MCU."

Section 5.2.1.3, 5.2.2.2, and Appendix G contain a more detailed discussion of the confining capability of the Middle Confining Unit and the review team assessment of the impacts of deep well injection at the Turkey Point site.

<u>Hydraulic Properties of the Floridan Aquifer System at the Turkey Point Site</u>

Exploratory well EW-1 was constructed on the site to determine the properties of the Boulder Zone and the confining nature of the overlying MCU that separates the Boulder Zone from the USDW zone within the Upper Floridan aquifer. The exploratory well was constructed to a depth of 3,232 ft below the drill pad. At the well location water-quality samples and rock core were collected and analyzed at various depths, and geophysical logging, video surveys and packer testing were performed to determine the hydraulic parameters of the rock layers. Based on these data the rocks encountered between depths of 1,535 and 3,232 ft were divided into three distinct zones (FPL 2012-TN1577; FPL 2012-TN1264). These zones roughly coincide with the MC1 and APPZ of the MCU, MC2 of the MCU, and the Boulder Zone of the Lower Floridan aquifer, respectively, and are as follows:

- 1,535 to 1,980 ft: This interval is characterized as having variable lithology and porosity and therefore not providing a reliable barrier to vertical flow of water. Hydraulic conductivities and porosities were not determined for this interval however, total dissolved solids (TDS) values are at or below 10,000 mg/L indicated that the base of the USDW (TDS <10,000 mg/L) would be located at or above this interval, which is within the zone identified as the APPZ of the MCU. Selected depth intervals were isolated using packers and hydraulic flow tests were conducted to estimate the permeability of the rock in those intervals. Straddle packer test performance data indicate that specific capacities within this zone ranged from 0.003 to 2.43 gpm/ft. Specific capacity is a measure of the pumping rate corresponding to water-level drawdown of 1 ft.

- 1,980 to 2,915 ft: This interval below the drill pad was found to be composed of consistently softer material. Lithologic logs indicate that the formation is comprised on layers of limestone, dolomitic limestone and dolomite. Core laboratory data indicated that vertical hydraulic conductivities ranged from 1.6x10-6 to 5.4x10-4 cm/sec and total porosities ranged from 27.4 to 43.4 percent. Pumping tests of packer-isolated intervals from 1,930 to 1,950 ft, 1,970 to 1,972 ft, and 2,058 to 2,080 ft below the drill pad resulted in low specific capacity values of 0.03, 0.003 and 0.05 gpm/ft, respectively (FPL 2012-TN1265). In some tested zones, a large drawdown resulted from a low pumping rate, indicating low hydraulic conductivity. Nine cores were collected throughout this interval. Core recovery was variable but between 85.7 percent, and 95.4 percent at three depths. Return velocities on sonic logs for depths within this interval are generally high. These data indicate that this unit, which is the MC2 of the MCU, is more confining than over and underlying units, is over 900 ft thick, and likely provides a barrier to vertical groundwater flow. These preliminary results indicate that a thick low-permeability confining layer exists between the proposed injection point within the Boulder Zone and the overlying USDW aquifer. These site-specific findings are consistent with characterization data and conclusions presented in studies of these same formations in South Florida and near the Turkey Point site. Maliva et al. (2007-TN1483) found that a confining layer with vertical hydraulic conductivity of 10–6 cm/sec resulted in minimal vertical migration over a 25-year simulation period. McNeill (2002-TN4571) similarly indicated that thin dolomitic units (such as the “Dolomite Confining Unit” discussed in section 5.2.1.3) were continuous throughout southeast Florida and provided, “…additional effective confinement of upwardly buoyant injected fluids.”
- 3,020 to 3,232 ft: This interval below the drill pad was found to contain highly porous and permeable rocks that form the Boulder Zone of the Lower Floridan aquifer. TDS values are greater than 30,000 mg/L which is comparable to seawater. Geophysical logging indicate a very large hole diameter consistent with open voids, low resistivity, and short formational acoustic travel times. Pumping tests indicated that this zone has a high specific capacity, with values measured around 49 gpm/ft. These preliminary results indicate that a thick low-permeability confining layer exists between the proposed injection point within the Boulder Zone and the overlying USDW aquifer. These site-specific findings are consistent with characterization data and conclusions presented in studies of these same formations in South Florida and near the Turkey Point site.

2.3.2 Water Use

Consideration of water use involves estimating the magnitude and timing of consumptive and nonconsumptive water uses. Nonconsumptive water use does not result in a reduction in the available water supply. An example near the Turkey Point site is the Everglades Alligator Farm that raises alligators (EAF 2014-TN3659). The farm pumps freshwater that is used in the farming of alligators but returns approximately the same volume of water to nearby watercourses or aquifers. On the other hand, consumptive water use results in a net reduction of the water supply available for downstream users. For instance, as a backup system of cooling water for proposed Turkey Point Units 6 and 7, water may be withdrawn from beneath Biscayne Bay for normal cooling. Most of that water would be evaporated in the cooling towers, and that evaporated water would be considered a consumptive loss. The following two sections describe the consumptive and nonconsumptive users of surface water and groundwater near the Turkey Point site. Although surface-water use and groundwater use are discussed separately, there is a close connection and interchange between surface-water and shallow groundwater resources in South Florida. For example, removing water from a pond will likely result in groundwater flow into the pond from the surficial aquifer, and pumping of a shallow well is likely to remove water from nearby surface-water features. One of the goals of the CERP is to increase sheet flow, and consequently enhance infiltration of surface water to the shallow Biscayne aquifer in the Biscayne coastal wetlands area.

2.3.2.1 Surface-Water Use

Regional water uses primarily support the restoration actions of CERP, in which surface runoff from areas to the north of the Everglades, including Lake Okeechobee, is being returned to natural channels (Shark River Slough and Taylor Slough) entering Everglades National Park. CERP restoration actions also include the restoration of sheet flow into Biscayne Bay. CERP projects in the region are identified in EIS Section 2.3.1.1 in the CERP subsection and in Figure 2-8.

For the local area, 34 permitted surface-water users were identified within a 10 mi radius of Turkey Point; the identified uses of water include landscaping, agriculture, industrial, and recreational irrigation (a golf course) (FPL 2014-TN4058). Landscape use accounts for the largest number (31) of permitted users but the golf course represents the largest single permitted use of 115.8 Mgd/yr. The water sources range from onsite lakes/ponds, onsite canals, onsite borrow pits, and Biscayne aquifer/onsite canals. Given that significant exchange occurs between surface water and shallow groundwater it is somewhat arbitrary to assign certain sources as surface water, except that waters may be withdrawn from a body of surface water. The review team confirmed the water uses by examining permit information for surface-water sources from the SFWMD (2012-TN1319), which are listed in Table 2-10. These permit locations are broken down by township and range (approximately 6 mi by 6 mi blocks).

Table 2-10. Consumptive Use Surface-Water Permits in the Region around the Turkey Point Site (from SFWMD 2012-TN1319). ***The surface-water sources include canals, lakes, and bays. The locations are by township and range; Turkey Point is located in T57S R40E, in the southeast portion of the grid (approximately Section 36).***

Location	Water Use	Number of Permits	Permit Volume (Mgm)
T56S-R40E	Agricultural	1	2.95
T56S-R40E	Industrial	3	1.52
T56S-R40E	Landscape	12	18.09
T56S-R39E	Landscape	6	13.6
T57S-R40E	Industrial	1	1.52
T57S-R39E	Golf Course	1	14.68
T57S-R39E	Industrial	1	42.00
T57S-R39E	Landscape	27	16.14
T57S-R38E	Industrial	1	0.30
T58S-R38E	Aquaculture (alligator farm)	1	2.25
T58S-R38E	Public Water Supply	1	6.30

Mgm = million gallons per month.

Subsequent to publication of the draft EIS, in accordance with the Administrative Order (FDEP 2014-TN4144), water from the L-31E Canal can be used as a short term resource during periods of excess flow to freshen the IWF in order to maintain an annual average salinity of no more than 34 psu. Because water in the L-31E Canal is freshwater, it is more efficient to use this water for freshening the IWF than water from the Upper Floridan aquifer or the Biscayne aquifer.

2.3.2.2 Groundwater Use

Biscayne Aquifer

The generally high permeability of the limestone, sandstone, and sand in the Biscayne aquifer has resulted in it being an important water supply. The USGS estimates that 486.2 Mgd of fresh groundwater was withdrawn from the Biscayne aquifer in Miami-Dade County during 2005 (Marella 2009-TN1521). About 400 Mgd of that was used for public water supplies, 46.5 Mgd was for agriculture, 29 Mgd was for industrial uses, 7.7 Mgd was used for recreational irrigation, and 2.9 Mgd went to household self-supply.

Nearly all of the potable water supplied by the MDWASD to southern Miami-Dade County comes from the Biscayne aquifer (Miami-Dade County 2014-TN3647). The exception is water from the Alexander Orr, Jr. water-treatment plant, which mixes some brackish groundwater from the Upper Floridan aquifer with Biscayne aquifer groundwater to serve County residents living between SW 8th Street and SW 264th Street (Miami-Dade County 2014-TN3647). The public water-supply wells located nearest to the proposed plant site serve the City of Homestead and are located at Newton Field, Harris Field and Witkop Park in Homestead (City of Homestead 2012-TN3648). These well fields are approximately 6.8, 7.3, and 7.7 mi, respectively, west-northwest of the plant site (distance measured from Google Earth). The potable water supply for the Florida Keys comes from Biscayne aquifer wells and an Upper Floridan aquifer well located west of Florida City (FKAA 2014-TN3649) approximately 9 mi west of the plant site.

The EPA has designated the Biscayne aquifer as a sole-source aquifer pursuant to Section 1424(e) of the Safe Drinking Water Act of 1974 (42 U.S.C. § 300f et seq.) (TN1337). However, the Biscayne aquifer in the immediate vicinity of proposed Units 6 and 7 is too saline to be used as a potable water supply over an area from the coastline to about 6 to 8 mi inland (Langevin 2001-TN1338; Renken et al. 2005-TN110) near the Turkey Point site (see Figure 2-12).

Subsequent to publication of the draft EIS, in accordance with the Administrative Order (FDEP 2014-TN4144), the Biscayne aquifer beneath the Turkey Point site can be used to freshen the IWF in order to maintain an annual average salinity of no more than 34 psu.

Also subsequent to publication of the draft EIS, in accordance with the Consent Agreement with Miami-Dade County (Miami Dade County v. Florida Power & Light 2015-TN4505), the hypersaline plume that extends beyond FPL's property line will be retracted so that a chlorinity of 19,000 does not extend beyond the property line. Water withdrawn from the hypersaline plume will be injected into the Boulder Zone using an existing underground injection control well.

Upper Floridan Aquifer

Marella (2009-TN1521) reports that 3.5 Mgd of Floridan aquifer groundwater was used in Miami-Dade County during 2005 and 93 percent of that water was saline. Upper Floridan aquifer water is used for irrigation at seven golf courses in Southeast Florida (SFWMD 2013-TN3461). Two of these, the Ocean Reef and Card Sound Golf Clubs, are located approximately 7.7 and 9 mi southeast of the Turkey Point site. The Upper Floridan aquifer in the immediate vicinity of the Turkey Point plant area is used to supply cooling-tower makeup water at a rate of about 12.6 Mgd to Turkey Point Unit 5 (FPL 2014-TN4058). Desalinization is used to treat brackish water from the Upper Floridan aquifer for domestic use at several locations in South Florida, including the well operated by the Florida Keys Aqueduct Authority (SFWMD 2013-TN3461) and two plants in Miami-Dade County (SFWMD 2012-TN1522). Therefore, additional future use of brackish water from the Upper Floridan aquifer is possible.

Projections of groundwater use for the SFWMD Lower East Coast Planning Area indicate an 18 percent increase in the demand for public water supplies from 2010 to 2030 for Miami-Dade County (SFWMD 2013-TN3461). The SFWMD determined that part of this increased demand will be met by "alternative supplies" including desalinization, reclaimed water treatment, water conservation programs, and aquifer storage systems. Additional freshwater will also be needed for ecosystem restoration projects such as CERP. This water will come mainly from rerouting of excess runoff and potentially from reclaimed water.

The FDEP has permitted over 180 Class I injection wells for injection of municipal and industrial wastewater into the Boulder Zone of the Florida aquifer system. The Boulder Zone of the Lower Floridan aquifer is used for injection of municipal and industrial wastewater because of its isolation, high permeability, and salinity similar to seawater (Miller 1990-TN550). The top of the Boulder Zone at the Turkey Point site about 3,000 ft below ground surface and is proposed for injection disposal of cooling-tower blowdown and other waste streams from Units 6 and 7. The Boulder Zone is currently used for treated municipal waste water injection at MDWASD's SDWWTP approximately 9 mi north of the Turkey Point site and at several other locations in Florida (Maliva et al. 2007-TN1483).

Subsequent to publication of the draft EIS, in accordance with the Administrative Order (FDEP 2014-TN4144), the Upper Floridan aquifer can be used to freshen the IWF to maintain an annual average salinity of no more than 34 psu. Because Upper Floridan aquifer currently has salinities around 3 psu, it is far more effective than Biscayne aquifer water in freshening the IWF. Withdrawals from the Upper Floridan aquifer for freshening are limited to 14 Mgd.

2.3.3 Water Quality

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

2.3.3.1 Surface-Water Quality

The FDEP, under the Federal Water Pollution Control Act (Clean Water Act) Section 305(b) (33 U.S.C. § 1344 et seq.) (TN1019), prepares a statewide Water Quality Inventory. The FDEP also identifies impaired waterbodies during this inventory process and lists them on the Clean Water Act's Section 303(d) List of Impaired Waters. Portions of the estuary and streams along the southeast coast, including Biscayne Bay, appear on the final 2010 Section 303(d) List as impaired waterbodies because of copper, fecal coliforms, mercury, and nutrients (FDEP 2010-TN1253).

Surface-water quality is routinely monitored by the SFWMD and other agencies (SFWMD 2012-TN1318). For the purposes of the analysis of the impacts from the operation of the radial collector wells, FPL also collected a sample from Biscayne Bay and analyzed it for conventional and priority pollutants (FPL 2009-TN1263). For the data collected during the SFWMD's monitoring program, only results from station BISC123 (the same location as BISC12 in Figure 2-14) are examined because it is the station nearest the site. Routine monitoring occurred at monthly intervals. The review team reviewed the data for seasonal variations and the variability within each month of the year; hence, the measurements over the period of record are plotted by month (Figure 2-21) with the monthly data and the monthly averages for the period of record. The measurements are from samples collected at depths of <3 ft and are regarded as surface measurements. Measurements at >3 ft depths are not available for many of the constituents and are not examined here.

Average surface-water temperatures vary from 18.5°C during the winter months to 30.6°C during the summer months (Figure 2-21(a)). The temperature range during the summer months (approximately 3°C) is relatively small in comparison to the range during the winter (approximately 14°C). During the winter, air temperatures in South Florida can be much cooler than normal because of the penetration of cold fronts, while during the summer, weather patterns typically produce more uniform temperatures.

Dissolved oxygen is governed first by temperature; lower oxygen saturation concentrations occur at higher temperatures and the highest saturation concentrations occur at the lowest temperatures. Secondarily, dissolved oxygen is increased by production from photosynthetic organisms (algae, marine vegetation) and decreased by respiration from all organisms inhabiting Biscayne Bay. In addition, dissolved oxygen is decreased by the decay of organic matter present in the Biscayne Bay. Because of these factors, the average surface dissolved oxygen during the winter months reaches a maximum of 7.4 mg O_2/L, while during the summer, average dissolved oxygen concentrations decline to 5.4 mg O_2/L (Figure 2-21(b)). The maximum and minimum dissolved oxygen concentrations occurred during the winter (9.1 mg O_2/L and 2.7 mg O_2/L). The maximum concentrations tend to be lowest during the summer, while the minimum concentrations exhibit two peaks: one in the late spring and another in late fall/early winter.

Average pH generally varied within a small range of 8.1 to 7.8 throughout the year; the highest pH values occurred during the summer months, likely due to photosynthetic processes (Figure 2-21(c)).

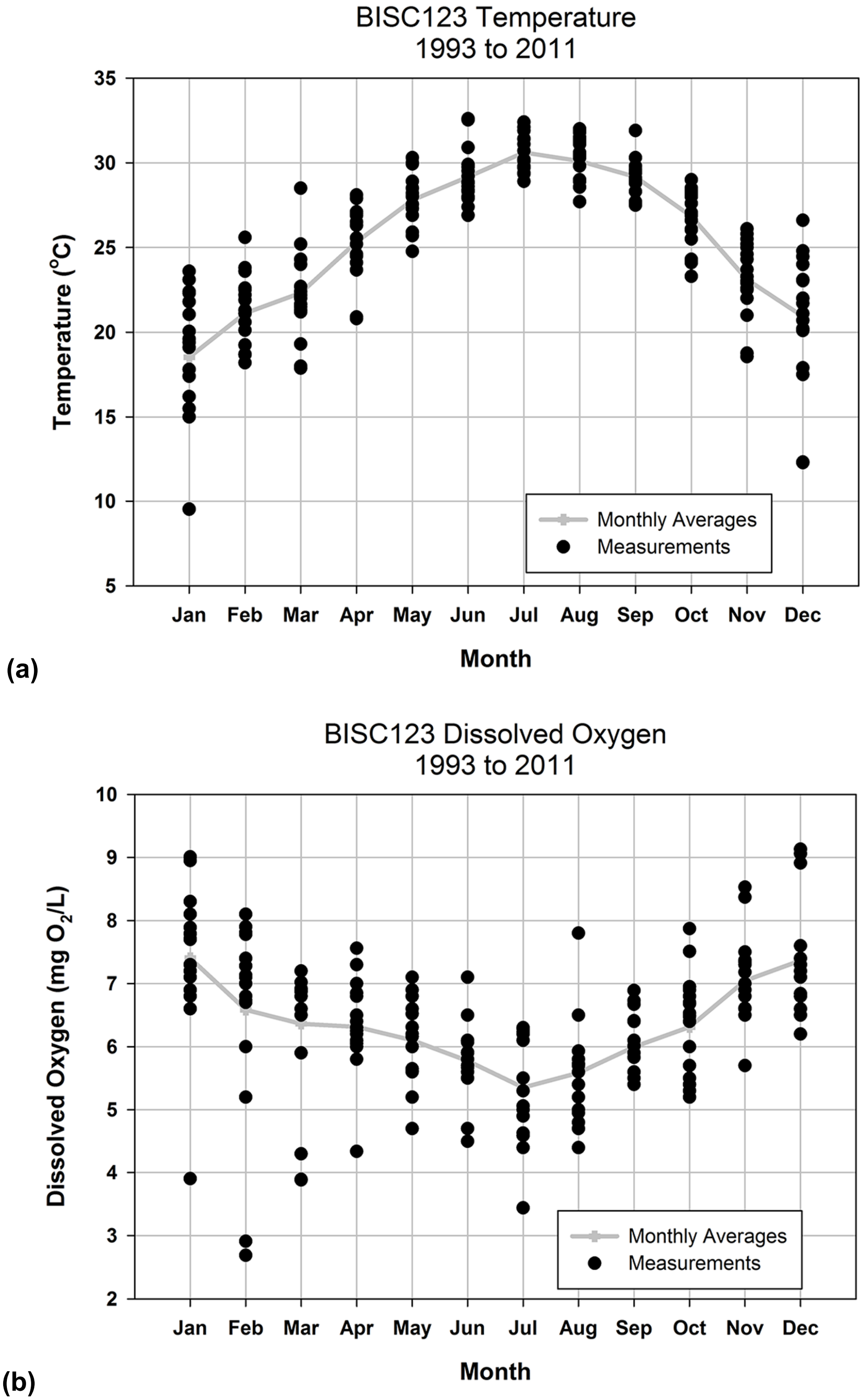
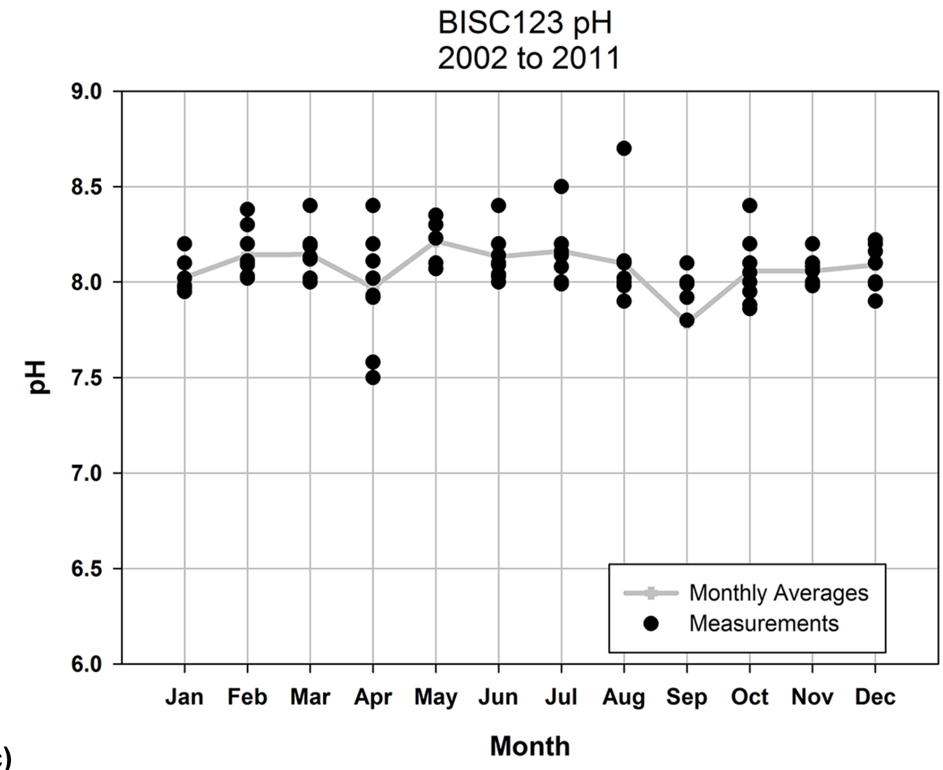
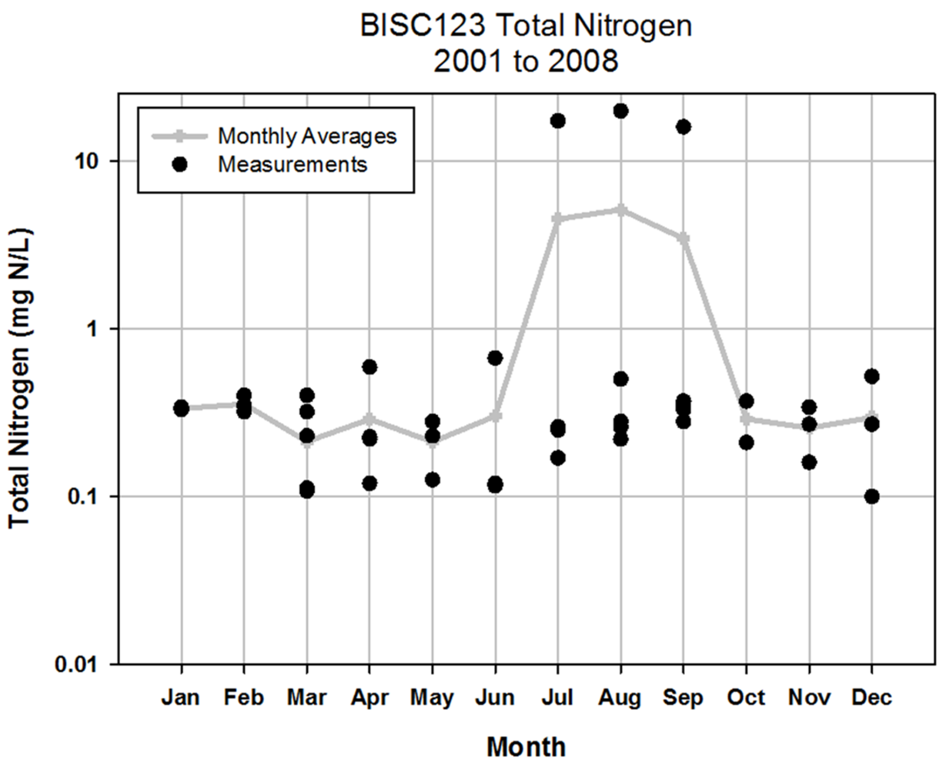


Figure 2-21. Monthly Water-Quality Measurements at Station BISC123 for the Period of Record Including the Monthly Averages for Each Constituent (SFWMD 2012-TN1318)

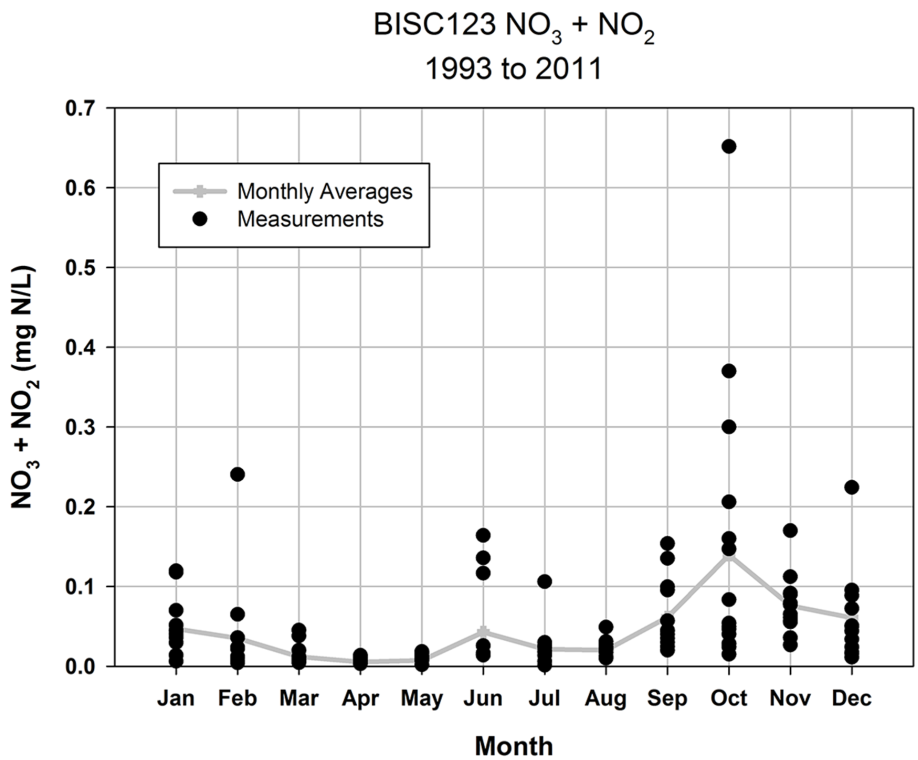


(c)

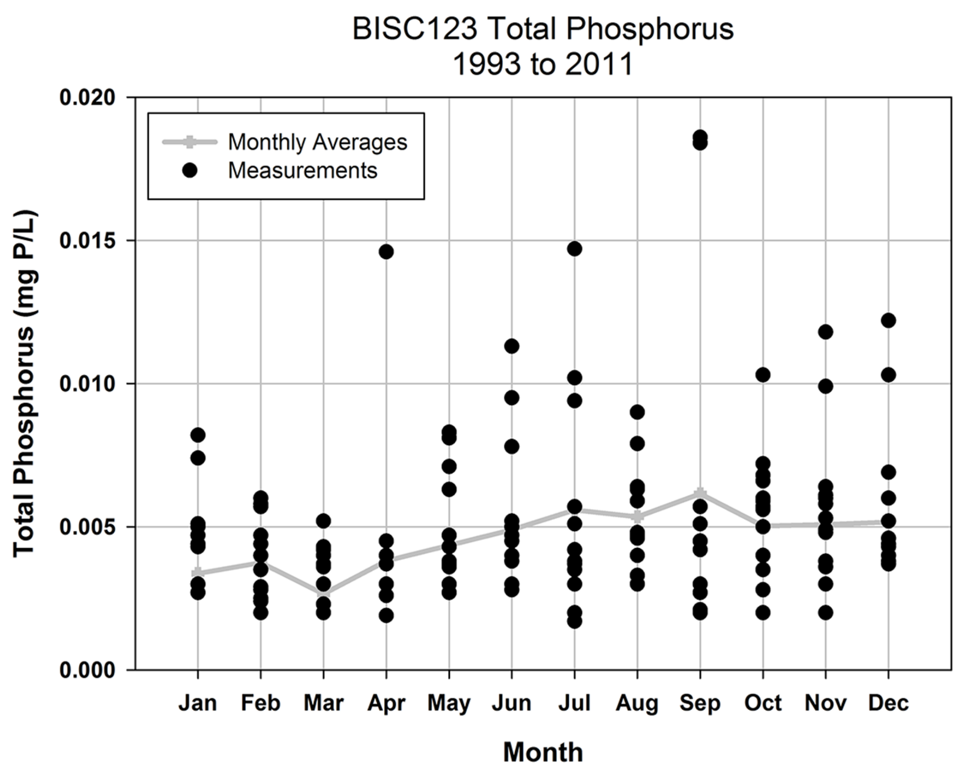


(d)

Figure 2-21. (contd)

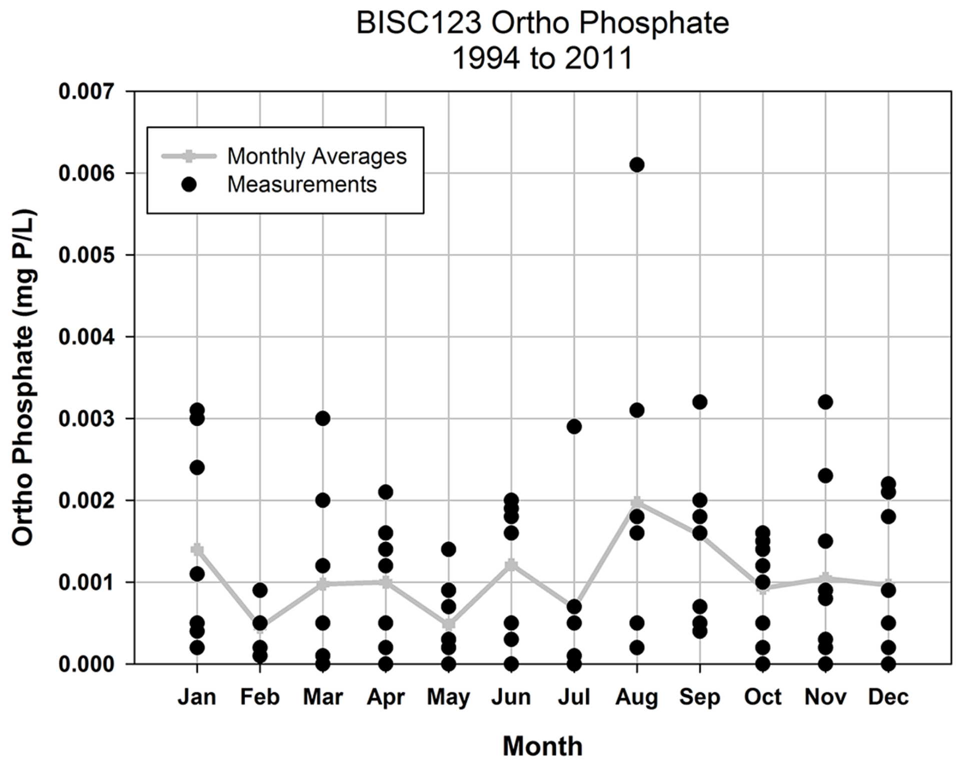


(e)

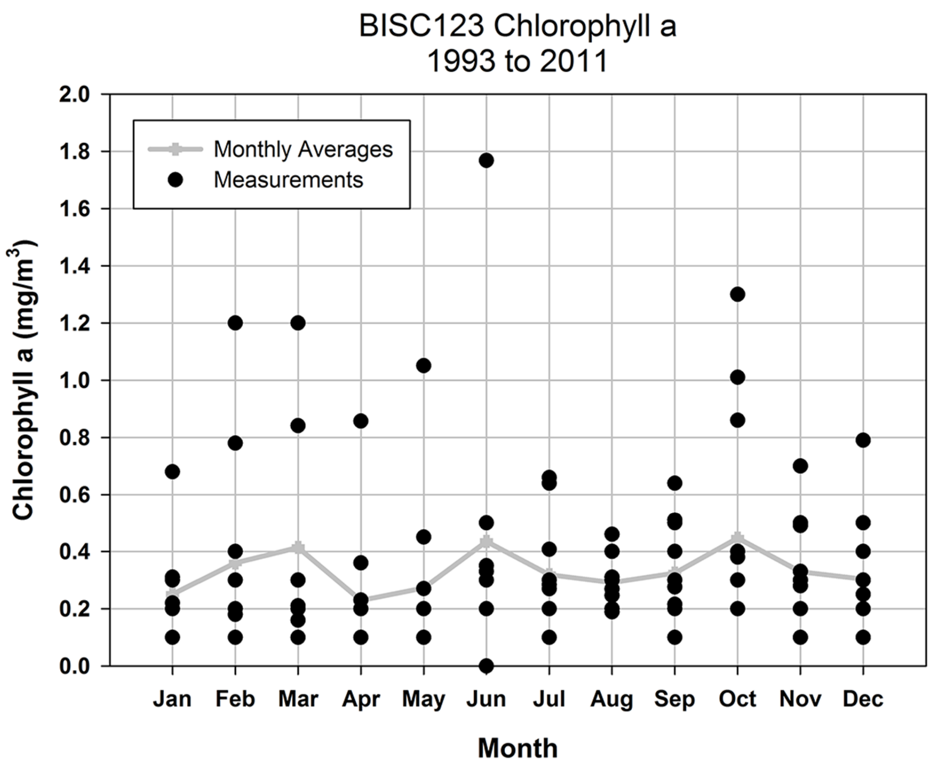


(f)

Figure 2-21. (contd)



(g)



(h)

Figure 2-21. (contd)

The average concentrations of total nitrogen (TN) were below 0.4 milligrams of nitrate per liter (mg N/L) throughout the year, but the period of record for this constituent is only 2001 to 2008, while most other constituents have measurements from 1993 to 2011 (Figure 2-21(d)). Note that three values included in the plot were from summer 2007 and had concentrations greater than 15 mg N/L. It is unclear why these samples had such large TN values. Other than these sample concentrations, the greatest reported concentration is <0.7 mg N/L. The average line in Figure 2-21(d) includes the effect of the large concentration in 2007. TN includes the components organic nitrogen, ammonia nitrogen, and nitrate + nitrite nitrogen. While inclusion of the large concentration values produces a trend in the average concentrations, no general trend can be ascribed. No clear trend is evident in the measured data because of the relatively high monthly variability and the short period of record.

Monthly average concentrations of nitrate+nitrite (NO_3+NO_2) are generally <0.1 mg N/L, although a small increase is seen in October measurements (Figure 2-21(e)). The October measurements also show that nitrate+nitrite reached concentrations of 0.3 mg N/L or greater in three separate years of monitoring (each point of a given month is a separate year). The lowest concentrations occur in the spring, particularly in April and May when measurements are near zero. In many systems this is the time of spring diatom blooms that would reduce inorganic nitrogen concentrations.

For total phosphorus, the monthly average concentrations suggest a slight maximum in summer and a minimum in late winter (Figure 2-21(f)). However, the relatively high variability of the measurements during the spring, summer, and fall may not support this visual analysis of the averages. During the three seasons, measurements tend be around 0.005 mg P/L or lower, but several measurements in each month have higher concentrations. The only months with relatively low variability are February and March.

Ortho phosphate concentrations are generally around 0.003 mg P/L or less. They show no apparent trends in monthly averaged concentrations or in the measurements, although it could be said that the maximum measurements in April, May, and June are the smallest for all the monthly measurements (Figure 2-21(g)).

Chlorophyll a measurements range widely except during the summer and winter months (Figure 2-20(h)). The largest measured values (>0.6 mg/m^3) occurred in late winter through spring and in October, although the monthly average tended to be around 0.3 mg/m^3 without any clear seasonal trend.

As part of the testing program for the radial collector wells, FPL collected a surface sample from Biscayne Bay for analysis of conventional and priority pollutants (FPL 2009-TN1263). The sampling station was located at north latitude 25° 26’ 15.2132” and west longitude 80° 19’ 35.6518”, which is 1 mi north of the proposed location of the radial collector wells. Typical wet chemistry constituents (such as TDS, alkalinity, sodium, potassium, calcium, and magnesium) were analyzed and reported. Other constituents (radiological, metals, chlorinated herbicides, organophosphorus pesticides, volatile organic compounds, organochlorine pesticides, and polychlorinated biphenyls [PCBs]) were analyzed for potential effects from effluents and drift from the cooling towers. Of these other constituents, strontium was measured at 9.84 mg/L, radium 226 was measured at 0.5±0.1 pCi/L, endosulfan I was detected at 0.00247 ug/L, Heptachlor was detected at 0.00691 ug/L 0.00152, and acetone was measured at 18.3 ug/L.[1]

(1) Based on experience with acetone, a laboratory solvent, the review team determined that the acetone measurement may reflect some sample contamination.

Subsequent to publication of the draft EIS, in accordance with the Administrative Order (FDEP 2014-TN4144), FPL is required to maintain an annual average salinity of no more than 34 psu in the IWF. This is a decrease in salinity from recent years. Some of the water used to freshen the IWF could come from the L-31E Canal. Water in the L-31E Canal could add other constituents including nutrients to the IWF. Any withdrawal of water from the L-31E Canal would decrease the total freshwater flow into Biscayne Bay.

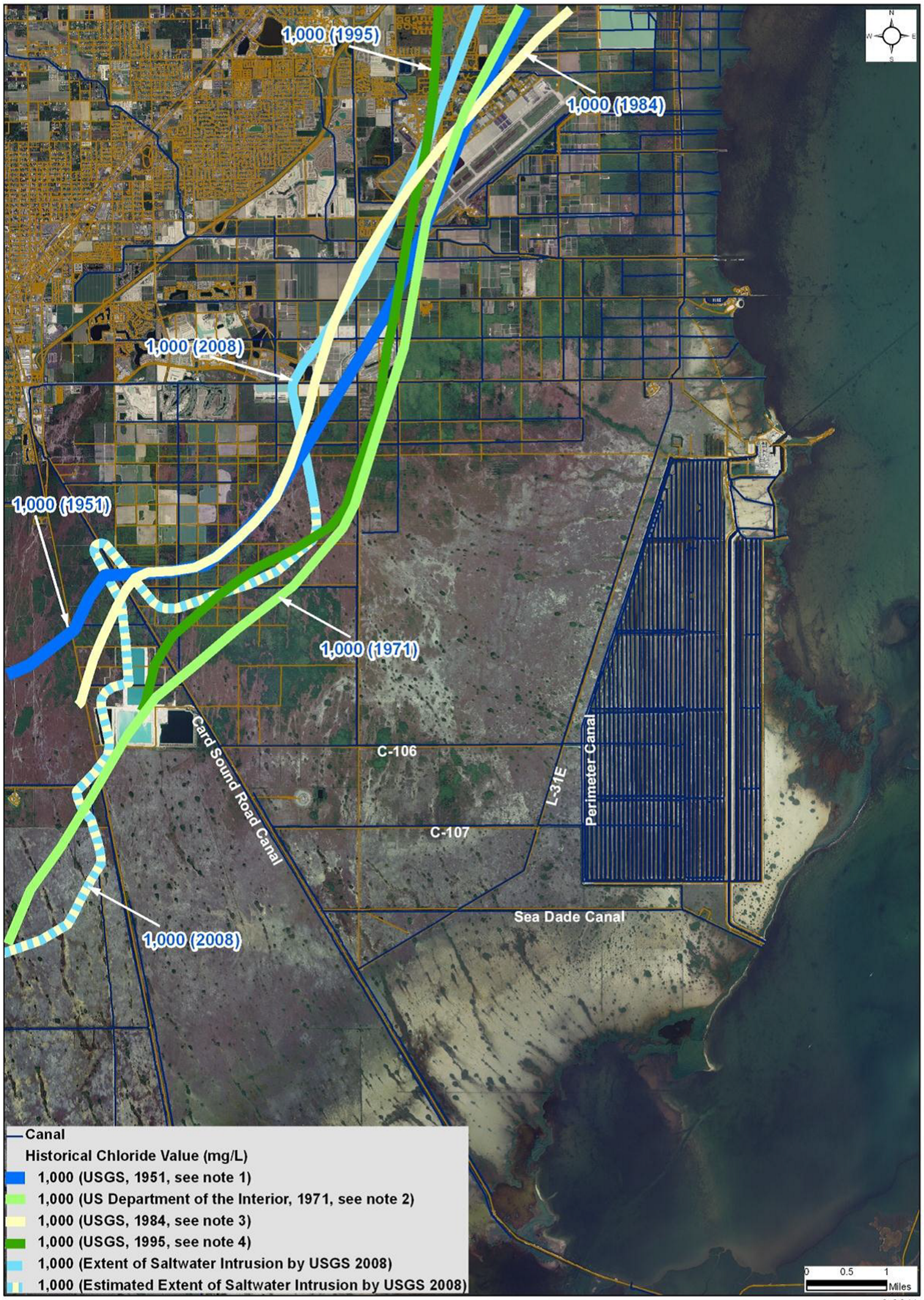
2.3.3.2 Groundwater Quality

The State of Florida has conducted an extensive characterization of the background water quality in the major aquifer systems (Renken et al. 2005-TN110). Groundwater quality in the vicinity of the Turkey Point site has also been assessed in support of FPL's Units 3 and 4 Uprate Project (FPL 2012-TN3439). Because of high salinity, groundwater in the vicinity of Turkey Point is not used as a drinking water source (FPL 2014-TN4058). The Biscayne aquifer at Turkey Point extends beneath Biscayne Bay and is in hydraulic communication with the water of the bay. Saltwater has migrated inland along the base of the inland portion of the aquifer in this area in response to the lowering of inland groundwater levels.

Saltwater intrusion into the inland portion of the Biscayne aquifer has occurred over a large area of the Southeast Florida coast including the Turkey Point site. Figure 2-22 shows the estimated extent of saltwater intrusion in the area at different times since 1951. Estimates of saltwater intrusion for Southeast Florida for 2011 are similar to the 2008 extent shown in Figure 2-20 above (Prinos et al. 2014-TN4569). This study also uses tritium measurements to illustrate that west of the site, salinity intrusion is due in part to westward migration of the hypersaline plume from the CCS. Differences in these estimated extents may be caused by changes in the number of available observation points as well as the degree of saltwater intrusion. The most important factors contributing to the regional intrusion of saltwater from the ocean into the aquifer are rerouting of sheet flow to drainage canals and groundwater pumping (Klein and Hull 1978-TN1351; Renken et al. 2005-TN110). Under natural conditions and with adequate inland recharge of freshwater, the aquifer water table is higher than the average sea-level elevation to balance the higher density of seawater. When the aquifer water table is lowered by pumping or canal drainage, the saltwater begins to move inland, usually at the base of the aquifer because of its higher density. Drainage canals without control structures drain freshwater from inland areas and also provide a conduit for seawater to flow inland at high tide and infiltrate the aquifer. Figure 2-23 shows canals and existing control structures in relation to the estimated extent of saltwater intrusion in 1996. Saltwater movement through the aquifer responds to inland groundwater levels with low groundwater levels resulting in inland and upward migration of saltwater and high groundwater levels resulting in seaward and downward movement of the saltwater plume.

The ER lists groundwater quality indicator parameters (temperature, pH, dissolved oxygen, specific conductivity, turbidity, and oxidation-reduction potential) for 12 observation wells completed in the Biscayne aquifer (FPL 2014-TN4058).

The State of Florida has conducted an extensive characterization of the background water quality in the major aquifer systems (Renken et al. 2005-TN110). Groundwater quality in the Biscayne aquifer has also recently been assessed to support FPL's Units 3 and 4 Uprate



Note 1: Source: US Department of the Interior. 1973. Resource and Land Information for South Dade County, Florida. Geological Survey Investigation I-850.
Note 2: Source: USGS, 1951. SaltWater Encroachment in Dade County, Florida. Information Circular No 9.
Note 3: Source: USGS, Delineation of Saltwater Intrusion in the Biscayne Aquifer, Eastern Dade County, Florida, 1995.
Note 4: Source: USGS, Delineation of Saltwater Intrusion in the Biscayne Aquifer, Eastern Dade County, Florida, 1995.

8-2011

Figure 2-22. USGS Estimated Extent of Saltwater Intrusion from 1951 to 2008 (FPL 2012-TN3439)

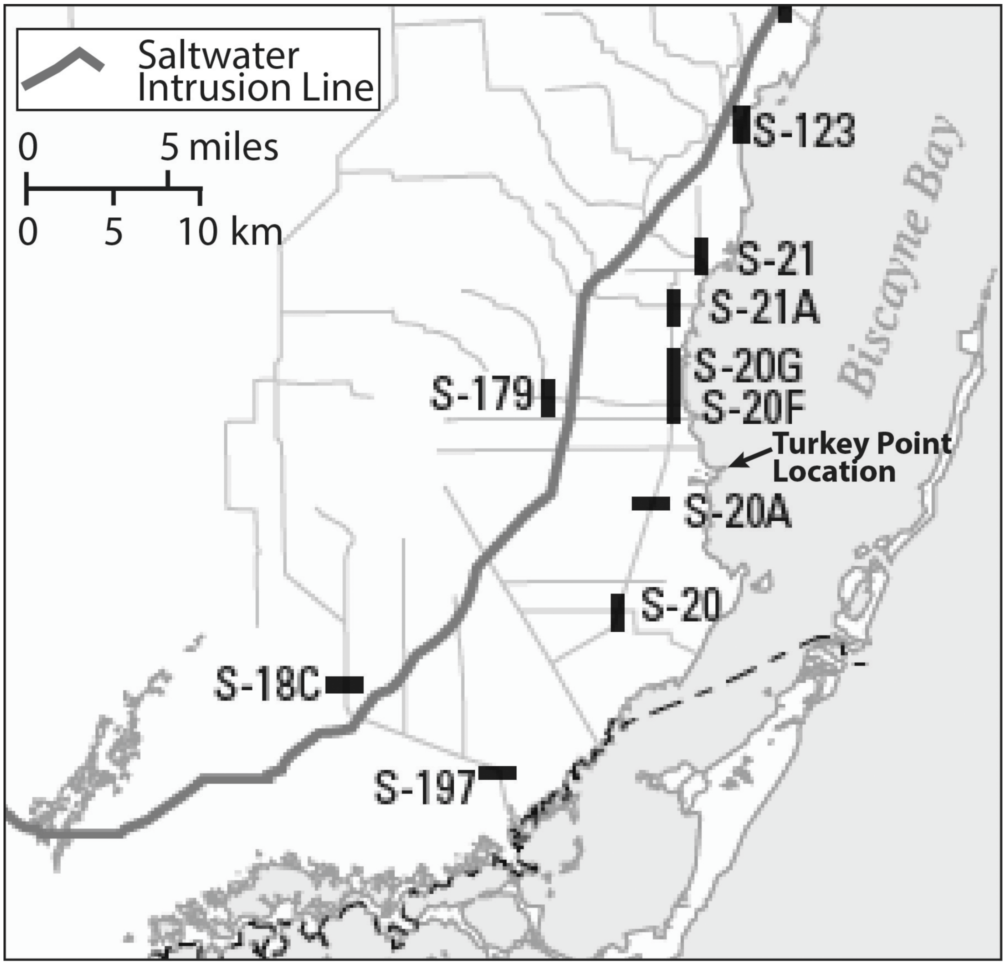


Figure 2-23. Landward Limit of the Saltwater Interface in 1996 and Canal Control Structures (modified from Renken et al. 2005-TN110)

Monitoring Project (FPL 2012-TN3439). The objective of the Uprate Monitoring Project is to better understand the interaction of the cooling canals with Biscayne aquifer and Biscayne Bay. Both tritium and TDS concentrations were found to be elevated in the Biscayne aquifer beneath the cooling canals and in groundwater below the bay adjacent to the cooling canals. Tritium was monitored as a tracer for the cooling-canal water, but is not regarded as a health concern at the observed concentrations (FPL 2012-TN3439). These data show that water in the cooling canals has moved into the Biscayne aquifer groundwater. Water can move from the aquifer into the cooling canals and from the cooling canals into the aquifer at different times depending on seasonal variation in the water table and variations in cooling-canal water levels caused by precipitation, evaporation, or changes in plant discharge. Hydraulic heads in monitoring wells near Biscayne Bay fluctuated in response to tidal cycles indicating a potential for tide-induced flow between the bay, shallow groundwater and the cooling canals in this area of the IWF.

Water quality in the Floridan aquifer system is affected by the degree of confinement, the length of flowpaths from recharge sources, and the proximity and connection to the ocean (Miller 1990-TN550). The Upper Floridan aquifer in southeastern Florida is generally brackish to saline depending on depth and distance from the coast (Reese 1994-TN1439). An average TDS concentration of 5,451 mg/L was reported for the Upper Floridan aquifer in the SCA for Turkey Point Unit 5 (FPL 2003-TN3437). Water in the Boulder Zone has quality similar to seawater and is likely recharged from the ocean based on the water chemistry and the anomalously low temperature of water in the Boulder Zone (Meyer 1989-TN2255). Water quality in the Boulder Zone and within Lower Floridan aquifer confining units has also been affected in some local areas by wastewater injection.

Subsequent to publication of the draft EIS, per the Administrative Order (FDEP 2014-TN4144), FPL is required maintain an annual average salinity of no more than 34 psu in the IWF. The addition of water to freshen the IWF would increase the water surface in the IWF, which would increase downward pressure from the IWF toward the Biscayne aquifer encouraging the (reduced salinity) water in the IWF into the aquifer on top of the existing hypersaline plume.

Also subsequent to publication of the draft EIS, per the Consent Agreement with Miami-Dade County (2015-TN4505), the hypersaline plume that extends beyond FPL's property line will be retracted so that a chlorinity of 19,000 does not extend beyond the property line. Water withdrawn from the hypersaline plume will be injected into the Boulder Zone using an existing underground injection control well. Rehydration of the Model Lands may also be attempted to provide increased hydraulic pressure against any advancement of the hypersaline plume toward the west. Neither an exact design of the system nor an estimate of the time it will take to achieve its goal, relative to construction and operation of Units 6 and 7, is known at this time.

2.3.4 Water Monitoring

Surface-water and groundwater monitoring at and near the proposed site are described below.

2.3.4.1 Surface-Water Monitoring

The SFWMD maintains an extensive database of monitoring stations (SFWMD 2012-TN1320) that includes water quality for Biscayne Bay and selected canals and stage measurements at some Biscayne Bay and canal stations. Figure 2-24 shows the locations of the surface stations from the SFWMD (2012-TN1320) near the IWF cooling canals and in Biscayne Bay. The SFWMD (2012-TN1318) discusses the purpose of the monitoring program for Biscayne Bay (BISC) and indicates that the Miami-Dade County Department of Environmental Resources Management (Miami-Dade County 2014-TN3663) and Florida International University conduct the monitoring of Biscayne Bay.

The NPS has provided the review team additional monitoring data (Figure 2-24) measured in Biscayne Bay (Bellmund 2012-TN4118). The monitoring data include salinity and water depth time series. The stations are located closer to the shoreline than the stations typically monitored by SFWMD and monitor salinity variations as CERP projects are implemented to increase freshwater inflows to Biscayne Bay.

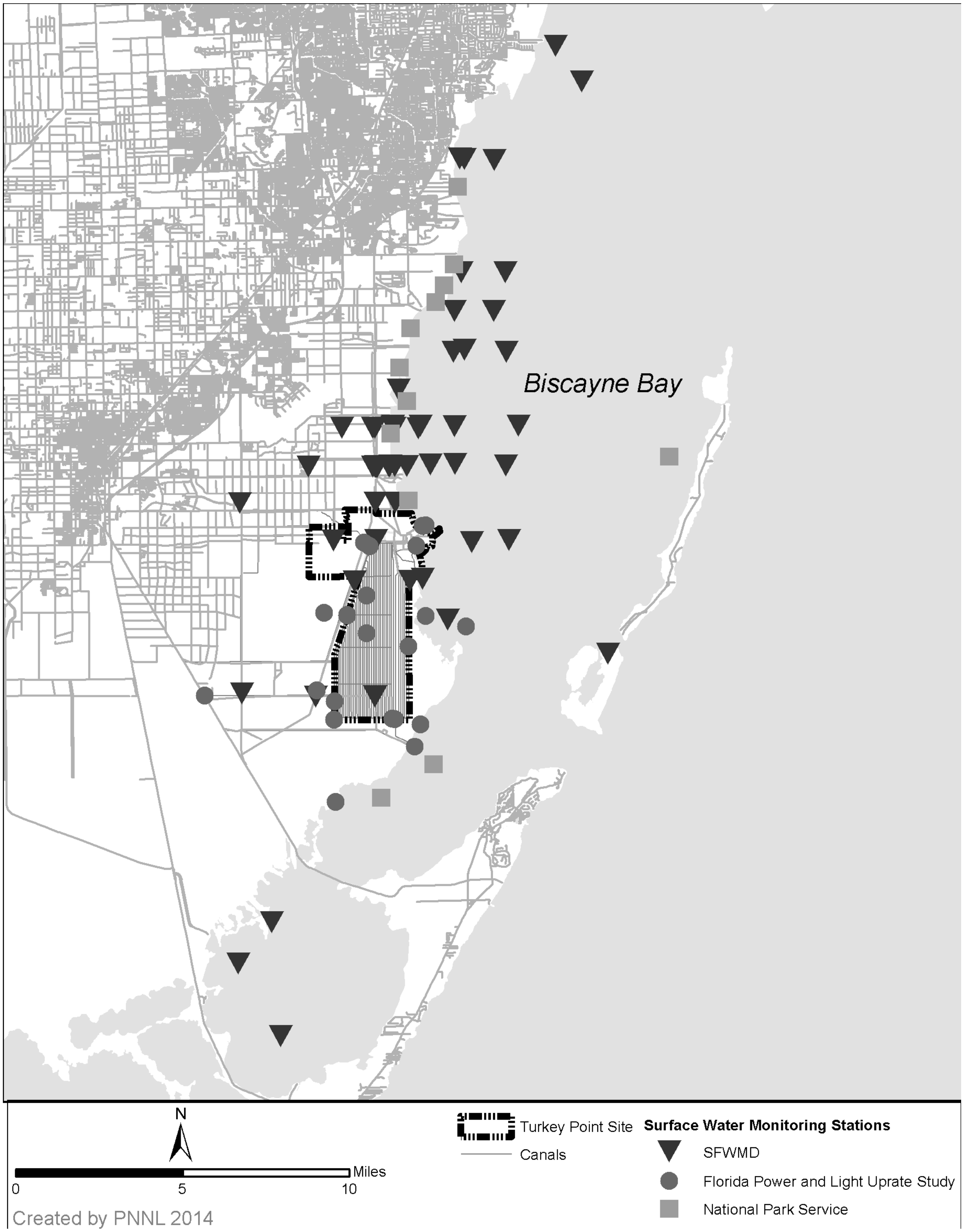


Figure 2-24. Locations of Surface-Water Monitoring Stations from SFWMD (SFWMD 2012-TN1320), the FPL Units 3 and 4 Uprate Project (FPL 2012-TN3439), and NPS (Bellmund 2012-TN4118)

FPL conducted a study of the CCS to evaluate its functioning with additional cooling-water requirements from uprating of Units 3 and 4 (FPL 2012-TN3439). This required monitoring of surface-water and groundwater elevations and water quality to determine the dynamic exchange processes that influence the CCS's functioning. Figure 2-24 shows the locations of the surface-water monitoring stations used for the uprate study (FPL 2012-TN3439). As part of the site certification process for the State of Florida, FPL is conducting a monitoring study of the IWF to evaluate the horizontal and vertical hydrologic exchanges with the surrounding environment. For the study, FPL installed 20 surface-water monitoring stations at locations surrounding the IWF.

Both the Consent Agreement (Miami Dade County v. Florida Power & Light 2015-TN4505) and Administrative Order (FDEP 2014-TN4144) may require additional surface-water monitoring. However, details about the monitoring required are not available at this time.

2.3.4.2 Groundwater Monitoring

Monitoring of groundwater occurs on the Turkey Point site in accordance with existing National Pollutant Discharge Elimination System and industrial stormwater permits associated with existing FPL facilities. Additional groundwater monitoring was performed to support the license application for Units 6 and 7, and to assess the impacts of the IWF cooling canals on groundwater as required by the Florida State Conditions of Certification for FPL's Units 3 and 4 Uprate Project.

Pre-application monitoring of the groundwater system underlying the proposed site for Units 6 and 7 included 10 monitoring well pairs (20 wells) installed in 2008 across the proposed plant area for measuring groundwater levels. Each pair included a well completed in the Miami Limestone/Key Largo Limestone at depths ranging from 14 to 28 ft and a well completed in the Fort Thompson Formation at depths ranging from 85 to 110 ft below ground surface. Water-level data were collected from these wells from June 2008 through June 2010 and are presented in Section 2.3 of the ER (FPL 2014-TN4058).

As discussed in Section 2.3.3.2 above, FPL installed 42 wells in 14 well clusters with monitoring wells completed in the shallow, intermediate, and deep portions of the Biscayne aquifer at each cluster to support FPL's Units 3 and 4 Uprate Monitoring Project (FPL 2012-TN3439). Monitoring well cluster locations are shown in Figure 2-25. Data on water levels and groundwater chemistry have been collected from these wells on an ongoing basis since June 2010 to support the Florida State Conditions of Certification for the proposed uprate of Turkey Point Units 3 and 4. The water quality of Biscayne Bay and the cooling canals and precipitation were also measured. Groundwater level and electrical conductance measurements were collected by an automated system every 15 minutes. And other parameters were measured on a periodic basis. This effort has resulted in automated near-continuous measurements of groundwater electrical conductivity, and periodic measurements of several other parameters, including major ions, nutrients, trace elements, gross alpha, tritium, deuterium, and isotopes of oxygen, strontium, and carbon.

Regional aquifer monitoring data are also routinely collected by the USGS and the SFWMD. Wells currently monitored the within 6 mi of the proposed plant location are shown in Figure 2-26 (USGS 2014-TN3575). Some of these wells are also included in the uprate monitoring well network (Figure 2-25).

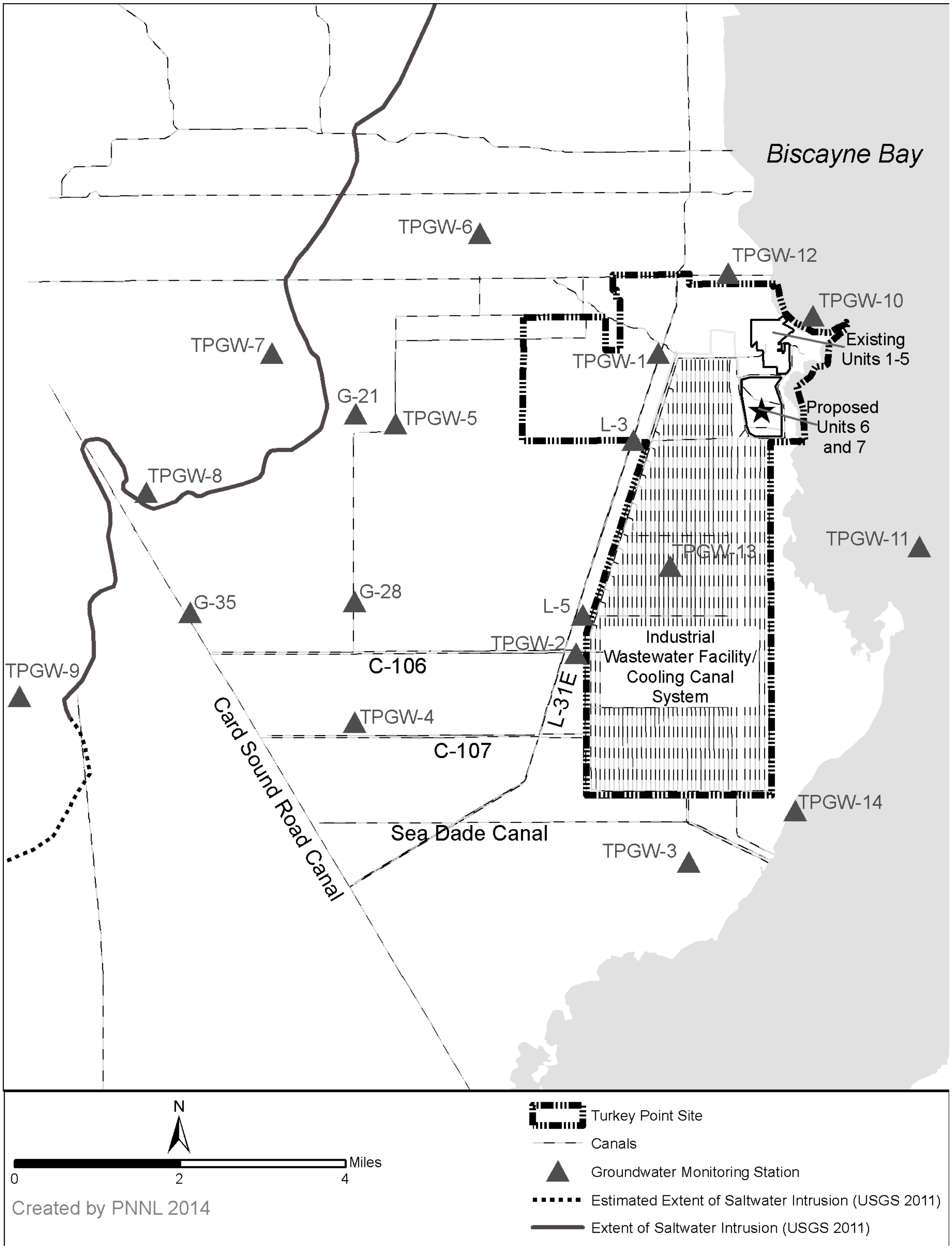


Figure 2-25. Locations of Groundwater Monitoring Well Clusters for the FPL Units 3 and 4 Uprate Project (FPL 2012-TN3439; USGS 2011-TN1801)

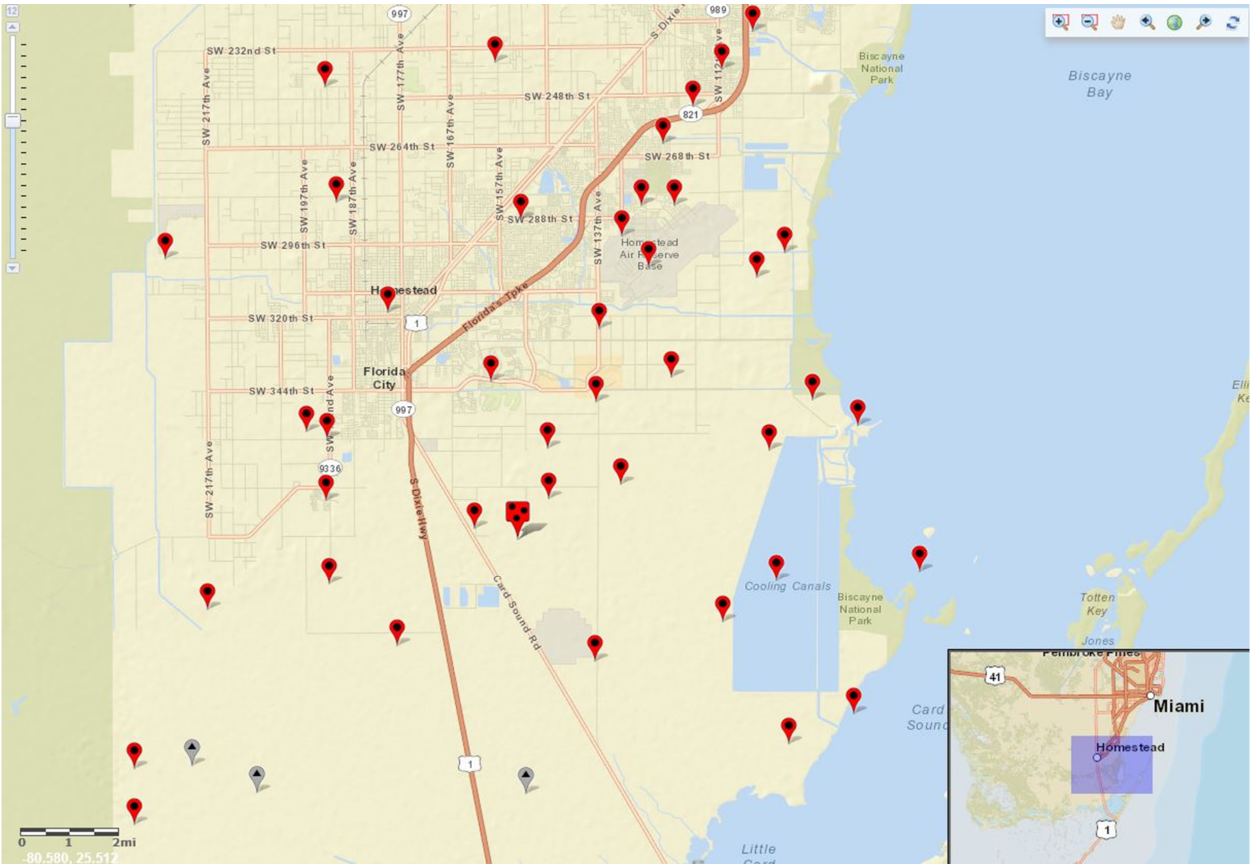


Figure 2-26. USGS Groundwater Monitoring Locations (red markers) within 6 Miles of the Proposed Plant Location (active in April 2014) (USGS 2014-TN3575)

Information from the testing of deep-injection Exploration Well 1 (EW-1) showed that the Upper Floridan aquifer within the Suwanee Limestone and upper part of the Avon Park Formation at the Turkey Point site contains brackish water with TDS concentrations less than 10,000 mg/L. The deeper Avon Park Formation below the MCU contained saline water with TDS concentrations higher that 10,000 mg/L. These intervals will be monitored at all of the deep-injection monitoring wells as part of the requirements of the FDEP Underground Injection Control (UIC) program. Boulder Zone injection interval and the deepest overlying USDW aquifer (Upper Floridan aquifer) monitoring data are required to be submitted to the FDEP on a monthly basis for permitted injection and monitoring wells at wastewater injection sites.

Both the Consent Agreement (Miami Dade County v. Florida Power & Light 2015-TN4505) and Administrative Order (FDEP 2014-TN4144) may require additional groundwater monitoring. However, details about the monitoring required are not available at this time.

2.4 Ecology

This section describes the terrestrial and aquatic ecology of the site and vicinity that might be affected by the design, siting, building, operation, and maintenance of proposed Turkey Point Units 6 and 7. Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from the building, operation, and maintenance of new nuclear power generating facilities and the new transmission line and pipeline rights-of-way. These descriptions support the evaluation of mitigation activities identified during the EIS analyses to avoid, reduce, minimize, rectify, or compensate for potential impacts. Descriptions are also provided to help compare the alternative sites to the proposed Turkey Point site. Monitoring programs for terrestrial and aquatic environments are also described.

2.4.1 Terrestrial and Wetland Ecology

This section identifies terrestrial and wetland ecological resources and describes species composition and other structural and functional attributes of terrestrial biotic assemblages that could be affected by the building, operation, and maintenance of the proposed Turkey Point Units 6 and 7. It also identifies "important" terrestrial species and resources, such as Federally and State-listed plants or wildlife, wildlife sanctuaries and natural areas as defined by the NRC in NUREG−1555 (NRC 2000-TN614) that might be affected by the proposed action. The purpose of this section is to describe current ecological communities and existing conditions. Some of the information presented in this section is based on FLUCFCS codes introduced in Section 2.2. Maps displaying FLUCFCS codes provide useful information about the composition and distribution of terrestrial habitats and wetlands. However, FLUCFCS codes and maps serve primarily to reflect land use and land cover and provide only an approximation of terrestrial habitat. The distribution of FLUCFCS codes indicative of wetlands (the 600-series codes) does not necessarily align with the presence or distribution of jurisdictional wetlands as defined by the USACE.

2.4.1.1 Terrestrial and Wetland Communities of the Site and Vicinity

Turkey Point Site

Turkey Point site is on the western shore of Biscayne Bay, which opens to the Atlantic Ocean. It is in the Mangrove and Coastal Glades physiographic province (McPherson and Halley 1996-TN98). This province occurs along the southern Florida coast in a band that narrows significantly northward from Biscayne Bay. The Mangrove and Coastal Glades province is defined as a broad band of wetlands at or near sea level that is often flooded by tides or freshwater runoff (McPherson and Halley 1996-TN98). The name of this province is derived from its abundance of three species of mangrove trees: black (*Avicennia germinans*), white (*Laguncularia racemosa*), and red (*Rhizophora mangle*). The descriptions of terrestrial habitats provided in this section are derived from different data sources. FLUCFCS maps were used to characterize lands of the Turkey Point property and lands within the 6 mi vicinity. Habitats within the proposed Units 6 and 7 area were characterized during an ecological assessment conducted in 2008 (FPL 2014-TN4058).

The ecology in southern Florida is directly tied to the hydrology and natural seasonal hydrologic fluctuations that occur in this region. Wetlands are the predominant landscape feature of southern Florida. The low and flat elevation, proximity to Biscayne Bay, and high average rainfall result in the predominance of wetlands. Terrestrial land cover on the Turkey Point site is presented in Table 2-2. Land on the Turkey Point site is used primarily for electric power facilities, and facilities for existing Turkey Point Units 1–5 occupy approximately 5,672 ac, composing almost half of the Turkey Point site. Freshwater marsh is the predominant natural land cover on the Turkey Point site.

Wetlands are also the predominant habitat type within the proposed Units 6 and 7 plant area and include mudflats, dwarf mangrove, mangrove heads, open water, canals, and wetland spoil areas (Figure 2-27). Most of the plant area comprises mudflats that are inundated annually for 3 to 4 months and are sparsely vegetated with saltwort (*Batis maritime*), sea-oxeye (*Borrichia frutescens*), wood glasswort (*Salicornia virginica*), and dwarf glasswort (Salicornia begelovii) (FPL 2014-TN4058). Dwarf mangrove habitats contain stunted mangroves of the three species present (black, white, and red), but individual plants are stunted due to high salinities and fluctuating water levels. Mangroves that occupy approximately 12 ac of the proposed Units 6 and 7 plant area are remnant mangrove populations found within historical tidal creeks that were disconnected from Biscayne Bay during previous development; they are known as mangrove heads (FPL 2014-TN4058). Open waters, adjoining cooling canals of the IWF, occupy approximately 8 ac and contain scattered widgeon grass (*Ruppia maritima*) and shoal grass (*Halodule wrightii*) patches (FPL 2014-TN4058). Wetland spoil areas totaling about 9 ac occur adjacent to remnant canals and contain mangrove species as well as buttonwood (*Conocarpus erectus*) and non-native Australian pine (*Casuarina equisetifolia*) (FPL 2014-TN4058).

The proposed project area also contains highly disturbed upland habitats including roadways raised with fill and spoil piles (FPL 2010-TN272). The raised fill areas contain maintained grasses as well as poisonwood (*Metopium toxiferum*), buttonwood, wild sage (*Lantana involucrata*), ground orchid (*Bletia* species), sea grape (*Coccoloba uvifera*), and the exotics Brazilian pepper (*Schinus terebinthifolius*) and Australian pine (FPL 2014-TN4058). Miami-Dade County Code (Part III, Chapter 24, Section 24.49) (Miami-Dade Code of Ordinances 24-49-TN1168) mandates protection of specific native tree species and protections do not include poisonwood, Brazilian pepper, Australian pine, or Melaleuca. Results of a tree survey, that documented all trees with either a diameter greater than 3 in. or a total height greater than 12 ft, indicate over 1,300 individual stems of 43 species of trees occur in survey areas encompassing the project area (FPL 2011-TN1312). Trees generally occur on artificial raised fill areas created by past construction activities that constitute most uplands areas on the site, such as raised roadsides, canal berms, and undeveloped portions of raised areas (FPL 2011-TN1312). FPL tree survey results do not include wetland trees such as buttonwood or the three mangrove species (FPL 2011-TN1312) even though they are defined and protected as such by Miami-Dade County (Miami-Dade Code of Ordinances 24-49-TN1168). Mangroves and other wetland trees are regarded and regulated as wetlands in this EIS.

Land-cover classes in the vicinity of the Turkey Point site are presented in Table 2-3. Most lands within 6 mi are classified as wetlands. Most of the uplands support forest, occupying 23 percent of the nearby landscape. Although much of the forested habitat in the vicinity is dominated by non-native tree species, even these trees provide valuable habitat to local wildlife. Previously disturbed or developed land-use classes within the Turkey Point site vicinity include agriculture and urban development as well as lands classified as “other,” which includes open water and barren land. Although considerable industrial and residential development has occurred within Miami-Dade County, the Turkey Point site is in a relatively undeveloped and rural area where most lands within 6 mi have not been developed into agriculture or urbanized.

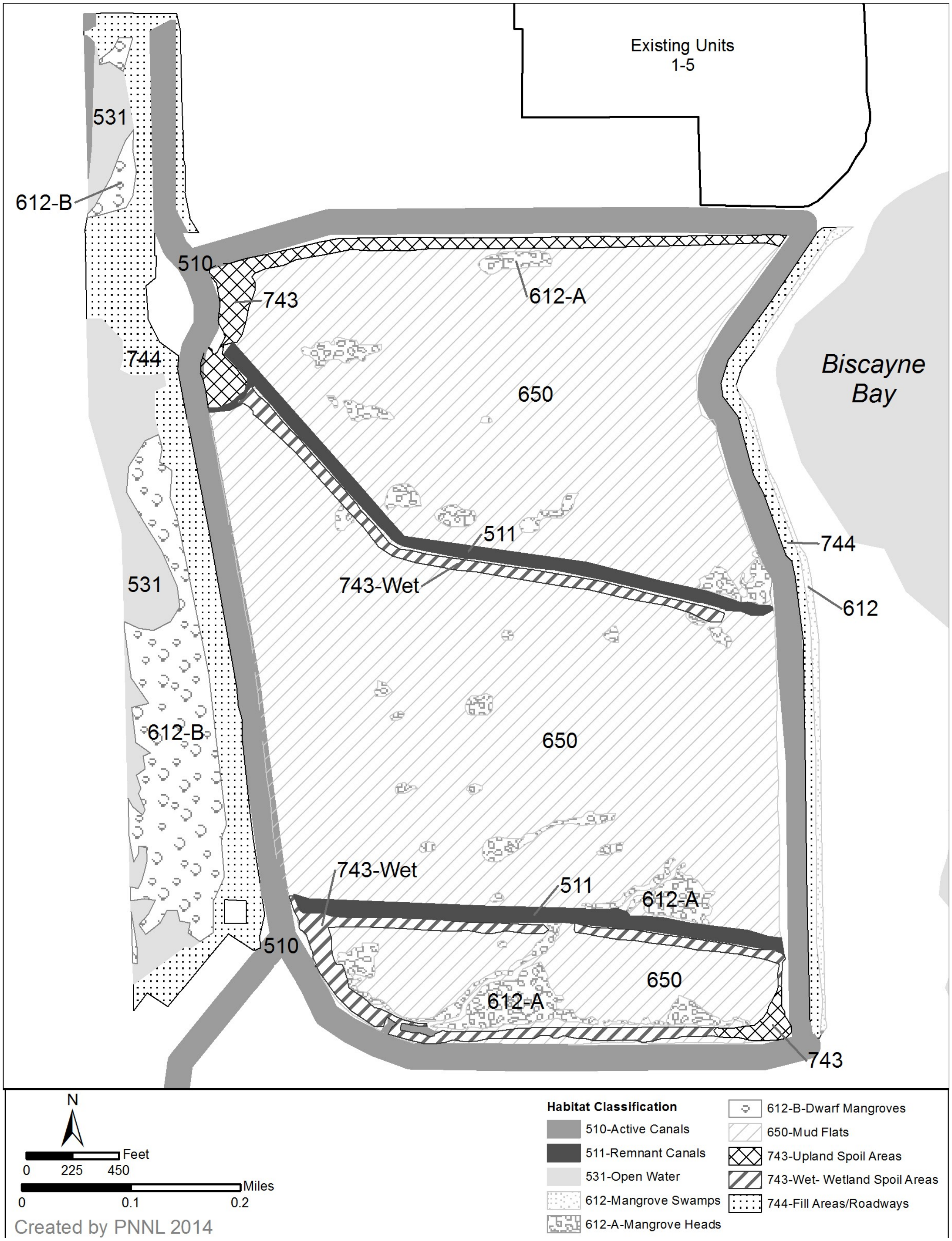


Figure 2-27. Habitat Classification at the Proposed Units 6 and 7 Plant Area (FPL 2014-TN4058)

Wildlife

Ecosystems within South Florida support rich wildlife diversity, including approximately 350 bird, 50 reptile, 40 mammal, and 15 amphibian species (NPS 2015-TN4437). Surveys to characterize wildlife on the Turkey Point site and in the vicinity were conducted in 1972 and in 2005 through 2009 (FPL 2014-TN4058). The most recent surveys included limited pedestrian and vehicular surveys to determine the relative abundance of migratory and resident bird species. Most of the project area was surveyed, including the IWF, the plant area, two mangrove areas immediately north of the plant area, the radial collector well site, the originally proposed reclaimed water-treatment site, and a small portion of the proposed access road west of the IWF (FPL 2009-TN1334).

Wildlife species observed during these surveys were those expected to occur in the types of habitats present in South Florida. Most of the site comprises wetlands, and wetland birds are the predominant fauna. Forty-six species of birds within 11 bird families were observed, 35 of which are commonly associated with wetlands (FPL 2010-TN272). Wading birds (*Pelicaniformes*) are common and abundant on the mudflats and along the canals on the site and include various herons, egrets, and ibis. Shorebirds (*Charadriiformes*) are also strongly represented by sandpipers, plovers, and numerous others (FPL 2010-TN272). Historical data and other observations indicate at least 38 additional bird species have been observed on the site (FPL 2014-TN4058).

During April 2009, surveys were also conducted to determine small mammal, amphibian, and reptile presence and relative abundance within areas that would be disturbed by building proposed Units 6 and 7 (FPL 2009-TN1444). Small mammals were trapped and identified using baited live traps. Reptiles and amphibians were captured using coverboards, minnow traps, and dip nets, and were also recorded during pedestrian searches. Habitats surveyed included marsh, mangrove, and ditches. Reptiles were observed, including the American crocodile (*Crocodylus acutus*), eastern diamondback rattlesnake (*Crotalus adamanteus*), the non-native green iguana (*Iguana iguana*), and an unidentified gecko (*Hemidactylus* sp.). In addition, three species of anole lizards (*Anolis* sp.), the Florida softshell turtle (*Apalone ferox*), and five snake species were observed. Amphibians were also observed, including nine frog species (FPL 2014-TN4058). An eastern narrow-mouthed toad (*Grastrophryne carolinensis*) was found in April 2009 and the southern toad (*Bufo terrestris*) was also observed (FPL 2009-TN1334).

Four mammal species, the cotton rat (*Sigmodon hispidus*), black rat (*Rattus rattus*), raccoon (*Procyon lotor*), and marsh rabbit (*Sylvilagus palustris*), were observed. White-tailed deer (*Odocoileus virginianus*), opossum (*Didelphis virginiana*), and eastern cottontail (*Sylvilagus floridanus*) have also been observed on the Turkey Point site. Although numerous bat species occur in South Florida, no bats were observed in 2009 during a single 2-hour bat survey conducted between mangrove habitat and the existing facilities, and bat distribution and abundance is unknown (FPL 2014-TN4058). As in most areas of South Florida, bats presumably occur within the 6 mi vicinity of Turkey Point.

Immediately to the east and adjoining the boundary of the Turkey Point site is Biscayne National Park, which encompasses approximately 270 mi^2 and includes the mangrove forests along the mainland shoreline, the southern portion of Biscayne Bay, barrier island keys, and the nearshore waters out to approximately 14 mi from the shoreline (NPS 2011-TN103). Biscayne

National Park is recognized for both terrestrial and aquatic resources as well as cultural history, and management of the park is focused on preservation of natural and cultural resources while providing recreation (NPS 2011-TN103). The Everglades National Park, the largest subtropical wilderness in the United States, is approximately 12 mi west of the Turkey Point site. The Everglades National Park encompasses almost 1.5 million ac and is recognized for its rich biological diversity. It has been designated an International Biosphere Reserve, World Heritage Site, and Wetland of International Significance. Management of the Everglades National Park balances the preservation of these resources while providing recreation (NPS 1979-TN104). Extensive canal and levee systems constructed for agricultural purposes have altered surface-water flow and have changed the ecology of South Florida, including Biscayne National Park and Everglades National Park. Goals of the CERP include restoration of the Everglades ecosystem (CEPP 2011-TN107).

2.4.1.2 Terrestrial Resources – Associated Offsite Facilities

Reclaimed Water Pipeline Corridor

Units 6 and 7 would use reclaimed wastewater for cooling purposes and a reclaimed water pipeline would convey this water to the site. The 9 mi long corridor for this pipeline would include a 6.5 mi section that would be installed within the Clear Sky to Davis transmission line corridor. The remaining 2.5 mi would be installed within a new corridor. The 134 ac of land cover within the entire 9 mi corridor that would be affected consists of mostly developed lands and wetlands, including mostly mangrove swamps, mixed wetland hardwoods, and freshwater marsh (Table 2-11).

Table 2-11. Acreage of Land-Cover Classes within the Proposed Units 6 and 7 Offsite Reclaimed Water Pipeline Corridor

FLUCFCS Code[(a)]	Code Description	Acres
166	Holding ponds	0.56
215	Field crops	0.13
241	Tree nurseries	13.29
241-W	Wet tree nurseries	0.16
242	Sod farms	0.02
310	Hebaceous (dry prairie)	1.07
320	Shrub and brushland	0.5
422	Brazilian pepper	0.27
510	Canals	0.98
511	Ditches	0.72
612	Mangrove swamps	17.15
612/619	Mangrove swamps/exotic wetland hardwoods	4.46
612-B	Dwarf mangroves	2.36
617	Mixed wetland hardwoods	10.65
641	Freshwater marshes	7.09
740	Disturbed land	1.68
744	Fill areas (highways and railways)	0.02
814	Roads and highways	55.31
831	Electrical power facilities	9.8
834	Sewage treatment	6.98
835	Solid waste disposal	0.46
	Total	133.66

(a) FLUCFCS = Florida Land Use, Cover, and Forms Classification System.

Potable Water Pipeline Corridor

A potable water pipeline would also be built within a 10 mi long corridor from the MDWASD facility to support the proposed units. This corridor would lie within the footprint of other proposed access roadway improvments and existing roadway medians (FPL 2014-TN4058; FPL 2015-TN4442).

Transmission Line Corridors

FPL has proposed East and West corridors to service proposed Units 6 and 7. Two different routes for the western corridor, the Preferred and the Consensus, have also been proposed. Both the Preferred and Consensus routes are redundant over a substantial portion of their lengths. However, the routes diverge for a portion of the distance between the Clear Sky and Levee substations (Figure 2-5).

The West Preferred corridor between the Clear Sky and Levee substations traverses a landscape of mostly agriculture, wetlands, and open water (Table 2-4) and includes a segment along the eastern boundary of Everglades National Park. Wetland cover types include mostly freshwater marshes, dwarf mangroves, mixed wetland hardwoods, exotic wetland hardwoods, wet prairies, mangrove swamps, and sawgrass. Wetland plant communities in this vicinity have been adversely affected by previous development immediately adjacent to the corridor, including the effects of habitat and hydrologic modifications, increased nutrients, and introduction of exotic plant species (NPS 2015-TN4437). Upland habitats include shrub and brushland along with dry prairie. Two access roads would also be required to access the West Preferred corridor. The route for the Krome Avenue access road traverses freshwater marsh, exotic wetland hardwoods, streams and waterways, and existing roads. Land within the proposed Tamiami Trail access road consists of wetlands and existing roads.

Land within the West Consensus corridor consists mostly of wetlands and includes sawgrass, exotic wetland hardwoods, wet prairie, freshwater marsh, and mixed wetland shrubs. Wetlands here have also been adversely affected by previous development, and exotic plants are abundant in previously disturbed locations (NPS 2015-TN4437). The abundance of non-native and invasive wildlife species would also be expected to be greater in this corridor than in the West Preferred corridor due to its proximity to disturbance from previous development, possibly reducing the overall habitat quality (FWS 2008-TN4438). The West Consensus corridor also contains uplands including dry prairie. Four new access roads would be needed if the west transmission line is built within this corridor. An access near NW 12th Street would occupy rock quarry and agricultural lands. Access to the West Consensus corridor from Tamiami Trail would occur through wetlands composed mostly of exotic wetland hardwoods. Access near the L-31 Canal would occur over or through dikes, levees, and canals. An access road near NW 88th Street would occupy Australian pine cover, freshwater marsh, and exotic wetland hardwoods in addition to small amounts of other land cover. The Levee to Pennsuco segment of both proposed west transmission line corridors is mostly wetlands and previously developed land.

The Clear Sky to Davis segment of the East corridor occupies mostly agriculture land cover. Wetland types are almost exclusively mangrove swamp. Dry prairie is the predominant upland cover. The Davis to Miami segment lies within an urban landscape. No wetlands are present and very little natural cover remains.

In addition to transmission lines, four substations would be modified in support of proposed Units 6 and 7. A new substation, the Clear Sky substation, is also proposed to be constructed on the Units 6 and 7 project area. All existing and proposed transmission facilities are or would be within Miami-Dade County.

2.4.1.3 Important Terrestrial Species and Habitats – Site and Vicinity

This section describes Federally and State-listed, proposed threatened and endangered terrestrial species, candidate species for listing, commercially and recreationally valuable species, species critical for ecological structure and function, and biological indicator species as defined as important by the NRC in NUREG−1555 (NRC 2000-TN614). Designated and proposed critical habitat that may occur in the vicinity of the site is also discussed. Only species with recorded occurrences in Miami-Dade County (FFWCC 2011-TN158; FNAI 2014-TN3668) and species having the potential to occur in Miami-Dade County are discussed (FWS 2012-TN117). Species identified by FPL as being commercially or recreationally valuable are also included in this section (FPL 2014-TN4058).

Federally Listed Species

Thirty-nine terrestrial species listed or proposed to be listed by the U.S. Fish and Wildlife Service (FWS) as Federally threatened, endangered, or candidates for listing as threatened or endangered are known to occur in Miami-Dade County (FWS 2012-TN117). Almost half (18) of this list consists of plants, and the rest of the list includes 12 birds, 2 mammals, a single reptile, and 5 invertebrates (Table 2-12). Other listed species that occur in the aquatic environment, including the American crocodile, are discussed in the aquatic ecology sections.

Table 2-12. Federally Listed Species Known to Occur within Terrestrial Habitats of Miami-Dade County or in the Vicinity of the Turkey Point Site

Common Name	Scientific Name	Federal Status[a,b]	State Status[c]
Plants			
Crenulate lead-plant	*Amorpha herbacea var. crenulata*	LE	SE
Blodgett's silverbush	*Argythamnia blodgettii*	PT	SE
Florida brickell-bush[d]	*Brickellia eupatorioides (mosieri) var. floridana*	LE	SE
Deltoid spurge	*Chamaesyce deltoidea ssp. deltoidea*	LE	SE
Pinelands (spurge) sandmat[d]	*Chamaesyce deltoidea ssp. pinetorum*	C	SE
Garber's spurge	*Chamaesyce garberi*	LT	SE
Cape Sable thoroughwort	*Chromolaena frustrata*	LE	SE
Florida semaphore cactus	*Consolea (Opuntia) corallicola*	LE	SE
Okeechobee gourd	*Cucurbita okeechobeensis ssp. okeechobeensis*	LE	
Florida prairie-clover	*Dalea carthagenensis floridana*	C	SE

Table 2-12. (contd)

Common Name	Scientific Name	Federal Status[a, b]	State Status[c]
Florida pineland crabgrass	*Digitaria pauciflora*	C	SE
Small's milkpea	*Galactia smallii*	LE	SE
Beach jacquemontia	*Jacquemontia reclinata*	LE	SE
Sand flax[d]	*Linum arenicola*	PE	SE
Carter's small-flowered flax	*Linum carteri carteri*	LE	SE
Tiny polygala	*Polygala smallii*	LE	SE
Everglades bully	*Sideroxylon reclinatum ssp. austrofloridense*	C	
Florida filmy or bristle fern	*Trichomanes punctatum ssp. floridanum*	LE	SE
Invertebrates			
Florida leafwing butterfly	*Anaea troglodyte floridalis*	LE	
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	LE	ST
Schaus swallowtail butterfly	*Heraclides [Papilio] aristodemus ponceanus*	LE	SE
Bartram's scrub-hairstreak butterfly	*Strymon acis bartrami*	LE	
Stock Island tree snail	*Orthalicus reses reses*	LT	ST
Miami tiger beetle	*Cicendelidia floridana*	PE	
Reptiles			
Eastern indigo snake	*Drymarchon corais couperi*	LT	ST
Birds			
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	LE	SE
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	LE	SE
Florida scrub jay	*Aphelocoma coerulescens*	LT	ST
Rufa red knot	*Calidris canutus rufa*	LT	
Ivory-billed woodpecker	*Campephilus principalis*	LE	SE
Piping plover	*Charadrius melodus*	LT	ST
Kirtland's warbler	*Dendroica kirtlandii*	LE	SE
Wood stork	*Mycteria americana*	LT	SE
Red-cockaded woodpecker	*Picoides borealis*	LE	SE
Audubon's crested caracara	*Polyborus plancus audubonii*	LT	ST
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	LE	SE
Bachman's warbler	*Vermivora bachmanii*	LE	SE
Mammals			
Florida bonneted bat	*Eumops floridanus*	LE	ST
Florida panther	*Puma (=Felis) concolor coryi*	LE	SE

(a) Federal status: confirmed 1/14/2014; (FWS 2014-TN2918). State status confirmed 1/14/2014; FNAI 2014-TN3668).
(b) Federal Status: LE = Federal endangered; LT = Federal threatened; C = Federal candidate.
(c) State status: FE = Federally designated and endangered; PE = Federally proposed endangered; FT = Federally designated threatened; PT = Federally proposed threatened; SE = State endangered; ST = State Threatened; blank = no status. All Federally listed species that occur in Florida are not included on the State of Florida's list as Federally designated species in addition to the State listing process (FFWCC 2011-TN158)
(d) Species detected in surveys of plant site and/or transmission line corridor right-of-way (Tables 2.4-1 and 2.4-4 in the ER) (FPL 2014-TN4058)

Source: FWS 2014-TN2918

Terrestrial species listed as endangered or threatened under the Federal Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. § 1531 et seq.) (TN1010) are under the jurisdiction of the FWS. The staff has prepared a biological assessment of the Federally listed threatened and endangered terrestrial plant and animal species that potentially could occur at or near Turkey Point site (Appendix F).

<u>Plants</u>

<u>Crenulate Lead-Plant (*Amorpha herbacea var. crenulata*)</u>. This Federally and State-listed endangered species is found in eight sites within Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). The plant is a deciduous shrub that occurs in seasonally hydrated soils and in areas subject to frequent burning. It is found specifically in marl prairies (flatlands with marl over limestone substrate that are seasonally inundated) and wet pine rocklands (flatlands with exposed limestone substrate) (FWS 1999-TN136). FPL indicated this species was observed within the vicinity of the Turkey Point Property (FPL 2011-TN1374) and it is known to occur in six conservation areas near the Turkey Point site, although none occur within 6 mi of the site (Gann et al. 2012-TN137). It was not observed during survey of the transmission line corridors. Plant surveys were not conducted offsite within the potable water corridor or reclaimed water corridor. Land-cover classification indicates suitable habitat may not be present at these locations.

<u>Blodgett's Silverbush (*Argythamnia blodgettii*)</u>. This species is proposed as Federally threatened and is also a State-listed endangered species within Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). It is a forb that occurs in sunny gaps and edges in pine rockland, rockland hammock, and coastal berm habitats (FNAI 2000-TN139). This spurge is found in 18 conservation areas in Miami-Dade and Monroe counties (Gann et al. 2012-TN137), including Biscayne National Park and Everglades National Park, which are adjacent to the Turkey Point site (FNAI 2012-TN1445). FPL acknowledged this species has been observed in the vicinity of the Turkey Point property (FPL 2011-TN1374) although it was not observed within the transmission line corridors during a ground survey, conducted following freezing weather, of a pine rockland between SW 300 and 304 Streets. Ground surveyors acknowledged this species has the potential to occur within this rockland (FPL 2009-TN657). It is unknown if it occurs at other offsite facilities as plant surveys were not conducted within the potable water corridor or reclaimed water corridor but land-cover classification information indicates suitable habitat may not be present at these locations.

<u>Florida Brickell-Bush (*Brickellia eupatorioides [mosieri] var. floridana*)</u>. This plant is a Federally and State-listed endangered species found within Miami-Dade County (79 FR 52567 [TN4068]; FNAI 2014-TN3668). The Florida brickell-bush is a forb that inhabits pine rocklands with an open shrub layer, exposed limestone, and minimal leaf litter (FNAI 2000-TN139). It is endemic to the Miami Rock Ridge and has been observed in the vicinity of the Turkey Point property (FPL 2011-TN1374) and within transmission line corridor rights-of-way associated with proposed Turkey Point Units 6 and 7 (FPL 2014-TN4058). Critical habitat for this species has been designated within and adjacent to proposed transmission line corridors for Units 6 and 7 (80 FR 49845) (TN4493). Occurrence within the potable water corridor or reclaimed water corridor is unknown because there were no surveys conducted at these locations. Land-cover classification information indicates habitat suitable for this species may not be present at these locations.

Deltoid Spurge (*Chamaesyce deltoidea ssp. deltoidea*). This Federally and State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668) is a perennial forb endemic to Miami-Dade County and occurs in areas with open shrub canopy, exposed limestone, and minimal litter. It is most often associated with the edges of sand pockets; the plants grow both in sand and on oolitic limestone (Gann et al. 2012-TN137). Deltoid spurge is found in 10 conservation areas in Miami-Dade County north and west of the Turkey Point site (Gann et al. 2012-TN1322). FPL indicated deltoid spurge has been observed in the Turkey Point property vicinity, and habitat preferences indicate berms within the IWF created with limestone fill may provide suitable habitat. However, plant surveys were not conducted within the IWF. Surveys were also not conducted within the potable water corridor or reclaimed water corridor so occurrence at these locations is unknown. This species was not observed within the transmission line corridors.

Pineland Sandmat (*Chamaesyce deltoidea ssp. pinetorum*). This plant is proposed as a Federally threatened species and is also a State-listed endangered species that occurs within Miami-Dade County (79 FR 52567 [TN4068]; FNAI 2014-TN3668). It is a perennial forb found in pine rocklands with scattered shrubs and exposed limestone (FNAI 2000-TN139). It is endemic to South Florida and has been observed in the vicinity of the Turkey Point property (FPL 2011-TN1374) as well as in the transmission line corridor rights-of-way associated with proposed Turkey Point Units 6 and 7 (FPL 2014-TN4058). It has not been observed within any of the other offsite facility locations, but no surveys were conducted within the other offsite facilities. Land-cover classification information indicates suitable habitat may not be present at the other offsite facility locations.

Garber's Spurge (*Chamaesyce garberi*). This plant is a Federally listed threatened species and a State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). The plant is a short-lived, perennial forb. It requires open sunny areas where frequent fires have maintained an open canopy. It has been found in the following four habitats: beach dune, coastal rock barren, hammock edge, and pine rockland (FWS 2007-TN3529). Garber's spurge is present in Everglades National Park west of the Turkey Point site (Gann et al. 2012-TN137). It is not known to occur within the proposed Units 6 and 7 plant area, the vicinity of the Turkey Point property, the transmission line corridors, and potable and reclaimed water corridors. However, a ground survey of a pine rockland between SW 300 and 304 Streets along the west transmission line corridor was done following freezing weather and ground surveyors acknowledged Garber's spurge has the potential to occur along the west transmission line corridor (FPL 2009-TN657). Disturbed upland habitats can be found at many proposed facility locations. Suitability of these uplands as habitat for Garber's spurge is unknown.

Cape Sable Thoroughwort (*Chromolaena frustrata*). This plant is a Federally listed endangered species that is found at rockland hammock edges, in coastal rock barrens, and in the ecotone between buttonwood hammock and coastal hardwood hammock (78 FR 63796) (TN4628). It does not occur in disturbed habitats (FWS 2010-TN1323). The Cape Sable thoroughwort is not known to occur within any of the proposed onsite or offsite project locations. Land-cover information does indicate hammock habitats are not present within any of the proposed locations, so the thoroughwort's unique habitat requirements likely preclude its occurrence within project areas.

Florida Semaphore Cactus (*Consolea [Opuntia] corallicola*). This cactus is a Federally listed endangered species and a State-listed endangered species within Miami-Dade County (FWS 2012-TN117; (78 FR 63796) (TN4628); FNAI 2014-TN3668). It is found in the buttonwood zone between rockland hammocks and coastal swamps (FNAI 2000-TN139). It was historically known to occur on coastal berms. It is not known to occur within the proposed Units 6 and 7 plant area but it has been recorded in Biscayne National Park (Gann et al. 2012-TN137). It also has not been observed at any offsite facilities, although surveys were limited to proposed transmission line corridors.

Okeechobee Gourd (*Cucurbita okeechobeensis ssp. okeechobeensis*). A Federally listed endangered species in Miami-Dade County (FWS 2012-TN117), this vine was locally common in pond apple (*Annona glabra*) forests that were formerly present within the region. The plant grows in swamps and wet soils along rivers and lakes; it appears to require fluctuating water levels where high water allows for seed dispersal and seeds germinate when water levels decline. Plants were seen north of Homestead in an agricultural area in 1965 (FWS 1999-TN136), but more recently the species appears to be restricted to nine sites in Glades and Palm Beach Counties (Gann et al. 2012-TN137). Okeechobee gourds have not been observed within any of the proposed project areas, on- or offsite. They have been observed growing in mowed power-line rights-of-way (FWS 1999-TN136), and land-cover information indicates the proposed transmission lines will cross through extensive wetland habitats. Wetland habitats also exist within the proposed potable water pipeline corridor and reclaimed water pipeline corridor (FPL 2014-TN4058). The occurrence of the Okeechobee gourd at any of these sites is unknown.

Florida Prairie-Clover (*Dalea carthagenensis floridana*). This plant is a Federally listed candidate species and a State-listed endangered species within Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). It is a shrub that inhabits pine rocklands, edges of rockland hammocks, coastal uplands, and marl prairies (FNAI 2000-TN139). Currently, there are only nine known populations (76 FR 66370) (TN1011), many of which are found on conservation lands north and west of the Turkey Point site, including Everglades National Park (Gann et al. 2012-TN137). The Florida prairie-clover was not observed within any of the proposed project sites. Suitable habitat is likely not present within the project sites within the Turkey Point property, and FPL determined the probability that this plant would occur within the Turkey Point vicinity was low (FPL 2011-TN1374). Offsite plant surveys were conducted within pine rocklands within proposed transmission line corridors, and those sites selected were remnant pine rocklands that would likely represent the most suitable habitats for the Florida prairie-clover.

Florida Pineland Crabgrass (*Digitaria pauciflora*). This plant is a Federally listed candidate species and a State-listed endangered species within Miami-Dade County. This grass species is endemic to South Florida where it is found in marl prairie and pine rockland habitats. Currently, it is found only in the Big Cypress National Preserve and Everglades National Park (Gann et al. 2012-TN137). FPL reported Florida pineland crabgrass was observed in the vicinity of the Turkey Point property (FPL 2011-TN1374). It has not been reported to occur within any of the offsite project areas including within selected pine rockland habitats along proposed transmission line corridors. Land-cover classification information indicates suitable habitat may not be present within the proposed Units 6 and 7 plant area and potable and reclaimed water pipeline corridors.

Small's Milkpea (*Galactia smallii*). This plant is a Federally and State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). Small's milkpea is a small, perennial legume with small purple flowers and a prostrate habit. The plant occurs in the pine rocklands of southern Miami-Dade County, and in 2007 it was only known at two sites near Homestead (FWS 1999-TN136). A 1994 survey found the plant at seven conservation areas, and it may occur in two additional conservation areas (Gann et al. 2012-TN137). None of these areas are within 6 mi of the Turkey Point site. Small's milkpea was not observed within the proposed Units 6 and 7 plant area as well as at any of the proposed offsite project areas. However, conditions during ground survey of a pine rockland between SW 300 and 304 Streets within the west transmission line corridor was done following freezing weather. Ground surveyors acknowledged Small's milkpea has the potential to occur within a pine rockland between SW 300 and 304 Streets within the west transmission line corridor (FPL 2009-TN657).

Beach jacquemontia (*Jacquemontia reclinata*). This Federally and State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668) is a member of the morning glory family. It is restricted to beach coastal strand and maritime hammock habitats (FWS 1999-TN136) and requires open areas generally found on the crest and lee side of stable dunes. It is also found in disturbed openings in maritime hammocks, coastal strand, and coastal scrub habitat (FWS 1999-TN136). Fewer than 500 plants are known from nine sites, all of which are more than 6 mi from the Turkey Point site (FNAI 2000-TN139). Beach jacquemontia was not observed within any of the proposed project areas, although only limited surveys were conducted in selected habitats along the transmission line corridors. Land-cover classification information indicates suitable habitat is likely not present within any of the project areas.

Sand flax (*Linum arenicola*). A proposed Federally endangered species and a Florida State endangered species found in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668), this forb is found in pine rockland, marl prairie, and adjacent disturbed areas (FNAI 2000-TN139). Sand flax occurs in Homestead Bayfront Park, which is less than 1 mi north of the Turkey Point site boundary (FNAI 2000-TN139). FPL also noted sand flax was observed in the vicinity of the Turkey Point site (FPL 2011-TN1374). Sand flax was also observed during survey of selected rockland habitats associated with the proposed transmission line corridors, and suspected as occurring within a pine rockland between SW 300 and 304 Streets along the west transmission line corridor (FPL 2009-TN657). It was not observed within any of the other proposed project areas offsite, but ground surveys for plants were not conducted at these locations.

Carter's Small-Flowered Flax (*Linum carteri* var. *carteri*). This Federal and Florida State endangered species in Miami-Dade County (79 FR 52567 [TN4068]; FNAI 2014-TN3668) is an annual herb found in pine rockland habitat. It is found in several conservation areas north of the Turkey Point site (Camp Owaissa Bauer, Deering Estate at Cutler, R. Hardy Matheson Preserve, and Rockdale Pineland) (Gann et al. 2012-TN137). Although it was not observed during ground surveys of the proposed transmission lines (FPL 2009-TN657), ground surveyors acknowledged it has the potential to occur within a pine rockland between SW 300 and 304 Streets within the west transmission line corridor. Critical habitat for this species has been designated within and adjacent to proposed transmission line corridors for proposed Units 6 and 7 and includes 11.2 ac within an FPL utility corridor (80 FR 49845) (TN4493). FPL also confirmed it was observed in the vicinity of the Turkey Point site (FPL 2011-TN1374). The occurrence, distribution, and abundance of Carter's small-flowered flax within the potable and reclaimed water pipeline corridors are unknown.

Tiny Polygala (*Polygala smallii*). The tiny polygala is a short-lived forb that is a Federally and State-listed endangered species found in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). The only known populations occur in sand pockets of pine rocklands, open sand pine scrub, slash pine, high pines, and well-drained coastal spoil. Within these habitats it requires high light levels and open sand with little to no organic litter. As of 2007, there were only 11 known populations of tiny polygala all of which are found within about 6 mi of the Atlantic Coast (FWS 1999-TN136). FPL noted this species has been observed in the vicinity of the Turkey Point property (FPL 2011-TN1374). It was not observed growing within the proposed transmission line corridors (FPL 2009-TN657). The occurrence of the tiny polygala at any of the other proposed offsite facility locations is unknown.

Everglades Bully (*Sideroxylon reclinatum ssp. austrofloridense*). A Federally listed candidate species within Miami-Dade County (FWS 2012-TN117), the Everglades bully is a thorny shrub that is endemic to Miami-Dade County. It is found in marl prairie and pine rockland habitats, and in several conservation areas to the west of the Turkey Point site (Lucille Hammock and Frog Pond/L-31 N Transition Lands) as well as in Everglades National Park (Gann et al. 2012-TN137). The Everglades bully was not observed growing in the Turkey Point property vicinity or within selected pine rockland habitats within the proposed transmission line corridors. Occurrence of this species at other proposed facility locations is unknown.

Florida Bristle Fern (*Trichomanes punctatum ssp. floridanum*). This fern is a Federally and State-listed endangered species within Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). It is found in rockland hammocks, sinkhole habitats (Gann et al. 2012-TN137), and on tree trunks that are in deep shade (NatureServe 2010-TN140). Although it has been documented in eight conservation areas in Miami-Dade County and historically occurred in Everglades National Park (Gann et al. 2012-TN137), there are currently only six small known populations, including four in Miami-Date County (80 FR 60439) (TN4492). The Florida bristle fern has not been observed within the proposed transmission line corridors and its occurrence at other proposed facility locations is not expected.

Invertebrates

Florida Leafwing Butterfly (*Anaea troglodyta floridalis*). A Federally listed endangered species in Miami-Dade County (79 FR 47222) (TN3726), the Florida leafwing butterfly lives in pine rocklands of Long Pine Key in the Everglades National Park that contain the larval host plant, pineland croton (*Croton linearis*) (78 FR 49878) (TN2844). A single adult Florida leafwing was observed in the Navy Wells Pine Rockland that lies in the vicinity of the west transmission line corridors as recently as 2008 (78 FR 49878) (TN2844) and major portions of this land parcel has been designated as critical habitat for this species (79 FR 47180) (TN3727). However, it is only known to occur in Long Pine Key in Everglades National Park and is not known to occur within any of the proposed project areas. The proposed East transmission line corridor borders another rockland fragment located on SW 152nd Street that has been proposed as Florida leafwing critical habitat for almost one-half mile. In addition, the pineland croton was observed growing in a pine rockland fragment (King's Highway rockland) found within a segment of all proposed west transmission line corridors between SW 300 and 304 Streets, and SW 202 and 204 Avenues (FPL 2009-TN657).This land parcel was originally proposed as critical habitat but was ultimately not designated as such (79 FR 47180) (TN3727).

Miami Blue Butterfly (*Cyclargus thomasi bethunebakeri*). This butterfly is a Federally listed endangered species and a State-listed endangered species within Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). Primarily a coastal species, the Miami blue inhabits tropical coastal hammocks, scrub, and pine rocklands (Daniels 2005-TN141). The butterfly relies on the pods of balloonvine (*Cardiospermum corindum*) and yellow nicker (*Caesalpinia bonduc*) as its primary larval hosts, and also possibly love-in-a-puff (*Cardiospermum halicacabum*). The butterfly now only occurs within the boundaries of Bahia Honda State Park on Bahia Honda Key in the Lower Florida Keys (Daniels 2005-TN141). Invertebrate surveys have not been conducted at any proposed project locations, so the occurrence of this butterfly at those locations is unknown. Pine rockland habitats exist within the proposed transmission line corridors.

Schaus Swallowtail Butterfly (*Heraclides aristodemus ponceanus*). This butterfly is a Federally and State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). Schaus swallowtail butterflies historically occurred in hardwood hammocks from South Miami to Lower Matecumbe Key, Florida (FWS 1999-TN136). The species is currently known to occur in 13 areas on the mainland and the Upper and Middle Keys since reintroduction efforts between 1995 and 1997. The males prefer trails and hammock edges while the females more often fly within the hammock, occasionally venturing out to feed on flowers but typically staying within the hammocks proper. The species rarely feeds in areas open to direct sunlight. Schaus swallowtail butterfly uses torchwood (*Amyris elemifera*) and wild lime (*Zanthoxylum fagara*) to deposit its eggs. Torchwood is also the primary source of food for the Schaus butterfly (FWS 1999-TN136). Invertebrate surveys have not been conducted at any proposed project locations, so the occurrence of this butterfly at those locations is unknown. Hammock habitats can still be found in the vicinity of Turkey Point and the proposed transmission line corridors, but they are small remnants in widely scattered in a highly fragmented landscape.

Bartram's Scrub-hairstreak Butterfly (*Strymon acis bartrami*). A Federally listed endangered species in Miami-Dade County (79 FR 47222) (TN3726), the hairstreak is found in pine rockland habitats (NatureServe 2010-TN140) in forest openings (Opler et al. 2012-TN142). Bartam's hairstreak is known to occur on Long Pine Key in the Everglades National Park and is sporadically observed within pine rockland fragments near the Everglades National Park border including the Navy Wells and Richmond Pine Rocklands (78 FR 49878) (TN2844). The larval host plant is the pineland croton (*Croton linearis*); adults feed on nectar from the flowers of the narrow-leafed croton and shepherd's needle (*Scandix pectenveneris*) (Opler et al. 2012-TN142). Pineland croton was observed within a pine rockland known as the King's Highway Pineland along the west transmission line corridor (FPL 2009-TN657), and this pine rockland fragment has been designated as critical habitat for Bartam's scrub-hairstreak (79 FR 47180) (TN3727). The proposed East transmission line corridor also borders designated critical habitat for this species. A rockland fragment located on SW 152nd Street borders an existing transmission route that would be expanded for almost one-half mile. Another rockland fragment designated as critical habitat lies immediately adjacent another existing transmission line corridor northeast of the Davis substation. The occurrence of Bartram's scrub-hairstreak at this location or any other proposed location is unknown, as invertebrate surveys have not been conducted at this or other proposed project locations.

Stock Island Tree Snail (*Orthalicus reses reses*). This snail is a Federally listed threatened species and a State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). This species has two subspecies, *O. r. reses* is listed and *O. r. nesodryas* is not. This arboreal snail inhabits the hardwood hammocks of the Florida Keys (FWS 1999-TN136). The snails historically occurred on Stock Island and Key West, but appear to have been extirpated from their historic range. Snails have been introduced by snail collectors to areas outside of their historic range including Key Largo and the southernmost parts of the mainland. The Stock Island tree snail survives best in hammocks with smooth-barked native trees that support relatively large amounts of lichens and algae. The snails lay their eggs in a cavity dug into the soil humus, usually at the base of a tree (FWS 1999-TN136). Invertebrate surveys have not been conducted at any proposed project locations, so the occurrence of the Stock Island tree snail at any of the proposed project locations is unknown. Hammock habitats can still be found in the vicinity of Turkey Point and the proposed transmission line corridors, but they are small remnants widely scattered in a highly fragmented landscape.

Miami Tiger Beetle (*Cicendelidia floridana*). The Miami tiger beetle is a pine rockland obligate species proposed to be Federally listed as endangered (80 FR 79533) (TN4578). This species was believed to be extinct until its rediscovery in 2007 (Brzoska et al. 2011-TN4494). These tiger beetles are very habitat specific in that they are only found in open sand microhabitat within pine rocklands of the Miami Rock Ridge. The historic distribution of this species is also believed to be restricted to the Miami Rock Ridge because pine rocklands here are the only ones that provide pockets of open, sandy microhabitat. The northern end of the Miami Rock Ridge stretches approximately from the city of North Miami Beach south to SW 216th Street (80 FR 79533) (TN4578). Currently Miami tiger beetles are known to occur in two locations, one being within four contiguous parcels within the Richmond Pine Rocklands complex. The second location is undisclosed, but is a pine rockland within urbanized south Miami near the Richmond Pine Rockland complex (80 FR 79533) (TN4578). The overall population size of this species is exceptionally small. The Richmond Pine Rocklands complex borders SW 137th Avenue and Coral Reef Drive near their intersection. Approximately 0.46 mi of the proposed East transmission corridor also borders the Richmond Pine Rockland complex near this intersection.

Reptiles

Eastern Indigo Snake (*Drymarchon corais couperi*). A Federally and State-listed threatened species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668), the eastern indigo snake is a large, black, non-venomous snake found primarily in upland habitats (FWS 1999-TN136). They have also been found in pinelands, tropical hardwood hammocks, and mangrove forests. The eastern indigo snake needs a mosaic of habitats to complete its annual cycle. In extreme South Florida (the Everglades and Florida Keys), eastern indigo snakes are found in tropical hardwood hammocks, pine rocklands, freshwater marshes, abandoned agricultural land, coastal prairie, mangrove swamps, and human-altered habitats (FWS 1999-TN136). Although the snake was previously observed within the EMB south of the IWF in 2004 and just south of

SW 344th Street/Palm Drive in 1982 (FPL 2014-TN4058), it was not observed during recent surveys of the Turkey Point site (FPL 2011-TN94). Eastern indigo snakes were also observed at two locations within the eastern transmission line corridor in 2011 (FPL 2012-TN1446). No road-killed eastern indigo snakes were observed during a year of monitoring in the vicinity of the western transmission corridors and the NPS determined the probability of occurrence within the vicinity of the corridor was low (NPS 2015-TN4437). Use of a wide range of habitats by this species makes it possible that it occurs at offsite locations. Occurrence of this snake within the potable water pipeline corridor and reclaimed water pipeline corridor is unknown.

American crocodile (*Crocodylus acutus*). See Section 2.4.2 for information about the American crocodile and the American alligator.

Birds

Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*). A Federally and State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668) and a bird of conservation concern (FWS 2008-TN4438), this medium-sized sparrow has a range that is restricted to the southern Florida peninsula (FWS 1999-TN136; FWS 2010-TN256). They are non-migratory residents of freshwater to brackish marshes of the Everglades region of Miami-Dade and Monroe counties. Their preferred nesting habitat appears to be a mixed marl prairie community that often includes muhly grass (*Muhlenbergia filipes*). The birds tend to avoid tall, dense, sawgrass-dominated communities and sites with permanent water cover (FWS 1999-TN136).

The species includes six subpopulations and the total estimated population is approximately 2,900 individuals (FWS 2010-TN256). Critical habitat designated for this species includes suitable habitat contained within five polygons that range in size from 4,800 to 39,000 ac that are south and west of the Turkey Point site. No Cape Sable seaside sparrows were observed during surveys at the Turkey Point site or the transmission line rights-of-way (FPL 2014-TN4058). Their well-known distribution and ecologically narrow habitat preference of this species very likely excludes the potential for this species to occur at any of the proposed project areas, as land-cover classification information indicates suitable habitat is not present.

Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*). This bird is a Federally and State-listed endangered species as well as a bird of conservation concern (FWS 2008-TN4438). Although listed by the FWS as occurring in Miami-Dade County, this species appears to be restricted to inland counties on the Florida peninsula and would not be expected to be found in Miami-Dade County (FWS 2012-TN284; FNAI 2000-TN139). Therefore, it is not expected to occur onsite or at any of the proposed offsite project locations.

Florida Scrub Jay (*Aphelocoma coerulescens*). This bird is a Federally and State-listed threatened species. Although listed by the FWS as occurring in Miami-Dade County, distribution information indicates the Florida scrub jay occurs in peninsular Florida, but only in counties north of Miami-Dade (FWS 2012-TN285). Therefore, it is also not expected to occur onsite or at any of the proposed offsite project locations.

<u>Red Knot (*Calidris canutus rufa*)</u>. The red knot is a Federally threatened species (78 FR 60024) (TN3199) and a bird of conservation concern (FWS 2008-TN4438). As of 2008, the *rufa* subspecies is thought to have three biogeographically distinct populations, one of which winters in the Southeast United States including Georgia, South Carolina, and Florida (FWS 2013-TN3202). During the winter of 1993-1994 the Florida Fish and Wildlife Conservation Commission (FFWCC) evaluated wintering shorebird distribution and abundance along the entire coast of Florida. It determined the most important shorebird wintering areas in Florida are along the Gulf Coast and there are no important sites for wintering shorebirds along the Atlantic Coast of Miami-Dade County (Sprandel et al. 2000-TN3203). Like other shorebirds, red knots winter in Florida primarily along the central Gulf Coast and that is where survey efforts are focused (FWS 2013-TN3202; FWS 2012-TN146; Niles et al. 2008-TN143). Approximately 550 red knots were observed during the winter of 2007-2008 along a portion of the west coast of Florida between Anclote Key and Cape Romano (Niles et al. 2008-TN143). More than 3,000 red knots were counted in Florida in 2006, and more than 1,000 were counted again in 2011 (FWS 2013-TN3202). A single red knot was observed during March 2009 in the vicinity of the existing CCS (FPL 2009-TN1334). Red knot migration flight has been observed to be very long, and includes flight over the open ocean directly to South America from coastal Massachusetts. However, during migration red knots can occur at suitable habitats all along the coast (FWS 2013-TN3202) and could be expected to occasionally occur in small numbers at the Turkey Point site.

Habitats used by red knots in winter include coastal beaches, tidal mudflats, salt marshes, and peat banks; they also use mangrove and brackish-water lagoons (FWS 2012-TN146). Roosting habitat that provides areas above the highest tides that is free from excessive human disturbance may also be important. Beach habitat along the east border of the Turkey Point property could be suitable for wintering red knots, and the proposed Units 6 and 7 plant area could also provide mudflat habitat suitable for foraging or roosting. Suitable habitat is not present at any of the offsite locations.

<u>Ivory-Billed Woodpecker (*Campephilus principalis*)</u>. Although this species was once believed to be extinct, its status has been revised to a Federally endangered species and would therefore be considered a Florida State-listed endangered species (see footnote “c” of Table 2-12). Although listed by the FWS as occurring in Miami-Dade County, distribution information indicates these woodpeckers do not occur in Florida (FWS 2012-TN286). Therefore, ivory-billed woodpeckers are not expected to occur onsite or at any of the proposed offsite project locations.

<u>Piping Plover (*Charadrius melodus*)</u>. A Federally and State-listed threatened species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668), the plover is a small, migratory shorebird that breeds only in three geographic regions of North American (FWS 1999-TN136). Piping plovers do not breed in Florida, but individuals from all three breeding populations do winter there and have been observed in Miami-Dade County. Their winter habitats include beaches, mudflats, and sandflats as well as barrier island beaches and spoil islands. Piping plovers seem to prefer landforms that provide tidal flats for foraging and open beaches for roosting within close proximity of each other. The migration pattern of piping plovers is not well documented, but birds should appear in Florida any time after late July through September and leave from late February to early April (FWS 1999-TN136). The piping plover is not known to occur on the Turkey Point property, and no piping plovers were seen during surveys of the Turkey Point site or the transmission line rights-of-way (FPL 2014-TN4058). Although the

piping plover has not been observed on the Turkey Point property, FPL acknowledged the probability of occurrence in the vicinity is moderate (FPL 2011-TN1374). The FFWCC has determined that piping plovers may occur within the proposed project area and have the potential to be affected (FFWCC 2012-TN520), and the proposed Units 6 and 7 plant area could provide suitable mudflat habitats for wintering piping plovers. Land-cover classification information indicates it is unlikely suitable habitat for the piping plover exists within the potable and reclaimed water pipeline corridors.

Kirtland's Warbler (*Dendroica kirtlandii*). This bird is a Federally listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). The warbler nests in a relatively small area of central Michigan and migrates south to the Bahamas in winter. Its migratory pattern brings it to the east coast of Florida in spring and fall. Migrating Kirtland's have been observed in a variety of habitats including woodlands, scrub, fencerows, and vegetated yards. They appear to prefer dense vegetation less than 1.5 m in height (FWS 1999-TN136). Sightings in Florida have occurred between late April and early May, and early September and late November. No Kirtland's warblers were observed on surveys of Turkey Point site or the transmission line rights-of-way and this species is not known to occur on any of the onsite of offsite project areas (FPL 2014-TN4058). Preference of a range of low shrub habitats including landscaping in urbanized areas indicates suitable habitat may exist at offsite facilities but is not present within proposed onsite locations.

Wood Stork (*Mycteria americana*). This large, long-legged wading bird is a Federally and State-listed threatened species in Miami-Dade County (79 FR 37077 [TN4039]; FNAI 2014-TN3668). It breeds in South Florida (FWS 1999-TN136) using a variety of wetlands including freshwater and estuarine habitats for nesting, roosting, and foraging (FWS 1997-TN225). Wood storks typically construct their nests in medium to tall trees that occur in stands either in swamps or on islands surrounded by relatively broad expanses of open water and often reuse colony sites many years. Wood storks have abandoned colony locations when water-management practices removed surface water from beneath nesting trees that afforded protection from land-based predators. During the non-breeding season, wood storks occur in a wide variety of wetland habitats including freshwater marshes, stock ponds, shallow, seasonally flooded roadside or agricultural ditches, narrow tidal creeks, or shallow tidal pools (FWS 1999-TN136). Foraging occurs in almost any shallow, open water where prey items become concentrated (FWS 1997-TN225).

Wood storks do not nest at the Turkey Point site but have been observed there as recently as June 2008 using shallow portions of the IWF to forage and roost during winter (FPL 2014-TN4058). Three storks were also observed using shallow wetlands of the mangrove area immediately west of the proposed Units 6 and 7 plant area. Wood storks nest in four colonies within 5 mi of the proposed Turkey Point-Levee transmission line corridors including a major colony within Everglades National Park (FPL 2012-TN2043). The distance from the nearest colony (3b Mud East) to the proposed West Preferred corridor is approximately 1,576 ft. The distance from the proposed West Consensus corridor to the Tamiami East 1 colony is approximately 1,237 ft (NPS 2015-TN4437). Wood stork colony use varies among years, and is related to hydrologic conditions and food availability (FWS 1999-TN136). Although in some years no storks may nest at any of these colonies, nesting was observed at one or more of them during 4 out of every 5 years (Table 2-13). Although there is no designated critical habitat for the wood stork, the FWS Southeast Florida Ecological Services Office recognizes a 0.47 mi (0.76 km) nest colony buffer and an 18.6 mi (29.9 km) core foraging area buffer around all known wood stork colonies that have had active nests within the last 10 years in South Florida (FWS 2010-TN226). None of the Turkey Point site occurs within the designated core foraging area for any wood stork colony (FWS 2014-TN3732). Portions of both the east and west transmission lines do intersect the core foraging areas of nine wood stork colonies (FPL 2012-TN2043). Impacts on suitable habitats within either of these buffer zones would require mitigation depending on the impact level (FWS 2010-TN226).

Table 2-13. Number of Nests at Wood Stork Colonies Located near the Proposed West Transmission Corridors from 1992–2011 (from NPS 2015-TN4437)

Year	Tamiami East 1	Tamiami East 2	Tamiami West (Coopertown)	3B Mud East
1992	20-150	0	30-100	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	150-180	0
1997	0	0	20-220	0
1998	0	0	0	0
1999	50	0	75-1374	0
2000	400	0	0	0
2001	0	0	1,400	0
2002	0	0	200-450	0
2003	0	0	20-400	0
2004	0	0	50	130
2005	0	0	5-110	20
2006	0	0	150-400	15
2007	0	0	50-75	0
2008	0	0	0	0
2009	10	20	240-1300	7
2010	15	30	650	0
2011	0	0	100-600	0

Red-Cockaded Woodpecker (*Picoides borealis*). This woodpecker is a Federally and State-listed threatened species. Although listed by the FWS as occurring in Miami-Dade County, distribution information indicates this species is not known to occur in Miami-Dade County and would not be expected to occur at or in the vicinity of any of the proposed project locations (FWS 2012-TN287).

Audubon's Crested Caracara (*Polyborus plancus audubonii*). A Federally and State-listed threatened species in Miami-Dade County (FWS 2012-TN117), the caracara is a resident, diurnal, and non-migratory species that occurs in Florida and parts of the southwestern United States. The Florida population commonly occurs in dry or wet prairie areas with scattered cabbage palms (*Sabal palmetto*) or in lightly wooded areas. Caracaras prefer to nest in cabbage palms surrounded by open habitats with low ground cover and a low density of tall or shrubby vegetation. Observation and radio-telemetry suggest there are three congregation areas in south-central Florida: one along the Kissimmee River north of SR-98, one north of

US-27 in Glades County, and one in the vicinity of Eagle Island Road in northern Okeechobee County (FWS 1999-TN136). This species is not known to occur at any of the proposed project locations and no caracaras were observed during surveys of the Turkey Point site or along transmission line rights-of-way (FPL 2014-TN4058). Suitable habitat is not present within the proposed Units 6 and 7 plant area or within the Turkey Point property. It is unknown if suitable habitat is present at any of the proposed offsite locations.

Everglades Snail Kite (*Rostrhamus sociabilis plumbeus*). This Federally and State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668) is a subspecies of a wide-ranging New World raptor found primarily in lowland tropical freshwater marshes in Central and South America. In the United States it is restricted to peninsular Florida in the watersheds of the Everglades, lakes Okeechobee and Kissimmee, and the upper St. Johns River. The Everglade snail kite was first listed as endangered in 1967 when the entire population was estimated to number in the dozens. Populations estimates approached 300 individuals in the late 1970s (Sykes 1979-TN4040), and 1,000 individuals in 1994 (FWS 1999-TN136). Recent Everglade snail kite population modeling indicates the population may have peaked at approximately 3,500 individuals in the late 1990s (Martin 2007-TN4041). More recently, the entire Florida population was dramatically decreasing in size and last estimated to number approximately 700 individuals in 2008 (Reichert et al. 2011-TN2467; NPS 2015-TN4437). Most of the Florida lands occupied by Everglade snail kites are located north and west of the proposed project areas. Lowland freshwater marsh habitat is present within much of the West Preferred corridor and Everglade snail kite nesting has also been previously observed along the section of the West Preferred corridor that lies along the east Everglades. During 2010–2012, at least 14 snail kites were observed by the FFWCC from the L-31 Levee where the preferred transmission line corridor would be built, including nests within 1,000 ft of both the Preferred and Consensus corridors (FFWCC 2013-TN2339; NPS 2015-TN4437). The FFWCC observed 31 snail kite nests during this same time frame immediately north in Water Conservation Area 3B that is bordered by the West Preferred route. Snail kite nests within Water Conservation Area 3B tend to be located along existing canals and kites forage across the local landscape (Reichert et al. 2011-TN2467). Snail kite nesting here represents one of few areas where successful nesting has occurred within the southern portion of the snail kites range (FFWCC 2013-TN2339). A snail kite was also observed within the EMB adjacent to the Turkey Point site (FPL 2014-TN4058). FWS-designated critical habitat for the snail kite exists in western Miami-Dade County beginning about 22 mi west of the Turkey Point site. None of the proposed project areas occurs within FWS-designated critical habitat. The FWS has also established a snail kite consultation area that includes much of southern Florida. Although Turkey Point site is excluded from this consultation area, major portions of the west transmission route lie within this designated area (FWS 2003-TN227). Land-cover classification information indicates freshwater marsh habitat also exists within the potable water pipeline corridor, and reclaimed water pipeline corridor. Suitability of these habitats for the Everglades snail kite is unknown.

Bachman's Warbler (*Vermivora bachmanii*). This bird is a Federally listed endangered species in Miami-Dade County (FWS 2012-TN117). Bachman's warbler breeds in the southeastern United States and winters in western Cuba and the Isle of Pines (FWS 1999-TN136). There are no breeding records for Florida where this species is an early spring and fall transient.

Bachman's warbler has not been observed in Florida since 1977 and not anywhere in the United States since 1988 (FWS 1999-TN136). Migratory records of this species are scarce, especially since their rapid decline in the early 1990s; as a result, habitat information is almost nonexistent. It is not expected to occur at any of the proposed project locations due to its apparent extirpation from the U.S.

<u>Mammals</u>

<u>Florida Bonneted Bat (*Eumops floridanus*)</u>. This bat is a Federally listed endangered species that was originally proposed for listing as an endangered species in 2012 (77 FR 60750 [TN2276]; FWS 2012-TN117) and subsequently listed in October 2013. It is also a Florida State-listed endangered species within Miami-Dade County (FNAI 2014-TN3668). The bat is a year-round resident and roosts in palms and hollow trees, and may also use building roofs covered with Spanish tiles (FNAI 2000-TN139). They forage high in the air over natural and man-made landscapes (FNAI 2000-TN139). Florida bonneted bat calls were recorded near Homestead, Florida (FWS 2011-TN147), along the L-31 Canal in the vicinity of the West Preferred corridor, and at Zoo Miami located in the vicinity of the East Preferred corridor (78 FR 61004 [TN2659]; NPS 2015-TN4437) indicating this species is known to occur in highly urbanized landscapes in eastern Miami-Dade County. Very little is known about the distribution and abundance of this bat at any of the proposed project locations, but FPL acknowledged the Florida bonneted bat has been observed in the Turkey Point vicinity (FPL 2011-TN1374). All proposed project sites lie within the FWS Florida bonneted bat consultation area. Most of the proposed west transmission corridors and a portion of the east transmission corridor also occur within the FWS Florida bonneted bat focal area. Species consultation areas are used to determine whether formal consultation is required for a listed species, and specific guidance is provided in focal areas for making effect determinations provided in Appendix L. Suitable habitat (palms, hollow trees, and buildings roofed with Spanish tiles) does not appear to be abundant in the landscape around much of the project areas. Palms planted for landscaping are present around existing facilities within the Turkey Point site and may be more abundant where transmission line corridors, such as the Davis to Miami section of the East corridor, pass through previously developed residential and industrial areas.

<u>Florida Panther (*Puma concolor coryi*)</u>. This subspecies of the mountain lion is a Federally and State-listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). A small population of 100 to 160 individuals in South Florida represents the only known remaining wild population of this subspecies (FFWCC 2010-TN3438). The panther presently occupies one of the least-developed areas in the eastern United States; a contiguous system of large private ranches and public conservation lands in Broward, Collier, Glades, Hendry, Lee, Miami-Dade, Monroe, and Palm Beach Counties totaling more than 809,400 ha. The largest contiguous tract of panther habitat is in the Big Cypress Swamp/Everglades physiographic regions south and west of the proposed project areas. Telemetry surveys indicated panthers use a mosaic of habitats and although they prefer upland and wetland forested habitats during daylight hours, they also use grassland/prairie and, marsh-shrub, and agricultural habitats (Kautz et al. 2006-TN3440; Land et al. 2008-TN4439). Understory thickets of tall, almost impenetrable, saw palmetto (*Serenoa repens*) have been identified as important denning cover for panthers. The FWS recognizes much of Miami-Dade County and South Florida as a Florida Panther Focus Area (FWS 1999-TN136). Although most of the FPL Turkey

Point site lies outside of the focus area, lands immediately adjacent to the south and west are contained within the focus area and are also considered to be within the panther's primary zone (FWS 2007-TN230). No confirmed panther occurrences have been recorded within the proposed reclaimed and potable water pipeline corridors on the Turkey Point property (FPL 2014-TN4058). Radio-collared panthers have been recorded near both routes of the proposed west transmission line corridor between the Clear Sky and Levee substation locations, and in October 2013 an adult and kitten were observed traveling east along the corridor approximately 2 mi west of the Turkey Point site boundary in the Model Lands Area (SFWMD 2013-TN2917). A historical Florida panther den was also located near the proposed western transmission line corridor. The FFWCC has determined that the Florida panther may occur within the proposed project area and could potentially be affected (FFWCC 2012-TN520).

<u>Puma (or mountain lion) (*Puma concolor*, all subspecies except *coryi*)</u>. This species is a Federally listed threatened species based on its similarity in appearance to the Florida panther (FWS 2012-TN117). The mountain lion occupies a wide variety of habitats including swamps, riparian woodlands, and broken country with good cover of brush or woodland (NatureServe 2010-TN140). The mountain lion is widely distributed throughout the United States but is not known to occur in Florida. This species will not be considered in further discussion.

<u>Red wolf (*Canis rufus*)</u>. This species is a Federally listed endangered species in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). The red wolf has been extirpated from its former range throughout the southeastern United States; it is not known to exist in Florida and now only exists in one major population in northeastern North Carolina, plus a couple of islands used for propagation (NatureServe 2010-TN140). This species will not be considered in further discussion.

State-Listed Species

The FFWCC is responsible for maintaining lists of rare species in Florida. Southern Florida is a biologically rich area with many endemic species (species naturally occurring nowhere else). In addition to Federally listed species there are 110 plant species (Table 2-14) and 23 animal species (Table 2-15) in Miami-Dade County that the FFWCC has listed as endangered, threatened, or as Species of Concern in addition to those that are also listed as endangered or threatened under the Federal ESA. Of these, FPL acknowledged one reptile, nine birds, a mammal, and 60 plant species were observed within the vicinity of the Turkey Point property (FPL 2011-TN1374). The least tern (*Sterna antillarum*), white-crowned pigeon (*Patagioenas leucocephala*), little blue heron (*Egretta caerulea*), roseate spoonbill (*Platalea ajaja*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), reddish egret (*Egretta rufescens*), and white ibis (*Eudocimus albus*) were previously observed on or adjacent to the proposed Units 6 and 7 plant area at the Turkey Point site (FPL 2014-TN4058). A single Florida burrowing owl (*Athene cunicularia floridana*) was observed once in 2010 along a road within the IWF (FPL 2012-TN1468).

Table 2-14. State-Listed Terrestrial or Wetland Plant Species Occurring in the Vicinity of the Turkey Point Site not Previously Discussed as a Federally Listed Species

Scientific Name	Common Name	State Status	Observed[(a)]	Habitat
Acrostichum aureum	Golden leather fern	ST	X	Brackish and freshwater marshes[(b)]
Adiantum melanoleucum	Fragrant maidenhair fern	SE		Sides of limestone sinks[(b)]
Adiantum tenerum	Brittle maidenhair fern	SE		Moist limestone in rockland hammocks[(b)]
Aeschynomene pratensis	Meadow jointvetch	SE		Marl prairie; cypress domes; swales[(c)]
Aletris bracteata	Bracted colic-root	SE		Marl prairie; pine rockland[(b)]
Alvaradoa amorphoides	Everglades leaf lace	SE		Pine rocklands and transition zones with rockland hammocks
Anemia wrightii	Wright's anemia	SE		Limestone pinnacles; walls of solution holes; pine rockland; rockland hammocks[(c)]
Argusia gnaphalodes	Sea lavender	SE		Beach dunes; coastal thickets[(b)]
Aristolochia pentandra	Marsh's dutchman's pipe	SE		Rockland hammock[(b)]
Asplenium trichomanes-dentatum	American toothed spleenwort	SE		Tropical hardwood hammocks; limestone outcrops; walls of limesinks[(c)]
Asplenium serratum	American bird's nest fern	SE		Cypress swamps; tropical rockland hammocks[(c)]
Asplenium verecundum	Modest spleenwort	SE		Rockland hammock; limestone outcrops, grottoes, and sinkholes
Basiphyllaea corallicola	Rockland orchid	SE		Pine rocklands and rockland hammock[(c)]
Beloglottis costaricensis	Costa Rican ladies'-tresses	SE		Rockland hammock[(b)]
Bourreria cassinifolia	Smooth strongbark	SE		Pine rocklands[(c)]
Brassia caudata[a]	Spider orchid	SE		Rockland hammock[(b)]
Byrsonima lucida	Locustberry	ST	X	Pine rocklands and rockland hammock[(b)]
Calyptranthes zuzygium	Myrtle-of-the-river	SE		Rockland hammocks; coastal berm[(c)]
Catopsis berteroniana	Powdery catopsis	SE		Tropical hammocks; cypress swamps[(c)]
Catopsis floribunda	Many-flowered catopsis	SE		Tropical hammocks; cypress swamps[(c)]

Table 2-14. (contd)

Scientific Name	Common Name	State Status	Observed[a]	Habitat
Chamaesyce deltoidea ssp. adhaerens	Hairy deltoid spurge	SE		Pine rockland[c]
Chamaesyce porteriana	Porter's broad-leaved spurge	SE		Pine rocklands, rockland hammock, coastal rock barrens, marl prairie[c]
Coccothrinax argentata	Florida silver palm	ST	X	Five habitats: coastal berm, coastal strand, maritime hammock, marl prairie, and pine rockland[b]
Colubrina cubensis var. floridana	Cuban snake-bark	SE		Rockland hammocks and pine rocklands[c]
Crossopetalum ilicifolium	Quailberry (Christmas berry)	ST	X	Marl prairie, pine rockland, rockland hammock[b]
Crossopetalum rhacoma	Rhacoma	ST		Coastal berm, coastal strand, pine rockland, rockland hammock[b]
Ctenitis sloanei	Florida tree fern	SE		Rockland hammocks and strand swamp[b]
Cyclopogon elatus	Tall neottia	SE		Rockland hammocks[b]
Cyrtopodium punctatum	Cowhorn orchid	SE		Cypress swamps, coastal hammocks, occasionally pinerocks and marl prairies[c])
Drypetes diversifolia	Milkbark	SE		Rockland hammocks[b]
Eltroplectris calcarata	Spurred neottia	SE		Mesic hammock, rockland hammock[c]
Prosthechea boothiana var. erythronioides	Dollar orchid	SE		Disturbed upland, rockland hammock, tidal swamp[b]
Encyclia cochleata var. triandra	Clamshell orchid	SE		Trunks and branches of pond apple, cypress, live oak, and buttonwood trees in swamps and hammocks[c]
Epidendrum nocturnum	Night-scented orchid	SE		Tree trunks, branches, and stumps in hammocks, swamps, and sloughs[c]
Ernodea cokeri	Coker's beach creeper	SE		Pine rocklands[c]
Eugenia confusa	Tropical ironwood	SE		Rockland hammocks[c]
Eugenia rhombea	Red stopper	SE		Rockland hammocks[c]
Eupatorium villosum	Villose fennel	SE		Pine rocklands, rockland hammocks[c]
Euphorbia pinetorum	Rockland painted-leaf	SE		Pine rocklands[b]
Galeandra bicarinata	Two-keeled helmet orchid	SE		Hammocks[b])

Table 2-14. (contd)

Scientific Name	Common Name	State Status	Observed[a]	Habitat
Glandularia maritima	Coastal vervain	SE		Back dunes, dune swales, coastal hammocks; disturbed, sandy areas[c]
Govenia floridana	Sheathing govenia	SE		Rockland hammocks[b]
Guaiacum sanctum	Lignumvitae	SE		Rockland hammocks[c]
Guzmania monostachia	Fakahatchee guzmania	SE		Swamps and wet hammocks[c]
Harrisia simpsonii	Simpson's prickly apple	SE		Scrubby flatwoods and xeric hammocks on the Atlantic Coastal Ridge[c]
Hippomane mancinella	Manchineel	SE		Coastal berms and hammocks in brackish areas just inland of the mangrove zone[c]
Hypelate trifoliata	White ironwood	SE		Rockland hammocks[c]
Ilex krugiana	Krug's holly	ST	X	Pine rockland, rockland hammock[b]
Ipomoea microdactyla	Wild potato morning glory	SE		Pine rocklands[c]
Ipomoea tenuissima	Rocklands morning glory	SE	X	Pine rocklands[c]
Jacquemontia curtissii	Pineland jacquemontia	ST	X	Disturbed upland, marl prairie, mesic flatwoods, pine rockland[b]
Jacquemontia pentanthos	Skyblue clustervine	SE	X	Bayhead, coastal rock barren, disturbed upland, marl prairie, pine rockland, rockland hammock[b]
Jacquinia keyensis	Joewood	ST		Coastal rock barren, coastal strand, disturbed upland, maritime hammock, pine rockland[b]
Lantana canescens	Small-headed lantana	SE		Transition zones between rockland hammock and pine rockland[c]
Lantana depressa var. depressa	Florida lantana	SE	X	Pine rocklands[b]
Lantana depressa var. floridana	Atlantic Coast Florida lantana	SE		Stabilized dunes of the Atlantic Coast barrier islands and relictual dunes of central Florida[b]
Voyria parasitica	Ghost plant	SE	X	Rockland hammocks, sinkholes[b]
Licaria triandra	Gulf licaria	SE		Rockland hammocks[c]
Linum carteri var. smallii	Small's flax	SE	X	Pine rocklands, pine flatwoods, adjacent disturbed areas[c]
Lomariopsis kunzeana	Holly vine fern	SE		Rockland hammocks, sinkholes[b]
Microgramma heterophylla	Climbing vine fern	SE		Rockland hammocks[b]

Table 2-14. (contd)

Scientific Name	Common Name	State Status	Observed[a]	Habitat
Odontosoria clavata	Wedgelet fern	SE		Pine rocklands, sinkholes, limestone ledges, rocky glades[c]
Okenia hypogaea	Burrowing four-o'clock	SE		Beach dune, disturbed upland[b]
Oncidium floridanum	Florida dancing lady orchid	SE		Rockland hammocks, cypress swamps[c]
Ophioglossum palmatum	Hand fern	SE		"Boots," or old leaf bases, of cabbage palms in maritime hammocks and wet hammocks[c]
Passiflora multiflora	White passion flower	SE		Tropical hammocks[c]
Passiflora sexflora	Everglades Key passion flower	SE		Tropical hammocks[c]
Pavonia paludicola	Mangrove mallow	SE		Disturbed wetland, tidal marsh, tidal swamp[b]
Peperomia obtusifolia	Blunt-leaved peperomia	SE		Rockland hammocks, hydric hammocks, strand swamps[c]
Phoradendron rubrum	Mahogany mistletoe	SE		Rockland hammock[b]
Picramnia pentandra	Bitter bush	SE		Rockland hammocks[c]
Dendrophylax lindenii	Ghost orchid	SE		Dense, wet subtropical to tropical forests and hammocks
Prescotia oligantha	Small-flowered prescotia	SE		Rockland hammock[b]
Prunus myrtifolia	West Indian cherry	ST		Rockland hammock[b]
Pseudophoenix sargentii	Florida cherry-palm	SE		Coastal berm, rockland hammock[b]
Psidium longipes	Mangrove berry	ST		Pine rockland, rockland hammocks[c]
Psychotria ligustrifolia	Bahama wild coffee	SE		Rockland hammock[c]
Pteris bahamensis	Bahama brake	ST	X	Disturbed upland, marl prairie, pine rockland, rockland hammock, sinkholes[b]
Pteroglossaspis ecristata	Giant orchid	ST		Sandhill, scrub, pine flatwoods, pine rocklands[c]
Roystonea elata	Florida royal palm	SE		Rocklands.
Sachsia polycephala	Bahama sachsia	ST	X	Disturbed upland, pine rockland[b]
Sacoila lanceolata var. paludicola	Fahkahatchee ladies'-tresses	ST		Swamps and hydric hammocks[c]
Schaefferia frutescens	Yellowwood	SE		Rockland hammock[b]

Table 2-14. (contd)

Scientific Name	Common Name	State Status	Observed[a]	Habitat
Actinostachys pennula	Ray fern	SE		Bayhead, floodplain forest, mesic flatwoods, rockland hammock[b]
Scutellaria havanensis	Havana skullcap	SE		Disturbed upland, pine rockland[b]
Selaginella eatonii	Eaton's spike moss	SE		Rockland hammocks and pine rocklands[b]
Spiranthes polyantha	Green ladies'-tresses	SE		Rock outcrops in mesic hammock, rockland hammock, maritime hammock[c]
Spiranthes torta	Southern ladies'-tresses	SE		Pine rockland, marl prairie, edges of rockland hammock[c]
Stylosanthes calcicola	Pineland pencil flower	SE		Pine rocklands and marl prairies, especially the transition zones between these two communities[c]
Swietenia mahagoni	West Indies mahogany	ST		Between pine rockland and marl prairie communities[c]
Tectaria fimbriata	Least Halberd fern	SE		Solution holes in limestone in rockland hammocks[c]
Tephrosia angustissima var. angustissima[a]	Devil's shoestring	SE		Pine rocklands[c]
Tephrosia angustissima var. corallicola	Rockland hoary-pea	SE		Pine rocklands[c]
Tephrosia angustissima var. curtissii	Coastal hoary-pea	SE		Scrub and sandy areas[c]
Thelypteris reptans	Creeping maiden fern	SE		Limestone grottoes and sinkholes[c]
Thelypteris sclerophylla	Stiff-leaved maiden fern	SE		Rockland hammock and sinkholes[b]
Thelypteris serrata	Toothed maiden fern	SE		Cypress swamps, sloughs, floodplains[c]
Thrinax morrisii	Brittle thatch palm	SE		Coastal berm, rockland hammock, pine rockland, maritime hammock, disturbed upland[b]
Thrinax radiata	Florida thatch palm	SE		Coastal berm, rockland hammock, pine rockland[b]

Table 2-14. (contd)

Scientific Name	Common Name	State Status	Observed[(a)]	Habitat
Tillandsia flexuosa	Banded wildpine	ST	X	17 habitats: coastal berm, coastal grassland, coastal rock barren, disturbed upland, dome swamp, freshwater tidal swamp, maritime hammock, marl prairie, pine rockland, rockland hammock, sandhill, scrub, shell mound, strand swamp, tidal marsh, tidal swamp, xeric hammock[(b)]
Tragia saxicola	Pineland noseburn	ST	X	Disturbed upland, pine rockland[(b)]
Trema lamarckianum	Lamarck's trema	SE	X	Disturbed upland, pine rockland, marl prairie, rockland hammock[(b)]
Trichomanes krausii	Kraus' bristle fern	SE		Buttressed roots and tree bases in rockland hammocks[(c)]
Trichomanes punctatum ssp. floridanum	Florida filmy fern	SE		Pine rockland[(c)]
Tripsacum floridanum	Florida gamagrass	ST	X	Pine rockland, marl prairie[(b)]
Tropidia polystachya	Young-palm orchid	SE		Rockland hammock[(b)]
Vanilla barbellata	Worm-vine orchid	SE		Mangroves, coastal hammocks, rocky pinelands, island hammocks in the Everglades[(c)]
Vanilla phaeantha	Leafy vanilla	SE		Island hammocks in the Everglades
Zanthoxylum coriaceum	Biscayne prickly ash	SE		Tropical coastal hammocks[(c)]
Zephyranthes simpsonii	Redmargin zephyrlily	ST		Disturbed upland, disturbed wetland, mesic flatwoods, swale, wet flatwoods[(b)]

(a) Species not listed as occurring in Miami-Dade County by the Florida Natural Areas Inventory (2000-TN139). Observed during botanical surveys within proposed transmission line corridor (FPL 2009-TN657).
(b) Gann et al. 2012-TN137
(c) FNAI 2000-TN139

Source: FPL 2014-TN4058

Table 2-15. State-Listed Terrestrial or Wetland Animal Species Occurring in the Vicinity of the Turkey Point Site Not Previously Discussed as a Federally Listed Species

Scientific Name	Common Name	State Status[(a)]	Observed[(b)]	Habitat[(c)]
Reptiles				
Gopherus polyphemus	Gopher tortoise	ST		Dry upland habitats, including sandhills, scrub, xeric oak hammock, and dry pine flatwoods; also disturbed habitats such as pastures, oldfields, and road shoulders
Pituophis melanoleucus mugitus	Florida pine snake	SSC		Sandhill and former sandhill, including oldfields and pastures; also sand pine scrub and scrubby flatwoods
Tantilla oolitica	Rim rock crowned snake	ST		Tropical hardwood hammocks, slash pine rocklands, and disturbed habitats (vacant lots and pastures)
Birds				
Aramus guarauna	Limpkin[(d)]	SSC		Mangroves, freshwater marshes, swamps, springs and spring runs, and pond and river margins; mostly resident
Athene cunicularia floridana	Florida burrowing owl[(d)]	SSC	X	Sparsely vegetated, sandy ground; open habitats among developed landscapes; resident
Egretta caerulea	Little blue heron[(d)]	SSC	X	Nests in coastal areas; feeds in shallow freshwater, brackish, and saltwater habitats; resident
Egretta rufescens	Reddish egret[(d)]	SSC	X	Nests on coastal mangrove islands; forages in shallow water; resident
Egretta thula	Snowy egret[(d)]	SSC	X	Nests in both inland and coastal wetlands; forages in permanently and seasonally flooded wetlands, streams, swamps, and in man-made impoundments and ditches; resident
Egretta tricolor	Tricolored heron[(d)]	SSC	X	Nests on mangrove islands or willow thickets; forages in permanently and seasonally flooded wetlands, swamps, tidal creeks, ditches and edges of ponds and lakes; resident
Eudocimus albus	White ibis[(d)]	SSC	X	Freshwater and wetlands, wet prairies, swales, seasonally inundated fields, and man-made ditches; resident
Falco sparverius paulus	Southeastern American kestrel	ST		Open pine habitats, woodland edges, prairies, and pastures; resident

Table 2-15. (contd)

Scientific Name	Common Name	State Status[(a)]	Observed[(b)]	Habitat[(c)]
Grus canadensis pratensis	Florida sandhill crane	ST		Prairies, freshwater marshes, and pasture lands; frequent feedlots, crop fields, golf courses and other open lawns; nests constructed in shallow water or in marshy areas; resident
Haematopus palliatus	American oystercatcher[(d)]	SSC		Large areas of beach, sandbar, mudflat and shellfish beds for foraging; sparsely vegetated, sandy areas for nesting; resident
Pandion haliaetus	Osprey	SSC		On or near large lakes, rivers, and coastal areas; nest in large living or dead trees and man-made structures; resident
Patagioenas leucocephala	White-crowned pigeon[(d)]	ST	X	Nests on mangrove islands and islets; forages in tropical hardwood hammocks; summer resident
Pelecanus occidentalis	Brown pelican[(d)]	SSC	X	Coastal; uses sand spits, sand bars, and islets for roosting; nests on small islands in bays and estuaries; resident
Eudocimus albus	Roseate spoonbill[(d)]	SSC	X	Nests on coastal mangrove islands or man-made dredge spoil islands; forages on shallow waters of variable salinity; resident
Rynchops niger	Black skimmer[(d)]	SSC		Coastal waters; nest on sand beaches, small coastal islands and dredge spoil islands; resident
Sterna antillarum	Least tern[(d)]	ST	X	Coastal areas for foraging; nests on substrate of well-drained sand or gravel that features little vegetation; summer resident
Mammals				
Neovison vison evergladensis	Everglades mink[(d)]	ST		Wetland communities, including salt marsh, freshwater marsh, cypress swamp, and hardwood swamp
Podomys floridanus	Florida mouse	SSC		Xeric upland communities with sandy soils, including scrub, sandhill, and ruderal sites
Ursus americanus floridanus	Florida black bear	ST		Variety of forested habitats including forested wetlands

(a) State Status: ST (threatened); SSC (Species of Concern); source: FNAI 2014-TN3666.
(b) Previously observed within the Turkey Point site or within the proposed Units 6 and 7 transmission line corridors.
(c) Sources for habitat information: FNAI 2000-TN139.
(d) Determined or presumed by the FFWCC to present and have the potential to be affected (FFWCC 2012-TN520).

Individuals or populations of 17 plant species listed by the State of Florida were observed within proposed transmission line corridors (FPL 2009-TN1449). Occurrences of both State threatened and State endangered species were common within the first 8 mi segment of the West corridors and the first 6 mi segment of the East corridor originating at Units 6 and 7. Numerous State endangered species were also observed within the final 3 mi segment of the West corridors nearest the Pennsuco substation. Scattered occurrences were also observed in other segments of the corridors. The Davis-Miami segment of the East corridor was not surveyed so the occurrence, distribution, or abundance of State-listed species is unknown (FPL 2009-TN1449). This portion lies within a mostly urbanized landscape, so occurrence of State-listed species would be expected to occur within scattered remnants of native vegetation.

Although many of the State-listed plants are found in either pine rockland or marl prairie habitats, neither of which occurs on the Turkey Point site, the range of habitats in which they occur indicates unreported species and populations likely occur within other proposed project areas. For instance, Small's flax (*Linum carteri var. smallii*) and the Bahama ladder brake (*Pteris bahamaensis*) are known to occur in disturbed habitat, much of which has not been surveyed. Also the banded wildpine (*Tillandsia flexuosa*) is an epiphyte that grows on a variety of other plants that occur in a wide range of habitat conditions. The full extent of which State-listed plant species occur within all proposed project areas is undetermined.

The FFWCC determined that the 12 bird and 1 mammal species described below and listed by the State of Florida are either known or likely to be present on the Turkey Point site (Table 2-15).

<u>Limpkin (*Aramus guarauna*)</u>

The limpkin is a resident wading bird that uses wetlands including mangroves, freshwater marshes, swamps, ponds, and canal banks (FNAI 2000-TN139). Although listed as a Species of Concern in Florida and a bird of conservation concern (FWS 2008-TN4438), its distribution is widespread in southern Florida. Land-cover classification information indicates habitat suitable for limpkins is present at all proposed onsite and offsite project locations.

<u>Florida Burrowing Owl (*Athene cunicularia floridana*)</u>

Florida burrowing owls are named for their propensity to nest in underground burrows. They prefer sparsely vegetated, sandy, upland habitats including dry prairies and sandhills. They have taken advantage of disturbances that create open habitats and use pastures, airports, parks, rights-of-way, and vacant residential lots (FNAI 2000-TN139). A single burrowing owl was observed in 2010 on a roadway within the IWF (FPL 2014-TN4058). The presence and abundance of this species at other proposed project locations is unknown. The affinity for upland habitats for burrowing would exclude this bird from most of the proposed project locations. Vacant upland lots and canal berms along some of the transmission line corridors may provide suitable burrowing habitat.

Little Blue Heron (*Egretta caerulea*)

This resident heron feeds in virtually all wetland habitat types in South Florida. Little blue herons nest in trees and their nesting colonies can be found nearly statewide in Florida (FNAI 2000-TN139). Little blue herons have been observed throughout the Turkey Point site where appropriate habitat is present (FPL 2014-TN4058). Wetlands are present at all proposed project locations and this heron is likely present there.

Reddish Egret (*Egretta rufescens*)

The reddish egret is a coastal bird of conservation concern (FWS 2008-TN4438) that nests on mangrove islands as well as non-native Brazilian pepper stands on dredge spoil islands. It forages in shallow water and will use sparsely vegetated tidal flats, shorelines, and salt evaporation pools (FNAI 2000-TN139). It is a resident species in Florida. Reddish egrets have been observed throughout the FPL Turkey Point site where appropriate habitat is present (FPL 2014-TN4058). This species is also likely to occur in wetlands at all offsite locations.

Snowy Egret (*Egretta thula*)

The snowy egret is also a resident species in South Florida. It nests in woody shrubs such as willow and mangrove and prefers nesting over the water or on islands. These egrets require a variety of wetland habitat types near nesting colonies to successfully forage, and breeding success has been related to water depth (FNAI 2000-TN139). Snowy egrets have been observed throughout the Turkey Point site where appropriate habitat is present (FPL 2014-TN4058). Snowy egrets regularly nest within wading bird colonies adjacent to the proposed western transmission line corridors and are also likely to occur in wetlands at all offsite locations.

Tricolored Heron (*Egretta tricolor*)

Like the snowy egret, the tricolored heron is a resident species that also nests in mangroves and willows as well as other woody vegetation over standing water or in islands. Tricolored herons prefer to feed in coastal wetlands including seasonally flooded habitats, mangrove swamps, ditches, and tidal creeks. Seasonal water-level fluctuation is critical to nesting success (FNAI 2000-TN139). Tricolored herons have been observed throughout the Turkey Point site where appropriate habitat is present (FPL 2014-TN4058) and are likely to occur in suitable wetland habitats at all offsite locations.

White Ibis (*Eudocimus albus*)

The white ibis is a medium-sized wading bird that uses a wide variety of freshwater and saltwater wetland habitats including brackish marsh, salt flats, forested wetlands, wet prairies, and ditches. Although present in Florida throughout the year, they are known for spring and fall movements in response to changing water levels. White ibis nests are found in trees, shrubs, and vines and their nomadic behavior can result in large annual fluctuations within a local breeding population (FNAI 2000-TN139). White ibises have been observed throughout the Turkey Point site where appropriate habitat is present (FPL 2014-TN4058). White ibis commonly nest within wading bird colonies adjacent to the proposed western transmission line corridors and suitable wetland habitat is also present at all other proposed offsite locations.

Roseate Spoonbill (*Eudocimus albus*)

The roseate spoonbill is a medium-sized wading bird that uses a variety of freshwater and saltwater wetlands in search of food. Spoonbills nest on mangrove islands, in Brazilian pepper stands on dredge spoil islands, or in willows near freshwater wetlands (FNAI 2000-TN139). It is a resident in South Florida and a bird of conservation concern (FWS 2008-TN4438). Roseate spoonbills were observed within Turkey Point site and within the proposed Units 6 and 7 plant area (FPL 2014-TN4058). They occasionally nest within wading bird colonies adjacent to the proposed western transmission line corridors and are likely present at all proposed offsite locations.

American Oystercatcher (*Haematopus palliates*)

The American oystercatcher is a large, resident shorebird along coastal Florida classified as a bird of conservation concern (FWS 2008-TN4438). Oystercatchers require large, open expanses including beaches, sandbars, mudflats, and shellfish beds to effectively forage. They prefer to nest on the ground in a large expanse of sparsely vegetated sandy habitat, but will also nest in or near sparse cover (FNAI 2000-TN139). Although not previously observed at any of the proposed project locations, FPL determined the likelihood of occurrence in the vicinity of the Turkey Point property was moderate (FPL 2011-TN1374).

White-Crowned Pigeon (*Patagioenas leucocephala*)

This pigeon, classified as a bird of conservation concern (FWS 2008-TN4438), nests on isolated mangrove islands in extreme South Florida. It feeds on the fruit produced by hardwood trees including poisonwood (FNAI 2000-TN139). Most white-crowned pigeons are only present during the May-September nesting season, although some may be present in South Florida during winter. White-crowned pigeons were observed within the proposed Units 6 and 7 plant area at the Turkey Point site (FPL 2014-TN4058). The presence and abundance of this pigeon at other proposed project locations is unknown.

Brown Pelican (*Pelecanus occidentalis*)

The brown pelican is a coastal resident species that feeds mostly in shallow estuaries. It loafs and perches on exposed sand habitat such as spits and bars as well as mangrove islands. Brown pelicans nest on small islands near bays and estuaries either in small trees and shrubs or on the ground (FNAI 2000-TN139). Brown pelicans were observed during reconnaissance of the proposed project area (FPL 2014-TN4058). They would not be expected to occur at any of the offsite project areas as they are all inland.

Black Skimmer (*Rynchops niger*)

The black skimmer is a gull-like bird that forages over coastal waters including bays, estuaries, tidal creeks, and inland lakes. It is a bird of conservation concern (FWS 2008-TN4438) that resides along most of the coast but is more abundant in South Florida during the winter. Black skimmers nest on sand beaches, small islands, and dredge spoil islands, and have also been found nesting along a road in an agricultural setting (FNAI 2000-TN139). They are not known to occur at any of the proposed project locations, but roads within the IWF could provide suitable nesting habitat.

Least Tern (*Sterna antillarum*)

The least tern is a coastal bird of conservation concern (FWS 2008-TN4438) that migrates to Florida to nest. Nesting occurs on well-drained sand or gravel substrates with little vegetation. These conditions typically exist on beaches along lagoons, bays, and estuaries. However, least terns have also been observed nesting on dredge spoil islands, construction sites, causeways, and mining areas (FNAI 2000-TN139). Least terns have nested along canals within the Turkey Point site (FPL 2012-TN1058). They are not known to occur at any of the proposed locations offsite and would not be expected due to habitat preferences.

Everglades Mink (*Neovison vison evergladensis*)

Very little is known about the Everglades mink, but it is a recognized subspecies of mink believed to occur locally in Florida (FFWCC 2011-TN643). Where it occurs, it would generally be found in wetland habitats. Wetland habitats occur at all onsite and offsite locations.

Other Important Species and Habitats

In addition to Federally and State-listed species and those proposed for listing, Environmental Standard Review Plan (ESRP) guidance (NRC 2000-TN614) identifies important species as those that are commercially valuable, recreationally valuable, essential to the maintenance or survival of commercially or recreationally valuable species, critical to the structure and function of local terrestrial ecosystems, and those that serve as biological indicators. Important habitats include wildlife refuges, sanctuaries, preserves, FWS-designated critical habitat, other State or Federally protected habitats, wetlands, and floodplains including EPA-designated Aquatic Resources of National Importance (ARNI). Factors that determine if an aquatic resource is an ARNI include economic importance, rarity or uniqueness, and the importance of the resource to protect, maintain, or enhance the quality of the Nation's waters (EPA 2015-TN4626).

Mangrove forests play a key role in the ecosystems where they occur and are the most biologically productive ecosystems in the world. Mangroves represent the link between upland and marine ecosystems in many tropical and subtropical areas, which contribute significant organic material to coastal and estuarine waters and provide a nursery to many aquatic and terrestrial animal species (USGS 2003-TN1304; FWS 1999-TN136). Mangrove forests are an integral part of South Florida's ecology and support an incredible number of bird species and provide vital habitat for many neotropical migrant songbirds, raptors, and estuarine birds. The red mangrove (*Rhizophora mangle*) is an important indicator of this highly valuable forest type in South Florida. Listed species that depend on or use mangroves include the Florida panther, wood stork, eastern indigo snake, Florida black bear, Everglades mink, white-crowned pigeon, brown pelican, tricolored heron, little blue heron, white ibis, snowy egret, reddish egret, and roseate spoonbill. Much of South Florida's mangrove forests have been lost to coastal urbanization and alteration of freshwater hydroperiod from impoundment (FWS 1999-TN136).

The EPA considers mangroves of South Florida as ARNI because they buffer uplands from storms, filter overland runoff, reduce turbidity, and fuction biologically in all of the ways mentioned in this paragraph.

Pine rockland is a savanna-like forest that occurs on limestone outcrops of the Miami Rock Ridge, which supports diverse shrub and herb layers that include almost as many as 374 different plant species (FWS 1999-TN136). Many endemic plant and animal species are dependent upon pine rocklands, and many Federally and State-listed plants and wildlife use pine rockland, including Blodgett's silverbush, Carter's small-flowered flax, Florida lantana, Garber's spurge, deltoid spurge, tiny polygala, small's milkpea, crenulate lead-plant, Kirtland's warbler, eastern indigo snake, Florida panther, and both Florida leafwing and Bartram's scrub-hairstreak butterflies. More than 90 plant Species of Concern have been recorded in pine rocklands (FWS 1999-TN136). Because pine rocklands occur at relatively high elevations in the southern Florida landscape, they are also ideal for urbanization and rural development, which has resulted in extensive loss and fragmentation. On the Florida peninsula, pine rockland fragments persist in Miami-Dade County from Florida City north to Southwest 32nd Street, northern Monroe County, and southeast Collier County (FWS 1999-TN136).

Marl prairie is a sparsely vegetated, grass-dominated community that is seasonally flooded. It occurs on marl substrates, which are impermeable fine white muds deposited on limestone (FWS 1999-TN136). Unlike similar marsh habitat, marl prairie supports a very high diversity of native plants including Federally and State-listed species. Historically, marl prairie was maintained by fire and is the primary habitat of the Cape Sable seaside sparrow.

Wetlands in various forms are the dominant land cover in South Florida. Likewise, most of the Turkey Point site and the vast majority of the proposed Units 6 and 7 plant area are also wetlands including open water, mud flat, remnant canals, wetland spoil, and mangroves.

Everglades National Park, immediately west of the Turkey Point site, encompasses over 1.5 million ac in Dade, Monroe, and Collier Counties in South Florida. It is recognized as a World Heritage Site, a Biosphere Reserve, a Wetland of International Significance, and an OFW. The EMB is a FPL-owned wetland mitigation area that links Everglades National Park with Biscayne Bay. It borders the Turkey Point site immediately west and south of the industrial wastewater canal system and encompasses over 13,000 ac. Biscayne National Park, bordering much of the east side of the Turkey Point site, encompasses 172,000 ac. Included within this national park is the southern expanse of Biscayne Bay, northern portion of Card Sound, the mangroves along the mainland shore, northern-most Florida Key islands, and extensive offshore coral reefs. Crocodile Lake National Wildlife Refuge, 10 mi south of the Turkey Point site, occupies 6,700 ac near Key Largo, Florida.

There is no FWS-designated critical habitat for terrestrial species on the FPL Turkey Point site (see Section 2.4.2.3 for discussion of the American crocodile designated critical habitat). However, critical habitat has been designated for the Cape Sable seaside sparrow and Everglades snail kite within a 50 mi radius of the FPL Turkey Point site. Cape Sable seaside sparrow critical habitat exists in southwestern Miami-Dade County as near as 15 mi to the west. Everglades snail kite critical habitat can be found in west and northwest Miami-Dade County about 22 mi west of the site as well as in Broward County to the north. Critical habitat has also been designated for the Florida leafwing and Bartram's scrub-hairstreak butterflies, Florida brickell-bush, and Carter's small-flowered flax. A single pine rockland fragment designated as critical habitat for Bartram's scrub-hairstreak, Florida brickell-bush, and Carter's small-flowered flax lies within both of the proposed western transmission line corridors. Additional critical habitat for all four of these species lies alongside or nearby other portions of the proposed transmission system.

Commercially and Recreationally Valuable Species

Although numerous game species including white-tailed deer (*Odocoileus virginianus*), mourning dove (*Zenaida macroura*), and cottontail rabbit (*Sylvilagus floridanus*) are present, public access for harvest of game animals is prohibited on the Turkey Point site (FPL 2014-TN4058). Waterfowl habitat is present and waterfowl are likely to occur in local wetlands and open water habitats. As with other game animals, public waterfowl hunting on the site is prohibited, and if hunting occurs in the immediate vicinity of the Turkey Point site waterfowl may be artificially concentrated on the site during hunting seasons.

Disease Vector and Pest Species

In epidemiology, a vector does not cause a disease, but instead spreads infection from one host to another. Numerous disease vectors exist in the animal kingdom. Blood-sucking insects such as mosquitoes, ticks, and fleas are widely known to transmit disease to both animals and humans. Mammals such as bats, raccoons, and skunks (*Mephitidae*) have also been implicated in the spread of disease. No known occurrences of vector-borne illness have been associated with disease vectors and pests on the Turkey Point site (FPL 2014-TN4058).

Exotic plant species, when aggressive in nature, can displace or eliminate native plant species. The Florida Exotic Pest Plant Council maintains a list of invasive plant species (FLEPPC 2011-TN240). Melaleuca (*Melaleuca quinquenervia*), Old World climbing fern (*Lygodium microphyllum*), Asian swordfern (*Nephrolepus multiflora*), and Burma reed (*Neyraudia reynaudiana*) have been observed during reconnaissance surveys of the proposed Units 6 and 7 transmission line corridors (FPL 2009-TN657). Brazilian pepper and Australian pine also occur in these corridors. The NPS funds efforts to control the spread of Malaleuca in the East Everglades Expansion Area (NPS 2011-TN242).

The tropical climate of South Florida has enabled the establishment of numerous reptile species in the region. The Burmese python (*Python molurus* ssp. *bivittatus*) is probably the most well-known exotic reptile that now inhabits South Florida. The establishment of this snake species has coincided with a dramatic decrease in medium-sized mammals within Everglades National Park, and control efforts to limit the Burmese python population in Florida are ongoing (Dorcas et al. 2011-TN241). The Argentine black-and-white tegu (*Tupanimbis merianae*) is a relatively new arrival, but has spread rapidly in the vicinity of Turkey Point. This egg-eating omnivore has the potential to affect many species, including alligators and crocodiles, and is the subject of a multi-agency control effort in the immediate vicinity of the Turkey Point site.

Biological Indicators

Wading birds are an important part of the South Florida ecosystem and have been identified as an indicator of ecosystem health for the Everglades and a primary goal of CERP

(Recover 2005-TN4031). Listed wading bird species include the Federally threatened wood stork and State-listed little blue heron, tricolored heron, reddish egret, snowy egret, white ibis, and roseate spoonbill. Additional South Florida wading bird species in the project vicinity include the double-crested cormorant (*Phalacrocorax auritus*), great egret (*Ardea alba*), cattle egret (*Bubulcus ibis*), green heron (*Butorides virescens*), great blue heron (*A. herodias*), and black- and yellow-crowned night-herons (*Nicticorax nicticorax* and *Nictanassa violacea*). Historic wading bird population estimates, although controversial, were estimated to be approximately 125,000−150,000 attempted nests in the 1930s (Bancroft 1989-TN3571). Populations have since declined and in 2013 it was estimated that almost 50,000 wading bird nests were initiated, which is twice as many as were estimated annually from 2010−2012. As recently as 2009 more than 87,500 nests were estimated (SFWMD 2013-TN4034). Four wading bird species are used to monitor ecosystem restoration and health: the great egret, snowy egret, white ibis, and the wood stork. Generally, populations of these species are trending upward since the 1990s with the exception of snowy egrets, which have declined recently (SFWMD 2013-TN4034).

2.4.1.4 Important Terrestrial Species – Transmission Lines

This section describes commercially and recreationally valuable species, Federally and State-listed and proposed threatened and endangered terrestrial species, and designated and proposed critical habitat that may occur in the transmission line corridors and in the vicinity of the proposed 500 kV transmission line. Habitat types observed within transmission line corridors have been described as disturbed upland, disturbed wetland, Everglades tree island, marl prairie, pine rockland, Everglades swale, tidal marsh, tidal swamp, dwarf mangrove swamp, rocky glade, sinkhole, cypress strand swamp, dwarf cypress prairie, agriculture, and urban development (FPL 2009-TN657). Natural and disturbed transitional areas such as canal edges, ditch banks, and dirt roads also provide habitat.

Federally Listed Species

All existing and proposed transmission lines that would support proposed Units 6 and 7 are in Miami-Dade County. Federally listed species that could be affected by the construction, operation, and maintenance of proposed Units 6 and 7 transmission facilities are listed in Table 2-12. Field reconnaissance surveys to determine the presence, absence, distribution, and abundance of Federally listed wildlife were conducted along existing or proposed transmission lines during April and June 2008 (FPL 2011-TN94).

<u>Fauna</u>

The FWS and the State of Florida has identified 29 Federally and State-listed terrestrial wildlife species as occurring or potentially occurring within the existing or proposed transmission line corridors (Table 2-16). Although Bartram's scrub-hairstreak and the Florida leafwing do not occur within the corridors, proposed critical habitat for these two butterflies does occur within the western transmission line corridors. In addition, the bald eagle (*Haliaeetus leucocephalus*) is managed under the Bald and Golden Eagle Protection Act (16 U.S.C. § 668 et seq.) (TN1447) and the State of Florida Bald Eagle Management Plan (FFWCC 2008-TN1448).

Table 2-16. Federally and State-Listed Terrestrial Wildlife Species Identified by the State of Florida as Occurring or Potentially Occurring within Transmission Line Corridors Associated with Proposed Units 6 and 7

Common Name	Scientific Name	Federal Status[(a)]	State Status[(b)]
American oystercatcher	*Haematopus palliatus*		SSC
Black skimmer	*Rhynchops niger*		SSC
Brown pelican	*Pelecanus occidentalis*		SSC
Florida burrowing owl	*Athene cunicularia*		SSC
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	LE	SE
Eastern indigo snake	*Drmarchon couperi*	LT	ST
Everglades mink	*Mustela vison*		ST
Florida bonneted bat	*Eumops floridanus*	LE	SE
Florida black bear	*Ursus americanus floridanus*		ST
Florida mouse	*Podomys floridanus*		SSC
Florida panther	*Puma concolor*	LE	SE
Florida pine snake	*Pituophis melanoleucus mugitus*		SSC
Florida sandhill crane	*Grus canadensis pratensis*		ST
Gopher frog	*Lithobates capita*		SSC
Gopher tortoise	*Gopherus polyphemus*		ST
Least tern	*Sterna antillarum*		ST
Little blue heron	*Egretta caerulea*		SSC
Limpkin	*Aramus guarauna*		SSC
Piping plover	*Charadrius melodus*	LT	ST
Reddish egret	*Egretta rufescens*		SSC
Rim rock crown snake	*Tantilla ooliticus*		ST
Roseate spoonbill	*Platalea ajaja*		SSC
Everglades snail kite	*Rostrhamus sociabilis plumbeus*	LE	SE
Snowy egret	*Egretta thula*		SSC
Southeastern American kestrel	*Falco sparverius paulus*		ST
Tricolored heron	*Egretta tricolor*		SSC
White-crowned pigeon	*Patagioenas leucocephala*		ST
White ibis	*Eudocimus albus*		SSC
Wood stork	*Mycteria americana*	LT	SE

(a) Federal Status: LE = endangered; LT = threatened.
State Status: SE (endangered); ST (threatened); SSC (Species of Concern); source Florida Natural Areas Inventory – 4/5/2010. All Federally listed species that occur in Florida are not included on the State of Florida's list as Federally designated species in addition to the State listing process (FFWCC 2011-TN158).

Source: FFWCC 2011-TN554

The Cape Sable seaside sparrow is a Federally and State-listed endangered species that nests in mixed marl prairie community in Miami-Dade County (FWS 2012-TN117; FNAI 2014-TN3668). The entire species has a total estimated population of only 2,900 individuals (FWS 2010-TN256). No Cape Sable seaside sparrows were observed during surveys of the transmission line corridors associated with rights-of-way (FPL 2014-TN4058).

The eastern indigo snake is a Federally and State-listed threatened species (FWS 2012-TN117; FNAI 2014-TN3668). Although this species is found primarily in upland habitats, it requires a mosaic of habitats and has been found in pinelands, tropical hardwood hammocks, mangrove forests, and human-altered habitats (FWS 1999-TN136). None were observed during recent surveys of the transmission line corridors (FPL 2014-TN4058).

Historically, Florida panthers have been observed within lands that occur within the two proposed western transmission line corridors. Also, both existing and proposed transmission lines pass through the FWS-designated Florida panther primary and secondary focus zones.

The piping plover is a Federally and State-listed threatened species (FWS 2012-TN117; FNAI 2014-TN3668). Piping plovers do not breed in Florida, but individuals from all three breeding populations winter there and have been observed in Miami-Dade County (FWS 1999-TN136). Their winter habitat includes beaches, mudflats, and sandflats, as well as, barrier island beaches, and spoil islands. No piping plovers were seen during surveys of Turkey Point plant or the transmission line rights-of-way (FPL 2014-TN4058).

The Everglades snail kite is a Federally and State-listed endangered species (FWS 2012-TN117; FNAI 2014-TN3668). The snail kite is a wide-ranging New World raptor found primarily in lowland freshwater marshes. In Florida, the population appears to be restricted to the watersheds of the Everglades, Okeechobee and Kissimmee lakes, and the upper St. Johns River. FWS-designated critical habitat for the snail kite exists in western Miami-Dade County beginning about 22 mi west of the Turkey Point site.

The only Federally listed species directly observed during reconnaissance surveys was the Everglades snail kite. A single snail kite was observed perched along the West Preferred transmission line corridor. This observation was made within a portion of the proposed corridor that lies along the boundary of the East Everglades Expansion Area and passes through a sawgrass marsh. Snail kites are known to forage in sawgrass habitats.

The wood stork is a Federally and State-listed threatened species (79 FR 37077 [TN4039]; FNAI 2014-TN3668). The wood stork uses a variety of wetlands including freshwater and estuarine habitats for nesting, roosting, and foraging and constructs nests in medium to tall trees surrounded by open water. Colonial nest sites are often reused over many years (FWS 1997-TN225). Wood storks forage in almost any shallow, open water where prey items become concentrated (FWS 1997-TN225).

Wood storks have historically nested in two different locations south of the Tamiami Trail (US-41) within 5 mi of the proposed Turkey Point to Levee transmission line corridors (FPL 2014-TN4058). One colony occurs within 1 mi of the West Preferred transmission line corridors. The other colony is within 3 mi of this corridor. Wood storks could be found in shallow wetlands within existing and proposed transmission line corridors (FPL 2011-TN94). Although there is no designated critical habitat for the wood stork, the FWS Southeast Florida Ecological Services Office recognizes a 0.47 mi (0.76 km) nest colony buffer and an 18.6 mi (29.9 km) core foraging area buffer around all known wood stork colonies that have had active nests within the last 10 years in South Florida. Impacts on suitable habitats within either of these buffer zones would require mitigation depending on the impact level (FWS 2010-TN226).

Habitat within the West Preferred and West Consensus corridors has been designated as critical habitat for the endangered Bartram's scrub-hairstreak and Florida leafwing butterflies. Expansion of the Clear Sky to Davis portion of the East corridor would also occur adjacent to pine rockland that surrounds the Miami Metro Zoo, University of Miami-south campus, and the Gold Coast Railroad Museum that has also been designated as critical habitat for these two butterflies.

Flora

A single Federally listed species and two candidates have been observed within transmission line corridors that would support proposed Units 6 and 7 at the Turkey Point site. The endangered Florida brickell-bush inhabits pine rocklands with an open shrub layer, exposed limestone, and minimal leaf litter (FNAI 2000-TN139). It is endemic to the Miami Rock Ridge (FPL 2014-TN4058). The pineland spurge or pineland sandmat is found in pine rocklands with scattered shrubs and exposed limestone (FNAI 2000-TN139). Sand flax is also found in pine rockland, marl prairie, and adjacent disturbed areas (FNAI 2000-TN139). During 2009 reconnaissance surveys, two remnant pine rockland habitat patches were noted adjacent to the Davis to Miami corridor. Pine rockland habitat is known to harbor many endemic plant species, and a threatened and endangered plant survey was recommended in these areas (FPL 2009-TN1449).

State-Listed Species

As with Federally listed species, the State-listed species in Table 2-14 and Table 2-15 for the FPL Turkey Point site are also the species that could be affected by building and operating the proposed Units 6 and 7 transmission facilities. Surveys for State-listed wildlife have not been conducted along existing or proposed transmission lines. Reconnaissance surveys were conducted during September 2008 and February 2009 to determine the presence, distribution, and abundance of State-listed plants.

A total of 36 State-listed plant species, including a Federally endangered species and two candidate species, have been observed within transmission line corridors that would support proposed Units 6 and 7 (Table 2-17) (FPL 2014-TN4058; FPL 2009-TN657). The vast majority of the listed plants were found in fragments of pine rockland habitat. However, some of the plants were also observed in disturbed habitats, including at the sides of dirt roads, on transmission tower pads created from spoil within mangrove stands, in marl prairie remnants, and along canal edges.

Although numerous game species, including white-tailed deer, mourning dove, and cottontail rabbit, are present, public access for harvest of game animals is prohibited on the Turkey Point site (FPL 2014-TN4058). Waterfowl habitat is present and waterfowl are likely to occur in local wetlands and open water habitats. As with other game animals, public waterfowl hunting on the site is prohibited, and if hunting occurs in the immediate vicinity of the Turkey Point site waterfowl may be artificially concentrated on the site during hunting seasons.

Table 2-17. Federally and State-Listed Plant Species Observed within Transmission Line Corridors Associated with Proposed Units 6 and 7 (Source: FPL 2014-TN4058)

Common Name	Scientific Name	Federal Status[(a)]	State Status[(b)]	Habitats Observed Growing In[(c)]
Golden leather fern	*Acrostichum aureum*		ST	Bayhead
Pineland-allamanda	*Angadenia berteroi*		ST	Pine rockland
Pinepink	*Bletia purpurea*		ST	Road edge, mangrove spoil pads
Florida brickell-bush	*Brickellia mosieri*	LE	SE	Pine rockland
Locustberry	*Byrsonima lucida*		ST	Spoil pad, Pine rockland
White sunbonnets	*Chaptalia albicans*		ST	Pine rockland
Pineland (spurge) sandmat	*Chamaesyce deltoidea ssp. pinetorum*	LC	SE	Pine rockland
Florida silver palm (Silver palm)	*Coccothrinax argentata*		ST	Pine rockland
Quailberry (Christmas berry)	*Crossopetalum ilicifolium*		ST	Pine rockland
Blodgett's swallowwort	*Cynanchum blodgettii*		ST	Pine rockland
Krug's holly	*Ilex krugiana*		ST	Pine rockland
Rockland morning glory (Wild potato morning glory)	*Ipomoea tenuissima*		SE	Pine rockland
Pineland clustervine (jacquemontia)	*Jacquemontia curtissii*		ST	Pine rockland
Skyblue clustervine	*Jacquemontia pentanthos*		SE	Pine rockland
Shrub eupatorium	*Koanophyllon villosum*		SE	Pine rockland
Pineland (Florida) lantana	*Lantana depressa var. depressa*		SE	Pine rockland
Ghost plant	*Leiphaimos parasitica*		SE	Pine rockland
Sand flax	*Linum arenicola*	LC	SE	Disturbed road edge
Carter's large-flowered flax	*Linum carteri var. smallii*		SE	Canal edge
Pineland blackanthers	*Melanthera parvifolia*		ST	Pine rockland
Southern fogfruit	*Phyla stoechadifolia*		SE	Disturbance, marl prairie
Pineland poinsettia	*Poinsettia pinetorum*		SE	Pine rockland
Bahama ladder brake	*Pteris bahamensis*		ST	Road edge, mangrove spoil pads, pine rockland
Small-leaf snoutbean	*Rhynchosia parvifolia*		ST	Pine rockland
Bahama sachsia	*Sachsia polycephala*		ST	Pine rockland
Bahama senna	*Senna mexicana var. chapmanii*		ST	Pine rockland
Mullein nightshade	*Solanum donianum*		ST	Roadsides, marl prairie, mangrove spoil pads

Table 2-17. (contd)

Common Name	Scientific Name	Federal Status[(a)]	State Status[(b)]	Habitats Observed Growing in[(c)]
Everglade Keys false buttonweed	*Spermacoce terminalis*		ST	Pine rockland
West Indian lilac	*Tetrazygia bicolor*		ST	Pine rockland
Abrupt-tip maiden fern	Thelypteris augescens		ST	mangrove spoil pads, roadside
Twisted wildpine	Tillandsia balbisiana		ST	Bayhead
Banded wildpine	Tillandsia flexuosa		ST	Bayhead
Giant wildpine	Tillandsia utriculata		SE	Bayhead
Pineland noseburn	Tragia saxicola		ST	Pine rockland
West indian (Lamarck's) trema	Trema lamarckianum		SE	mangrove spoil pads, roadside,
Florida gamagrass	Tripsacum floridanum		ST	Pine rockland

(a) Federal Status: LE = Federal endangered; LC = Federal candidate species.
(b) State Status: SE = endangered; ST = threatened. Source: FNAI 2009-TN815.
(c) Habitat information provided by FPL 2009-TN657.

Surveys for other important species, including ecologically, commercially, and recreationally important species and habitats, were not conducted within the transmission line corridors. Peninsular Florida includes the entire range of a subspecies of wild turkey, the Osceola turkey (*Meleagris gallopavo osceola*) that is a popular game species. White-tailed deer, mourning doves, rabbits, waterfowl, and other game species would be expected in appropriate habitats.

As noted above, pine rockland and marl prairie habitats occur within transmission line corridors associated with proposed Units 6 and 7. These habitats are recognized for their high species diversity and ecological value. The proposed transmission line corridors also pass through mangroves, another ecologically important habitat in South Florida.

2.4.1.5 Important Terrestrial Species and Habitats – Other Offsite Facilities

Access Roads, Potable and Reclaimed Water Pipelines

FPL would build approximately 11 mi of access roads and 9 mi of potable water pipelines to support proposed Turkey Point Units 6 and 7. Although most of this work would occur within existing road rights-of-way, some agriculture, disturbed, canal, and wetland cover types would also be traversed. No surveys were conducted to determine the presence, distribution, or abundance of important terrestrial wildlife or plant species in the affected areas. FLUCFCS land-cover types present indicate water birds such as the wood stork, roseate spoonbill, white ibis, and various egret and heron species may be present. Plant species that thrive on disturbed lands in South Florida, including pinepink, sand flax, Bahama ladder brake, mullein nightshade, and West Indian trema, may be present along existing roadways (FPL 2014-TN4058). Proposed road development would occur within the primary zone of the Florida Panther Focus Area.

2.4.1.6 Terrestrial Monitoring

Ecological monitoring was required by the State of Florida Site Certification process for Units 3 and 4 at the Turkey Point site (SFWMD 2009-TN149). FPL's Groundwater, Surface Water, and Ecological Monitoring Plan calls for ecological monitoring to be conducted to establish the current status of ecological baseline conditions and biotic components (SFWMD 2009-TN149). FPL proposed a broad-scale vegetation assessment to characterize distribution and density of vegetation (SFWMD 2009-TN149). The plan calls for transects to be established within freshwater marshes, mangroves, sawgrass, pond, and nearshore habitats within the Turkey Point site to record patterns of plant community status and environmental conditions in consultation with relevant State of Florida agencies. Various vegetation characteristics, such as species composition, canopy height, and the number of sawgrass culms, would be recorded within plots at predetermined intervals. Measurements would be recorded annually, twice annually, and quarterly depending on the plot type. Leaves would be sampled twice a year for morphological and physiological characterization to document change over time. Surface and pore-water levels and attributes would also be measured at plots and within plants. Assessment methodologies differed slightly between freshwater and saline wetland habitats. All proposed methodologies were to be consistent with those used in the Everglades National Park by the National Science Foundation-funded Long-Term Ecological Research Program. Two years of data collection before Units 3 and 4 coming online was expected, and post-operation monitoring shall be specified by the State agencies. The level of effort and results of these activities is unknown.

2.4.1.7 Related Federal Projects and Consultation

The review team reviewed the possibility that activities of other Federal agencies (e.g., building a dam) might affect the issuance of a COL to FPL. Any such activities could result in cumulative environmental impacts and the possible need for another Federal agency to become a cooperating agency for preparation of the EIS (10 CFR 51.10(b)(2)) (TN250).

Federal lands within a 50 mi radius of the Turkey Point site include Everglades National Park, which lies to the south and west. The CERP is a long-term effort to capture, store, and redirect freshwater for environmental restoration of the entire Everglades ecosystem. Ecologic goals of the restoration include increasing the spatial extent of natural areas, improving habitat and its functional quality, and improving native plant and animal abundance and diversity. These goals would be accomplished through water management, invasive species control, protection and restoration of key ecosystem functions and habitats, and soil conservation measures.

Biscayne National Park borders the Turkey Point site to the east. Efforts to restore the ecological function to Biscayne Bay are ongoing.

State parks within 50 mi of the Turkey Point site include Oleta River State Park, Bill Baggs Cape Florida Park, Cape Florida State Recreation Area, Barnacle Historic State Park, John U. Lloyd Beach State Park, Dagny Johnson Key Largo Hammock Botanical State Park, John Pennekamp Coral Reef State Park, Long Key State Park, Curry Hammock State Park, Lignumvitae Key Botanical State Park, and Windley Key Fossil Reef Geological State Park.

The NRC is required under Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4321 et seq.) (TN661) to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the EIS. During the course of preparing this EIS, NRC consulted with the FWS and National Marine Fisheries Service (NMFS). Contact correspondence is included in Appendix F.

2.4.2 Aquatic Ecology

This section describes the aquatic environment and biota near the Turkey Point site and other areas potentially affected by the building, operation, and maintenance of proposed Turkey Point Units 6 and 7 and associated facilities, including transmission lines and pipelines. This section includes a description of the aquatic ecosystems at or near the site, a description of representative important species that are present or are expected to occur, and the location of sanctuaries, reserves, national parks, critical habitats, or other areas carrying special designation, as required by ESRP 2.4.2 (NRC 2000-TN614) and Executive Order 13158 (65 FR 34909) (TN3454).

As described in Section 2.1, the Turkey Point site is located on the southeastern coast of Florida in unincorporated Dade County. Figure 2-28 shows the location of the Turkey Point site with respect to Biscayne Bay and Card Sound, and the locations of the principal canal network near the area. Onsite aquatic resources include the IWF (cooling canals), surface-water habitats and canal systems, and Biscayne Bay nearshore areas adjacent to the Turkey Point peninsula (Figure 2-29). Nearby offsite aquatic resources include Biscayne Bay, Biscayne National Park, Biscayne Bay Aquatic Preserve, Florida Keys National Marine Sanctuary (FKNMS), and Card Sound. Everglades National Park is located south and west of the site.

Prior to drainage and development activities, the wetland and aquatic ecosystems of southern Florida encompassed approximately 8.9 million ac, and included ridge and slough landscapes, sawgrass plains, cypress and mangrove swamps, and coastal lagoons and bays (USACE/SFWMD 1999-TN116). Ogden et al. (2005-TN196) characterized this pre-drainage condition as a “hydrologically interconnected, slow-flowing system that extended from the Kissimmee River and Lake Okeechobee southward over low-gradient lands to the estuaries of Biscayne Bay, Ten Thousand Islands, and Florida Bay, and eastward and westward to the northern estuaries.” Browder et al. (2005-TN151) noted that prior to development, Biscayne Bay possessed both marine and estuarine habitat and fauna, and that construction of major canals and subsequent water drainage affected the salinity gradients and ecotones from the Everglades through coastal wetlands and tidal creeks into Biscayne Bay. Historical accounts suggest that prior to inlet and navigational dredging and related development, the northern and central portions of Biscayne Bay had much lower salinity conditions, low nutrient concentrations, and low turbidity/high light transmittance that promoted the presence of extensive seagrass meadows on the bay bottom (USACE/SFWMD 1999-TN116).

As described below, anthropogenic impacts over the last century have substantially altered the ecosystem and profoundly affected the three essential characteristics—salinity, nutrient concentrations, and turbidity—that defined historical conditions.

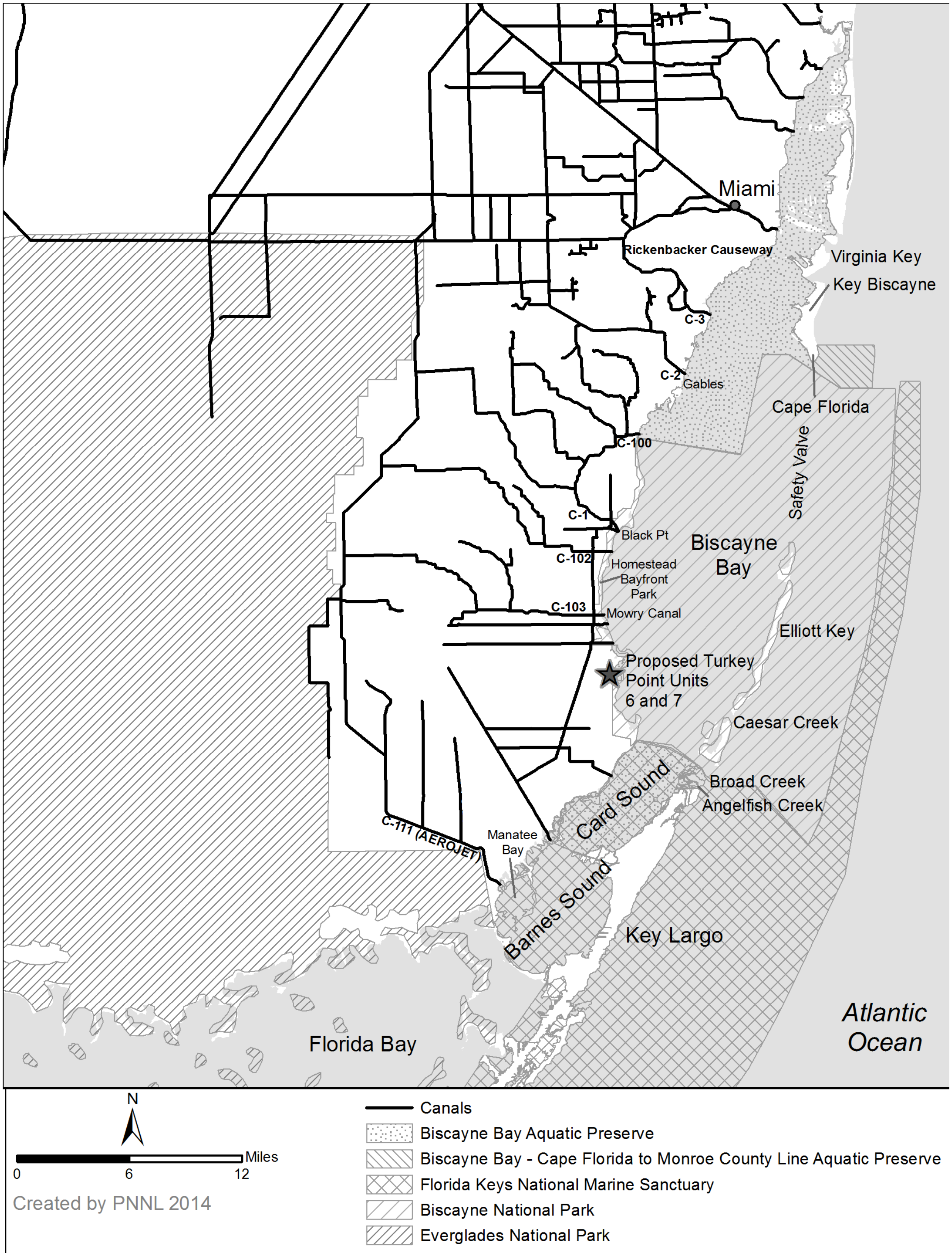


Figure 2-28. Turkey Point Site Location with Respect to Protected Areas

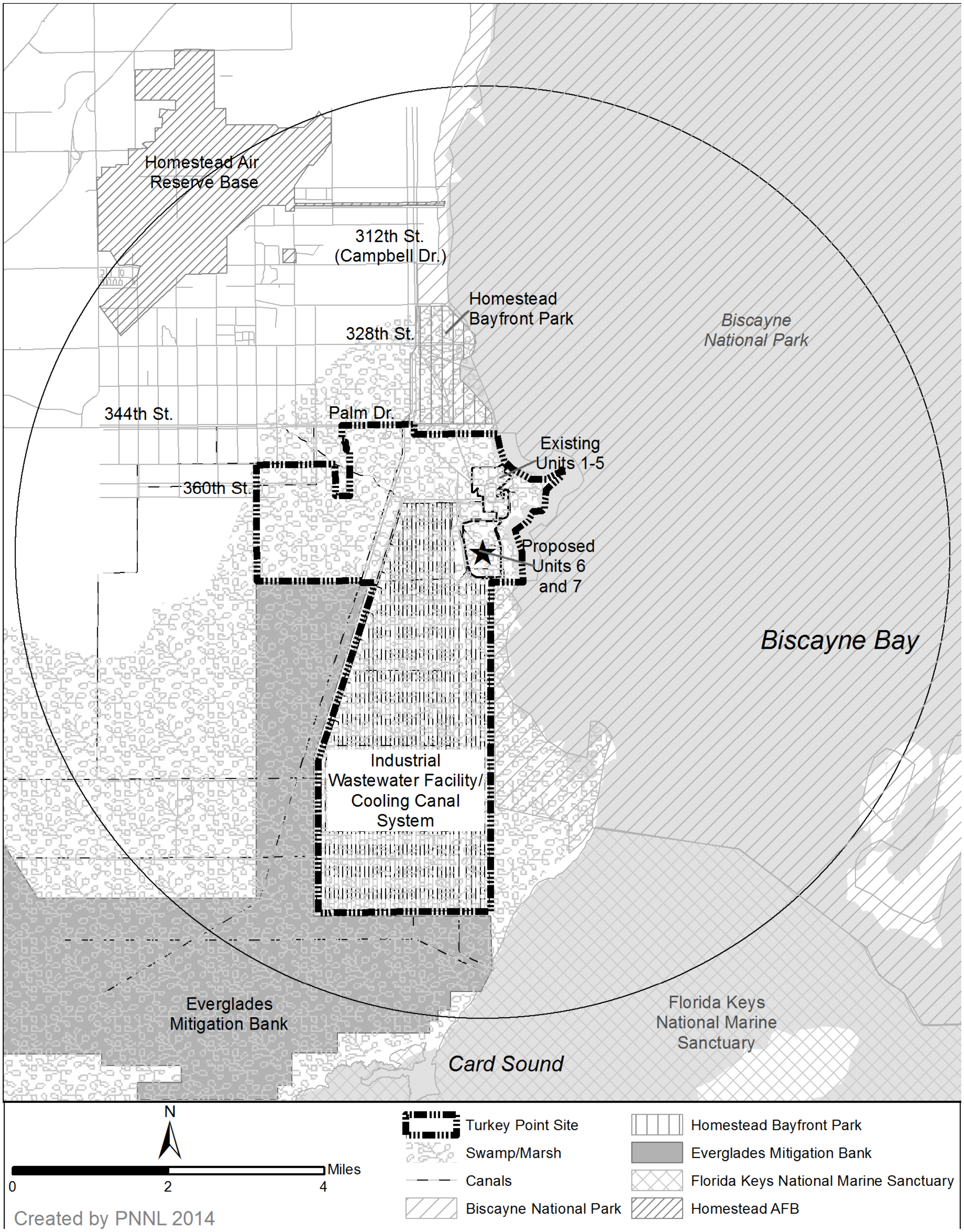


Figure 2-29. Turkey Point Site Showing Onsite Aquatic Resources, Surface-Water Habitats and Canal Systems, and Nearshore Areas Adjacent to the Turkey Point Peninsula

During the late 1800s and early 1900s, the lack of flood control was recognized as the principal impediment to development in South Florida. Land was drained to support urban and agricultural development, and a series of canals was constructed to support flood control, water supply and retention, irrigation, and transport. In 1948, Congress authorized the creation of the Central and Southern Florida Flood Control Project—one of the largest water-management systems in the world (Ogden et al. 2005-TN196). As a result of this and other projects, a substantial portion of the original wetland system in South Florida has been lost or converted to support agriculture, urban development, and related infrastructure. These changes have dramatically reduced sheet flow, and have created point-source discharge of freshwater into estuarine and coastal wetland areas. This substantially changed the dynamics of the system and resulting aquatic species compositions by reducing sheet flow, and creating pulsed point-source discharges into nearshore areas that are dissimilar in timing and duration to pre-development patterns. The effects of these practices have included the creation of deeper water habitats within canal systems that have contributed to the spread of exotic and nuisance species (Harvey et al. 2010-TN3158), the creation of unnatural habitats for predatory fishes and alligators, and unnatural reversals in wet and dry patterns (Ogden et al. 2005-TN197). Water-control structures and navigational locks have also contributed to the deaths of manatees (*Trichechus manatus latirostris*) (FWS 2001-TN223).

What follows is a description of the aquatic resources currently present at or near the Turkey Point site, including areas proposed for new transmission lines and pipelines. Resource descriptions include information provided by FPL as well as studies conducted by others to evaluate temporal trends or develop baseline assessments in support of the CERP. As discussed in Section 3, cooling-tower blowdown from the operation of proposed Units 6 and 7 would be injected into the Boulder Zone, an extremely permeable zone within a karstic fractured dolomite layer within the Lower Floridan aquifer in southeastern Florida, which extends from approximately 2,400 ft to at least 3,000 ft below ground surface (bgs) in the Miami-Dade County area (FPL 2014-TN4058). Because the review team is unaware of any aquatic resources within the Boulder Zone, it will not be discussed further with respect to aquatic resources.

2.4.2.1 Aquatic Resources – Site and Vicinity

This section provides a general description of aquatic resources that are or could be present at or near the Turkey Point site and the proposed Units 6 and 7 plant area. Sections 2.4.2.2 and 2.4.2.3 provide detailed information about proposed transmission lines and reclaimed and potable pipelines and representative important species that may be affected by the building and operation of proposed Turkey Point Units 6 and 7. As described in the ER (FPL 2014-TN4058), the surface-water habitats associated with the proposed Turkey Point Units 6 and 7 plant area include hypersaline mudflats, remnant and active canals and channels associated with operation of Units 1–4, dwarf mangrove wetlands, and open water.

What follows is a discussion of the aquatic species and habitats present on or near the Turkey Point site. As defined by ESRP 2.4.2 and Table 2.4.2.1 (NRC 2000-TN614), important habitats include the following:

- protected areas such as sanctuaries, refuges, or preserves, if they may be adversely affected by plant or transmission line and pipeline building or operation and maintenance, and
- habitats identified by State or Federal agencies as unique, rare, or of priority for protection, if these areas may be adversely affected by plant or transmission line and pipeline building, operation, and maintenance, including areas that have been designated as habitat for an evolutionary significant unit, distinct population segment, critical habitat, or essential fish habitat.

Onsite Aquatic Resources

Onsite aquatic resources include surface-water habitats and the IWF.

<u>Onsite Surface-Water Habitats</u>

As described in the ER (FPL 2014-TN4058), onsite surface-water habitats inclusive of the IWF include hypersaline mudflats, remnant canals, channels, dwarf mangrove wetlands, and areas of open water. As part of the pre-application monitoring, a survey of fish species was conducted in June 2009 in areas that would be affected by the building of the proposed new units. A variety of sampling gear was used, including minnow seines, cast nets, and minnow traps; entangling gear such as gill and trammel nets were avoided to protect resident American crocodile (*Crocodylus acutus*) populations. Water-quality measurements collected during sampling showed water temperatures ranged from 23.9 to 36.5°C; salinity was above 50 ppt at six sampling stations (TP-3A, TP-4, TP-5, TP-6, TP-7, TP-8) and ≤1.5 ppt at two stations in sawgrass/mangrove habitats (TP-1 and TP-2) (FPL 2009-TN201) (Figure 2-30). Fish collection results showed the Sheepshead Minnow (*Cyprinodon variegatus*)—the dominant species that occurred in seven of the eight sampling stations—represented 63 percent of the species composition. Sailfin Molly (*Poecilia latipinna*) and Goldspotted Killifish (*Floridichthys carpio*) were present at the majority of the sampling stations and represented 20.8 percent and 9.9 percent of the species composition, respectively. The remaining species that occurred were less common and collectively represented about 6 percent of the species composition (Table 2-18). No fish were collected at TP-2, which is in a marsh/mangrove community adjacent to Palm Drive (FPL 2009-TN201). All fish collected represented hardy species common to South Florida; no rare, unusual, sensitive, or protected species were collected (FPL 2009-TN201).

Industrial Wastewater Facility

The IWF occupies approximately 5,900 ac on the Turkey Point site (Figure 2-29). This facility provided cooling for Turkey Point Units 1 and 2, still provides cooling for Units 3 and 4, and receives blowdown water from the operation of Unit 5. The IWF contains an extensive system of canals and berms, and it has supported a variety of species of fish, mollusks, crustaceans, and submerged aquatic vegetation that are tolerant of subtropical, hypersaline environments. Table 2-19 provides a list of species known to occur in the IWF based on FPL monitoring studies (FPL 2014-TN4058). Many of these species are eaten by the State and Federally threatened American crocodiles that live in the IWF. FPL employees historically have also reported observing large game species such as Common Snook (*Centropomus undecimalis*) and Tarpon (*Megalops atlanticus*) in the IWF. These are most likely older individuals that have

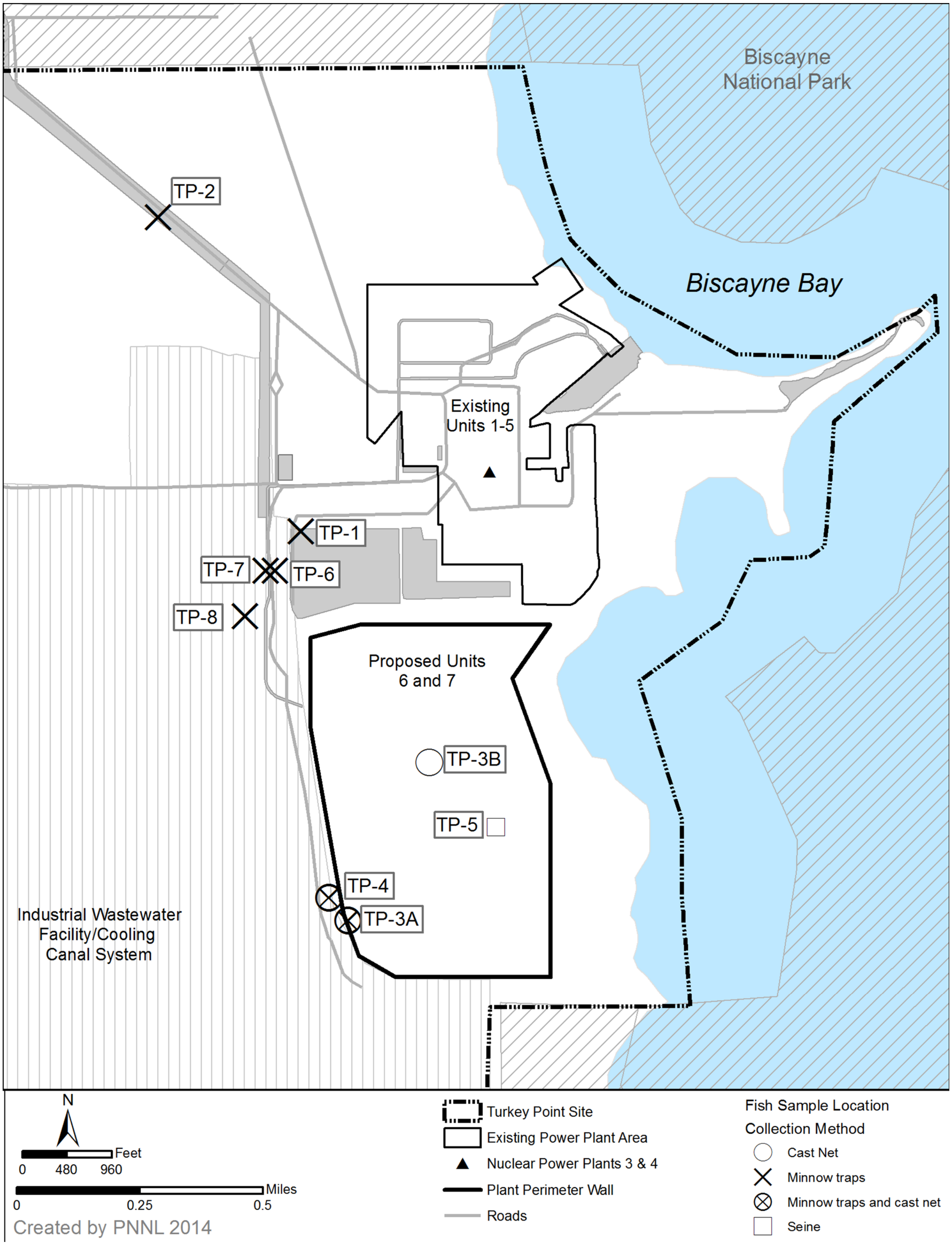


Figure 2-30. 2009 Fish Sampling Locations on the Turkey Point Site (Source: FPL 2009-TN201)

Table 2-18. Fish Species Present in Surface-Water Habitats Inclusive of the IWF on Turkey Point Site in Summer 2009

Common Name	Scientific Name	TP-1	TP-3	TP-4	TP-5	TP-6	TP-7	TP-8	Total	Percent Comp.
Sheepshead Minnow	*Cyprinodon variegatus*	4	70	25	43	87	37	7	273	63.0
Sailfin Molly	*Poecilia latipinna*	20	48	7	0	6	3	6	90	20.8
Goldspotted Killifish	*Floridichthys carpio*	0	3	1	22	15	1	1	43	9.9
Marsh Killifish	*Fundulus confluentus*	15	0	0	0	0	0	0	15	3.5
Gulf Killifish	*F. grandis*	3	0	1	0	0	1	1	6	1.4
Mosquitofish	*Gambusia holbrooki*	4	0	1	0	0	0	0	5	1.2
Gulf Toadfish	*Opsanus beta*	0	0	1	0	0	0	0	1	0.2

Source: FPL 2009-TN201

Table 2-19. Aquatic Species Documented in the Industrial Wastewater Facility (November 2007)

Common Name	Scientific Name
Reptiles	
American crocodile	*Crocodylus acutus*
Fish	
Sheepshead Minnow	*Cyprinodon variegatus*
Killifish	*Fundulus* sp.
Mosquitofish	*Gambusia* sp.
Mullet	*Mugil* sp.
Sailfin Molly	*Poecilia latipinna*
Needlefish	*Strongylura* sp.
Tarpon	*Megalops atlanticus*
Common Snook	*Centropomus undecimalis*
Mollusks	
Lightning whelk	*Busycon contrarium*
Ivory cerith	*Cerithium eburneum*
Lister’s tree oyster	*Isognomon radiatus*
Flat tree oyster	*Isognomon alatus*
Giant rams horm	*Marisa cornuarietis*
Eastern melamphus	*Melampus bidentatus*
Florida crown conch	*Melongena corona*
Tellin	*Tellin* sp.
Crustaceans	
Great land crab	*Cardisoma guanhumi*
Fiddler crab	*Uca* sp.
Submerged Aquatic Vegetation	
Mermaid’s wineglass (green algae)	*Acetabularia* sp.
Green algae	*Batophora* sp.
Green algae	*Caulerpa* sp.
Widgeon grass	*Ruppia maritima*

Source: Adapted from ER Rev 6 (FPL 2014-TN4058) persisted in the system since it was isolated from Biscayne Bay in 1973 (FPL 2014-TN4058). Recruitment of fish and invertebrates could also potentially occur from hurricane storm surge overtopping IWF canal berms.

As noted in Section 2.3, the water quality in the IWF varies inter-annually and intra-annually in response to plant operation and meteorological conditions. Rainfall will cause the salinity to decrease, and evaporation from induced evaporation and hot, dry meteorological conditions will cause salinity to increase over time. Water temperatures in the IWF are generally highest during the summer months, and decrease during the winter. During the summer of 2014, elevations of peak water temperature, salinity, and nutrient levels in the IWF were detected above historic background levels. Also during the same period an extensive algal bloom was observed, necessitating consultation with FDEP to approve addition of copper sulfate, hydrogen peroxide and bio-stimulants to attempt to control algal growth, and temporary addition of water from the Floridan aquifer to reduce salinity in the IWF. Water-quality conditions in 2015 continued the trend of increased salinity and nutrient levels, which prompted action by FPL to address water-quality conditions. Additional information about these actions and their implications to IWF water quality is found in Section 2.3.1.1. Given the extended period during which high temperatures (both peak and average), high salinity, and algal blooms occurred, it is likely that the ecosystem within the IWF has changed and is no longer representative of the biodiversity observed in 2007 (Table 2-19) or in 2009 (Table 2-18).

Adult American crocodiles were first observed in the IWF in 1976, and nesting was first documented on the cooling-canal berms in 1978 (Wasilewski and Enloe 2006-TN979). As a result, FPL developed a crocodile management plan that focused on the creation and enhancement of habitat and long-term population monitoring. Because of activities related to the proposed Turkey Point Units 6 and 7, aquatic resources in the canals could be affected by placement of fill to support construction activities, dewatering of excavations, stormwater runoff during construction and operation, and disposal of the “muck” excavated from the proposed Units 6 and 7 construction site along the existing IWF canal berms.

Turkey Point Nearshore Waters

Turkey Point is a narrow peninsula of land east of the Turkey Point facility that extends eastward into Biscayne Bay. The Turkey Point peninsula is the site for the proposed radial collector wells and is adjacent to the existing barge slip and canal. Much of the area consists of previously filled areas and roadways, and adjacent mangrove swamps (FPL 2010-TN272). Environmental studies in the vicinity of the Turkey Point site have included a benthic macroinvertebrate study at three locations near the Turkey Point peninsula and three stations in Card Sound on March 18, 2009 (EAI 2009-TN97), and a seagrass study along 26 transects around the peninsula on August 11 and 12, 2009 (EAI 2009-TN153).

Methods used during the benthic invertebrate sampling study included the collection of three replicate benthic samples at each station using a diver-operated core sampler with a surface area of 225 cm^2. Samples were collected along a single transect line at 250, 500, and 750 ft from shore (EAI 2009-TN97). Summary information shows that crustaceans, mollusks, and polychaetes accounted for 90 percent of the total individuals collected, and the highest abundances were generally observed at the sampling station 250 ft from shore (Table 2-20). Numerically predominant species at the Turkey Point transect stations included the polychaetes

Fabrinicinuda trilobata and *Exogone dispar*, the mollusk *Caecum pulchellum*, and the amphipod *Shoemakerella cubensis* (EAI 2009-TN97).

Table 2-20. Summary of Benthic Invertebrate Abundances near Turkey Point

Classification	Distance from Shore (ft) 250	500	750	Total
Crustaceans	207	50	63	**320**
Echinoderms	5	3	0	**8**
Miscellaneous taxa	28	37	20	**85**
Mollusks	79	64	78	**221**
Polychaetes	224	64	47	**335**
Total	543	218	208	**969**

Source: EAI 2009-TN97

On August 11 and 12, 2009, a seagrass survey around the Turkey Point peninsula was conducted by Ecological Associates, Inc. (EAI) under contract to FPL (EAI 2009-TN153). The survey encompassed a total area of approximately 49 ha and included 26 transects surrounding the Turkey Point peninsula. Transects were approximately 300 m long and spaced approximately 50 m apart (EAI 2009-TN153). At each transect, divers recorded the seagrass conditions (species and percent cover) at the shoreward and seaward end of each transect, and at 50 m intervals in between for a total of seven observation locations per transect. At each location, seagrasses were identified to species, and their percent cover was visually estimated. As described in the survey report (EAI 2009-TN153), the Braun-Blanquet method was used to estimate percent cover and species contribution. Two species of seagrass were documented in the study area: turtle grass (*Thalassia testudinum*) and shoal grass (*Halodule wrightii*); turtle grass was the more abundant of the two species (EAI 2009-TN153). Turtle grass coverage was highest in areas immediately surrounding the peninsula and generally decreased with increasing distance from shore. Average Braun-Blanquet coverage was estimated to be 25 to 50 percent. Shoal grass was less abundant and generally more restricted in its distribution; it occurred most often in shallow water near the shoreline (EAI 2009-TN153). Braun-Blanquet coverage was estimated to be <5 percent and was completely absent at most sampling stations. Various species of macroalgae were also observed during the survey, including *Halimeda* spp., *Penicillius* spp., *Udotea* spp., and *Laurecia* spp., and at times approached 100 percent coverage over some sampling locations (EAI 2009-TN153).

Turkey Point Barge-Turning Basin

The barge-turning basin was developed in 1979 and is used for transport of material and large components to the Turkey Point site, and historically for delivery of fuel oil to maintain existing units. The turning basin is approximately 18 ft deep, with entrance channel depths between 8 and 12 ft. The turning basin is 300 ft by 1,200 ft (FPL 2014-TN4058). The turning basin was surveyed in 2008 (FPL 2014-TN4058) for submerged aquatic vegetation, and was found to have sparse, patchy seagrass beds that primarily occur along the northern shore of the basin. FPL documented a total of 170 ft^2 (0.004 ac) of seagrass which was turtlegrass (*Thalassia testudinum*) and shoal grass (*Halodule wrightii*), with patch densities of 5 to 20 percent coverage in several small areas (FPL 2014-TN4058). Green algae (*Caulerpa paspaloides* var. *laxa*) and algae (*Acetabularia calyculus*) were also documented; green algae occurred along the southern edge of the basin and northeastern shore of the basin in areas of approximately 24 ft^2, and the algae co-occurred with green algae in the same area of the northeastern shore (FPL 2014-TN4058).

Offsite Aquatic Resources

Offsite aquatic resources include Biscayne Bay and its associated park and preserve; FKNMS; Card Sound and Canal; the EMB, Model Lands Basin, and Southern Glades Addition; as well as Everglades National Park and the Crocodile Lake National Wildlife Refuge.

<u>Biscayne Bay, Biscayne National Park, Biscayne Bay Aquatic Preserve</u>

Biscayne Bay and regions encompassing Biscayne National Park and Biscayne Bay Aquatic Preserve are a shallow subtropical saline lagoon that extends the length of Miami-Dade County (Figure 2-28). The eastern edge of the bay is bordered by a series of barrier islands that form the Florida Keys in Monroe County, and (from north to south) Virginia Key, Key Biscayne, Soldier Key, and Boca Chita Key, in Miami-Dade County. The western boundary of the bay is mainland, and the northern boundary of the bay near Miami is highly urbanized. Connection to the Atlantic Ocean is greatest north of Boca Chita where open access to the ocean is present in an area called "the Safety Valve," and most restricted in the southern bay at Card Sound and Barnes Sound due to the presence of Key Largo and associated barrier islands. The average depth of the bay is approximately 5 ft at mean lower low water; its maximum depth is approximately 13 ft. Salinity is highly variable, ranging from approximately 24 to 44 ppt, and highly influenced by rainfall and the point-source discharges of the existing canal systems. Annual natural water temperatures range from approximately 59°F to 92°F (15°C to 33°C) at the surface (FPL 2014-TN4058). The shallow depths of the bay and maximum spring tidal range of 0.9 m (3 ft) result in a vertically well-mixed system with weak stratification except in Biscayne Bay at the mouths of drainage canals (Wang et al. 2003-TN105).

Biscayne National Park was first established in 1968 as a national monument and was expanded in 1980 to approximately 173,000 ac of water, coastal lands, and 42 islands. Activities such as boating, snorkeling, and recreational and commercial fishing are allowed in the park, and numerous environmental studies are conducted or sponsored by the NPS to assess the condition of natural resources within park boundaries and provide information to support preservation and restoration activities (NPS 2011-TN184). The Biscayne Bay Aquatic Preserve (BBAP) includes 67,000 ac of sovereign submerged lands in Biscayne Bay and is managed by the FDEP's Office of Coastal and Aquatic Managed Areas. Waters within the BBAP are designated as an OFW, which affords special protection because of their natural attributes (FPL 2014-TN4058). A portion of the BBAP is located approximately 0.5 mi east of the proposed Units 6 and 7 plant area (FPL 2014-TN4058).

As noted above, Biscayne Bay was hydrologically connected to the Greater Everglades ecosystem through a series of tributaries, sloughs, and groundwater flow, and possessed both estuarine and marine habitats (Browder et al. 2005-TN151). Subsequent development of an extensive canal system has substantially changed the hydrodynamics, resulting in pulsed discharge of freshwater into the bay via point-sources at intervals that are dissimilar in timing and duration to pre-development patterns. As a result, large discharges now occur during the wet season (May through October), and less freshwater reaches the bay during the dry season

(November through April) (Wang et al. 2003-TN105). Freshwater discharge has contributed to bottom scouring, rapid salinity fluctuations, and changes in benthic and nearshore habitats that affect the growth, survival, and reproduction of many species (Browder et al. 2005-TN151).

Biscayne Bay in its present form supports a dynamic assemblage of fish, invertebrates, marine mammals, and extensive seagrass beds. As described by Browder et al. (2005-TN151), at least seven species of seagrass occur in Biscayne Bay, and seagrass has been documented to cover up to 64 percent of the bay bottom. Common seagrass species include turtle grass, shoal grass, manatee grass (*Syringodium filiforme*), widgeongrass (*Ruppia maritime*), and three species of *Halophila*, including *H. johnsonii,* which is Federally protected species (Browder et al. 2005-TN151). Coastal mangrove communities are also present, and provide important habitat for many estuarine fish and invertebrate species. In a study from 1998 to 2005, Serafy et al. (2007-TN215) found that mangrove-lined shorelines of Biscayne Bay were used by subadult and adult Gray Snapper (*Lutjanus griseus*), juvenile Great Barracuda (*Sphyraena barracuda*), and adult Goldspotted Killifish. Species identified by Browder et al. (2005-TN151) of special relevance and utility for monitoring and assessment of Biscayne Bay included pink shrimp (*Farfantenaeus duorarum*), blue and stone crabs (*Callinectes sapidus* and *Menippe mercenaria*), oysters (*Crassostrea* spp.), estuarine fish communities, common bottlenose dolphin (*Tursiops truncatus*), American crocodile, Florida manatee, and wading birds. Representative marine species identified by Robles et al. (2005-TN198) to assess the condition of marine resources in Biscayne National Park included spiny lobster (*Panulirus argus*), Red Grouper (*Epinephelus morio*), Red Drum (*Sciaenops ocellatus*), and Gray Snapper.

During the process of developing the salinity target for western portions of Biscayne Bay, the NPS identified six taxa considered to be highly dependent on estuarine salinities: the American crocodile, the Spotted Seatrout (*Cynoscion nebulosus*), Mojarra (*Eucinostomus* spp.), Silver Perch (*Bairdiella chrysoura*), pink shrimp, and eastern oyster (*Crassostrea virginica*) (NPS 2006-TN183). Additional information about the spatial and temporal distribution, relative abundance, and life history characteristics of 40 fish and invertebrate species in 20 estuaries along the Atlantic coast of North Carolina, South Carolina, Georgia, and Florida (including Biscayne Bay) is provided by Nelson et al. (1991-TN174). Of the 40 species included in the assessment, 20 were either not present or were considered rare in Biscayne Bay, including the blue mussel (*Mytilus edulis*), common ranga (*Rangia cuneata*), white shrimp (*Litopenaeus setiferus,* formerly *Penaeus setiferus*), Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), Blueback Herring (*Alosa aestivalis*), and Alewife (*A. pseudoharengus*). Nineteen species were common or highly abundant as adults, spawning adults, juveniles, larvae, or eggs in salinities ranging from 0.5 to >25 ppt (Table 2-21). This list, and the information above, represent a reasonable starting point for identifying ecologically, recreationally, or commercially important species in Biscayne Bay that may be affected by the construction and operation of the new units at Turkey Point, as required by ESRP 2.4.2 (NRC 2000-TN614).

<u>Florida Keys National Marine Sanctuary</u>

The FKNMS was designated on November 16, 1990, and is one of 14 marine protected areas in the National Oceanographic and Atmospheric Administration's (NOAA's) National Marine Sanctuary System. Sanctuary borders encompass 2,900 mi^2 of water surrounding the Florida Keys extending from south of Miami to the Dry Tortugas, excluding Tortuga National Park.

Table 2-21. Relative Abundance of Aquatic Species Commonly Found in Biscayne Bay for Given Salinity Ranges

Common Name	Scientific Name	Adult	Spawning Adults	Juveniles	Larvae	Eggs
Bay scallop	*Argopectin irradians*	Common >25 ppt	Common >25 ppt	Common >25 ppt	Common >25 ppt	Common >25 ppt
American oyster	*Crassostrea virginica*	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt
Hard clam	*Mercenaria* sp.	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt
Pink shrimp	*Penaeus duorarum*	Not present	Not present	Highly abundant 0.5 - >25 ppt	Highly abundant 0.5 - >25 ppt	Not present
Grass shrimp	*Palaemonetes pugio*	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt
Blue crab	*Callinectes sapidus*	Abundant to highly abundant 0.5 - >25 ppt	Common to abundant 0.5 - >25 ppt	Abundant to highly abundant 0.5 - >25 ppt	Abundant 0.5 - >25 ppt	Abundant 0.5 - >25 ppt
Ladyfish	*Elops saurus*	Common 0.5 - >25 ppt	Not present	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Not present
American Eel	*Anguilla rostrata*	Common 0.5 - >25 ppt	Not present	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Not present
Bay Anchovy	*Alosa mitchilli*	Highly abundant 0.5 - >25 ppt	Highly abundant 0.5 - >25 ppt	Highly abundant 0.5 - >25 ppt	Highly abundant 0.5 - >25 ppt	Highly abundant 0.5 - >25 ppt
Sheepshead Minnow	*Cyprinodon variegatus*	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt
Mummichug	*Fundulus heteroclitus*	Not present	Not present	Not present	Not present	Not present
Atlantic Silverside	*Menidia menidia*	Abundant 0.5 - >25 ppt	Abundant 0.5 - >25 ppt	Abundant 0.5 - >25 ppt	Abundant 0.5 - >25 ppt	Abundant 0.5 - >25 ppt
Gray snapper	*Lutijanus griseus*	Highly abundant 0.5 - >25 ppt	Not present	Highly abundant 0.5 - >25 ppt	Abundant to highly abundant 0.5 - >25 ppt	Not present
Pinfish	*Lagodon rhomboids*	Highly abundant 0.5 - >25 ppt	Not present	Highly abundant 0.5 - >25 ppt	Highly abundant 0.5 - >25 ppt	Not present
Spotted Seatrout	*Cynoscion nebulosus*	Common 0.5 - >25 ppt	Common >25ppt	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Common >25 ppt
Spot	*Leiostomus xanthurus*	Common 0.5 - >25 ppt	Not present	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Not present
Striped Mullet	*Mugil cephalus*	Common 0.5 - >25 ppt	Not present	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Not present
Spanish Mackerel	*Scomberomorus maculates*	Common 0.5 - >25 ppt	Not present	Common 0.5 - >25 ppt	Common >25 ppt	Not present
Gulf Flounder	*Paralichthys albigutta*	Common 0.5 - >25 ppt	Not present	Common 0.5 - >25 ppt	Common 0.5 - >25 ppt	Not present

Source: Adapted from Nelson et al. 1991-TN174.

FKNMS includes all of Card Sound and a slender area of Biscayne Bay to the east of Biscayne National Park. Biscayne National Park's eastern and southern boundaries are FKNMS boundaries as well. Natural features within sanctuary boundaries include extensive seagrass beds, mangrove-fringed islands, and the world's third-largest barrier reef. NOAA estimates more than 6,900 species of marine life are found in the waters of FKNMS (NOAA 2014-TN3201).

Card Sound and Card Sound Canal

Card Sound is a shallow bay south of the Turkey Point site (Figure 2-28) wholly within the FKNMS with limited connection to the Atlantic Ocean. The mangrove forests surrounding Card Sound are part of the longest continuous stretches of mangroves remaining on the east coast of Florida, and they serve as food and refuge for approximately 70 percent of the area's commercially and recreationally important marine species (FPL 2014-TN4058). Both Biscayne Bay and Card Sound are nursery areas for the spiny lobster, and the area from Cape Florida near Key Biscayne south to Card Sound is designated as the Biscayne Bay-Card Sound Lobster Sanctuary by the State of Florida (FPL 2014-TN4058).

In 2008 and 2009, EAI conducted a study in Card Sound near the Turkey Point site to characterize fish and shellfish resources. Sampling was conducted every other week from March 4, 2008 to February 17, 2009, for a total of 26 sampling events at three locations along the western shore of Card Sound near the southern boundary of Biscayne Bay. Trawl samples were used to collect juvenile and adult fish and shellfish; towed nets were used to collect icthyoplankton and shellfish larvae (EAI 2009-TN154). Table 2-22 provides a summary of the baseline aquatic resource sampling results for fish in Card Sound and Card Sound Canal in 2008-2009.

During the fish survey, a total of 4,679 individual fish were captured; the overall catch per unit effort (CPUE) was 7.5 specimens captured per 100 m trawled. Seven species accounted for 90 percent of the total captured; Pinfish were the most numerous (Table 2-22).

During the March 2008 to February 2009 sampling period, a total of 2,063 shellfish were collected with an overall CPUE of 3.3 specimens per 100 m trawl. Four species accounted for 90 percent of the total captured; pink shrimp were the most abundant, followed by other penaeid shrimp (*Farfantepenaeus* spp.), ornate blue crab (*Callinectes ornatus*), and Caribbean spiny lobster (*Panulirus argus*) (Table 2-23).

EAI (2009-TN154) also collected icthyoplankton samples from Card Sound from March 2008 to February 2009. For the assessment of fish egg abundance, a total of 26,277 eggs were collected from 3,991.6 m^3 of water, resulting in an overall density of 6.6 eggs per cubic meter. The majority of fish eggs were unidentified; approximately 12 percent were determined to be herring eggs (EAI 2009-TN154). Fish larvae sampling identified a total of 3,152 fish larvae representing 47 taxa in plankton samples, resulting in an average of 0.8 larvae per cubic meter of water. Larvae of gobies (family Gobiidae) accounted for approximately 22 percent of the total captured, followed by herring and blennies (family Labrisomidae and Chaenopsidae). In all, 10 taxa represented 90 percent of the total numbers collected (Table 2-24). The March 18, 2009 invertebrate study also included collections from three transects in Card Sound near the southern end of the Turkey Point site (EAI 2009-TN97). Crustaceans were the most numerically abundant taxa, followed by mollusks and polychaetes (Table 2-25). The general conclusion of EAI (2009-TN154) was that the 2008-2009 sampling of Card Sound was comparable to previous studies in Biscayne Bay.

Table 2-22. Fish Species Composing 90 Percent of the Total Catch in Card Sound during 2008-2009 Sampling Events

Common Name	Scientific Name	Total Number Collected	Percentage of Total	Catch per Unit Effort
Pinfish	*Lagodon rhomboides*	919	19.64	1.47
Bluestriped Grunt	*Haemulon sciurus*	591	12.63	0.94
Silver Jenny	*Eucinostomus gula*	577	12.33	0.92
White Grunt	*Haemulon plumierii*	544	11.63	0.87
Fringed Pipefish	*Anarchopterus criniger*	324	6.92	0.52
Scrawled Cowfish	*Acanthostracion quadricornis*	192	4.10	0.31
Gulf Toadfish	*Opsanus beta*	172	3.68	0.27
Gray Snapper	*Lutjanus griseus*	156	3.33	0.25
Planehead Filefish	*Stephanolepis hispida*	152	3.25	0.24
Mojarra	*Eucinostomus* spp.	130	2.78	0.21
Sea Bream	*Archosargus rhomboidalis*	104	2.22	0.17
Striped Burrfish	*Chilomycterus schoepfii*	82	1.75	0.13
Bandtail Puffer	*Sphoeroides spengleri*	81	1.73	0.13
Fringed Filefish	*Monocanthus ciliates*	72	1.54	0.11
Hogfish	*Lachnolaimus maximus*	57	1.22	0.09
Trunkfish	*Lactophrys trigonus*	40	0.85	0.06
Grass Porgy	*Calamus arctifrons*	39	0.83	0.06

Source: Adapted from EAI 2009-TN154.

Table 2-23. Shellfish Species Composing 90 Percent of the Total Catch in Card Sound during 2008-2009 Sampling Events

Common Name	Scientific Name	Total Number Collected	Percentage of Total	Catch per Unit Effort
Pink shrimp	*Farfantepenaeus duorarum*	1,153	55.89	1.84
Penaeid shrimp	*Farfantepenaeus* spp.	354	17.16	0.56
Ornate blue crab	*Callinectes ornatus*	187	9.06	0.30
Caribbean spiny lobster	*Panulirus argus*	172	8.34	0.27

Source: Adapted from EAI 2009-TN154.

Table 2-24. Fish Larvae Composing 90 Percent of the Total Collection in Card Sound during 2008-2009 Sampling Events

Common Name	Scientific Name	Total Number Collected	Percentage of Total	Catch per Unit Effort
Gobies	Family Gobiidae	921	29.22	0.2307
Herring	Family Clupeidae	509	16.15	0.1275
Labrisomid blennies	Family Labrisomidae	313	9.93	0.0784
True blennies	Family Chaenopsidae	257	8.15	0.0644
Hardhead Silverside	*Atherinomorus stipes*	234	7.42	0.0586
Code Goby	*Gobiosoma robustum*	203	6.44	0.0509
Spotted Dragonet	*Diplogrammus pauciradiatus*	132	4.19	0.0331
Sleepers	Family Eoeotridae	117	3.71	0.0293
Gobies	Suborder Gobioidei	86	2.73	0.0215
Herring-like fishes	Order Clupeiformes	71	2.25	0.0178

Source: Adapted from EAI 2009-TN154

Table 2-25. Summary of Benthic Invertebrate Abundances near Card Sound

	Distance from Shore (ft)			
Classification	250	500	750	Total
Crustaceans	234	498	268	**1,000**
Echinoderms	3	16	9	**28**
Miscellaneous taxa	31	4	26	**61**
Molusks	129	132	179	**440**
Polychaetes	27	45	88	**160**
Total	424	695	570	**1,689**

Source: EAI 2009-TN97

Everglades Mitigation Bank, Model Lands Basin, and Southern Glades Addition

The EMB is a 13,000 ac expanse of freshwater and estuarine wetlands west and south of the IWF (Figure 2-29). The EMB is owned and operated by FPL and is used as a commercial mitigation bank with wetland habitat credits that can be purchased to offset regional wetland impacts. The Model Lands Basin and Southern Glades Addition are also located to the west and south of the Turkey Point site. These areas represent a collaborative effort by the Environmentally Endangered Lands Program of Miami-Dade County and the SOR Program of the SFWMD to restore the natural environments of Biscayne Bay and its watershed. This area encompasses approximately 34,000 ac of freshwater and coastal wetlands, excluding the land reservations by RMC South Florida, Inc. and FPL for permitted industrial and/or mitigation uses, as described above (SFWMD 2005-TN217). These areas serve as habitat and refuge for a variety of birds, fish, reptiles, amphibians, and mammals, including numerous Federal and State threatened or endangered species. Key management issues in these locations include the continuing loss of habitat in adjacent areas due to land-use conversion, the presence of invasive and exotic species, and damage associated with unauthorized public use, including the discharge of firearms and solid waste dumping (SFWMD 2005-TN217).

Everglades National Park and Crocodile Lake National Wildlife Refuge

Everglades National Park is located south and west of the Turkey Point site and encompasses 2,353 mi^2 of wetlands, uplands, and submerged lands. The distance from the western border of the park to the boundary of the Turkey Point property ranges from 6 to 13 mi. The park was authorized by Congress in 1934 and established in 1947 to protect the biological resources of the southern Everglades ecosystem. Important ecosystem features of Everglades National Park include sawgrass sloughs, tropical hardwood hammocks, mangrove forests, and numerous lakes, ponds, and bays that sustain many threatened and endangered species (USACE 2010-TN113). Nearly 300 species of fish inhabit the freshwater marshes and marine coastlines of Everglades National Park, and fishing is popular within park boundaries. American alligator (*Alligator mississippiensis*), American crocodile, and sea turtles are found in Everglades National Park. Marine mammals documented within park boundaries include pilot whales (*Globicephala macrorhyncha*), common bottlenose dolphin, and Florida manatee (NPS 2010-TN194).

The 6,600 ac Crocodile Lake National Wildlife Refuge is approximately 10 mi south of the Turkey Point site, and it serves as a refuge for crocodiles and other wildlife requiring mangrove habitats.

2.4.2.2 Aquatic Resources – Transmission Lines and Related Pipeline

This section provides a general description of the proposed transmission lines that would need to be constructed or upgraded to support proposed Units 6 and 7 followed by a summary of the aquatic resources that are or could be present in those areas. Aquatic resources that may occur near the proposed pipeline are expected to be similar to those collocated transmission lines (Clear Sky to Davis and Davis to Miami). Detailed information about the proposed transmission line routes and configurations are provided in Section 2.2.2; additional information is provided in the Section 9 of SCA Rev 1 (FPL 2010-TN272), ER Revision 6, Section 2.2.2 (FPL 2014-TN4058), and the supplemental information about transmission corridor information provided by FPL in 2013 (FPL 2013-TN2941).

East Transmission Corridor

As described in Section 2.2.2, a new 230 kV approximately 19 mi long transmission line would be constructed to connect the proposed new Clear Sky substation to the existing Davis substation, and a new approximately 18 mi long 230 kV line would be constructed to connect the Davis substation to a new 230 kV bay position at the Miami substation. FPL stated (FPL 2014-TN4058) that these transmission lines would be largely collocated in an existing right-of-way or other linear/transportation corridors. Along the Clear Sky to Davis route, streams, waterways, and canals account for about 2 percent of the land cover, and mangrove swamps account for approximately 10 percent of the land use. Streams, waterways, canals, and reservoirs along the Davis to Miami Route account for less than 2 percent of the land use (FPL 2014-TN4058).

West Corridor Options

As described in Section 2.2.2, FPL has outlined two options for the West corridor that connects the Clear Sky, Levee, and Pennsuco substations. The two options differ primarily as to where the corridor would pass with respect to the Everglades National Park. The first option, termed the West Preferred corridor, passes along a segment of the eastern perimeter of the park. The second option, termed the West Consensus corridor, avoids the park perimeter by passing through lands to the east used mostly for limerock mining. The West Consensus corridor was certified in 2014 as the primary corridor for the location, construction, and operation of electrical transmission lines, and the West Preferred corridor was identified as the backup location (State of Florida 2014-TN3637). Land use associated with these corridors is predominantly related to farming activities. Aquatic habitats along the routes (e.g., streams, waterways and canals) represent between 16 percent and 36 percent of the land use, and vary with respect to the route chosen and transmission line segment (FPL 2013-TN2941).

Aquatic Resources

Table 2-26 lists the fish species that could occur in open water habitats associated with the proposed transmission line and pipeline corridors in Miami-Dade County based on information provided in ER Revision 6 (FPL 2014-TN4058). Based on FNAI findings, FPL believes the only State of Florida fish Species of Special Concern in Miami-Dade County that could potentially occur along the proposed transmission line and pipeline corridors is the Mangrove Rivulus (*Rivulus marmoratus*), although the corridors would not include ideal habitat (mangrove) for the fish (FPL 2014-TN4058). Federally or State-listed species that could potentially occur in transmission line and pipeline corridors include the American alligator and the Florida manatee, which may be found in the canal systems adjacent to the transmission and pipeline corridors. A discussion of these species follows. Because any or all of these species could potentially occur in the aquatic and wetland habitats crossed by the proposed corridors, the review team assumes threatened and endangered species surveys would occur prior to building.

Table 2-26. Fish Species that Could Occur in Open Water Habitats Associated with the Proposed Transmission Line Corridors in Dade County, Florida

Common Name	Scientific Name
Florida Species of Special Concern	
Mangrove Rivulus	*Rivulus marmoratus*
Common Native Freshwater Forage Fish	
Mosquitofish	*Gambusia holbrooki*
Sailfin Molly	*Poecilia latipinna*
Least Killifish	*Heterandria formosa*
Sunfishes	*Lepomis* spp.
Gars	*Lepisosteus* spp.
Common Non-Indigenous Fish	
Peacock Bass	*Cichla ocellaris*
Spotted Tilapia	*Tilapia mariae*
Blue Tilapia	*Oreochromis aureus*
Mayan Cichlid	*Cichlasoma urophthalmus*
Jaguar Guapote	*Cichlasoma managuense*
Oscar	*Astronotus ocellatus*

Source: ER Rev 6 (FPL 2014-TN4058)

2.4.2.3 Aquatic Species and Habitats

Important aquatic species are defined in ESRP 2.4.2 (NRC 2000-TN614) as all life stages that are critical to the structure and function of the local aquatic ecosystem, and include the following:

- rare species, defined as (1) those listed as threatened or endangered or designated as experimental populations or species by FWS or NMFS; (2) species listed as threatened or endangered by State agencies; and (3) Species of Concern as identified by State or Federal agencies
- commercially or recreationally valuable, or subsistence species
- species essential to the maintenance or survival of species that are rare and commercially or recreationally valuable
- species that serve as biological indicators to monitor the effects of the facilities on the aquatic environment
- marine mammals.

Ecologically, Commercially, and Recreationally Important Species

Table 2-27 lists species considered by the review team to be ecologically, commercially, and recreationally important to Biscayne Bay in the vicinity of the Turkey Point site based on the data and information presented above and past studies. These species contribute to the structure and function of Biscayne Bay, and could potentially be affected by the construction and operation of proposed Units 6 and 7. Table 2-27 also includes non-native and invasive species that occur in Biscayne Bay and have the potential to influence ecosystem dynamics. Federally and State-listed species are discussed later in this section. Brief descriptions of the life histories of species presented in Table 2-27 follow. The susceptibility of these species to adverse impacts associated with the construction and operation of the proposed Units 6 and 7 at Turkey Point is discussed in Chapters 4 and 5, respectively. Separate discussions are provided for Federally or State-listed species, and for those species with designated essential fish habitat.

<u>Marine Mammals</u>

The Biscayne Bay stock of common bottlenose dolphins is bounded to the north by Haulover Inlet (north of Miami) and to the south by the Card Sound Bridge, south of the Turkey Point site. Population trend data are not available for the Biscayne Bay stock, but NOAA initiated a photo-identification project for this species in 1990 (NOAA 2011-TN182). Threats to dolphins include coastal pollution, fatal interactions with crab and lobster pots, and entanglement in fishing gear (NOAA 2009-TN175). As discussed below, manatee are also present in Biscayne Bay. Marine mammals may also be sensitive to noise and vibration associated with nearshore construction activities and radial collector well installation.

Table 2-27. Ecologically, Recreationally, and Commercially Important Aquatic Species Likely to Occur at or near the Turkey Point Site

Common Name	Scientific Name	Classification	Designation[(a)]	Citation
Common bottlenose dolphin	*Tursiops truncatus*	Marine Mammal	Eco	(b)
Common Snook	*Centropomus undecimalis*	Game fish	Rec, Eco	(c)
Tarpon	*Megalops atlanticus*	Game fish	Rec, Eco	(c)
Spotted Seatrout	*Cynoscion nebulosus*	Game fish	Eco, Rec	(d)
Red Drum	*Sciaenops ocellatus*	Game fish	Eco, Com, Rec	(e)
Red Grouper	*Epinephelus morio*	Game fish	Eco, Com, Rec	(e)
Gray Snapper	*Lutjanus griseus*	Forage fish	Eco, Com, Rec	(e)
Mojarras	*Eucinostomus* spp.	Forage fish	Eco	(d)
Silver Jenny	*Eucinostomus gula*	Forage fish	Eco	(d)
Grunts	*Haemulon* spp.	Forage fish	Eco, Com, Rec	(f)
Bluestriped Grunt	*Haemulon sciurus*	Forage fish	Eco, Com, Rec	(f)
Fringed Pipefish	*Anarchopterus criniger*	Forage fish	Eco	(f)
Pinfish	*Lagodon rhomboides*	Forage fish	Eco, Rec	(f)
Sheepshead Minnow	*Cyprinodon variegatus*	Forage fish	Eco	(c)
Killifishes	*Fundulus* spp.	Forage fish	Eco	(c)
Mosquitofish	*Gambusia* sp.	Forage fish	Eco	(c)
Sailfin Molly	*Poecilia latipinna*	Forage fish	Eco, Com	(c)
Needlefish	*Strongylura* sp.	Forage fish	Eco	(c)
Silver Perch	*Bairdiella chrysoura*	Forage fish	Eco	(c)
Pink Shrimp	*Farfantepenaeus duorarum*	Crustacean	Eco, Com	(b, d, f)
Caribbean Spiny lobster	*Panulirus argus*	Crustaceran	Eco, Com, Rec	(e)
Blue Crab	*Callinectes sapidus*	Crustacean	Eco, Rec, Com	(b)
American Oyster	*Crassostrea virginica*	Mollusk	Eco, Rec, Com	(b, d)
Green Sea Urchin	*Lytechinus variegatus*	Echnonderm	Eco	(f)
Turtle Grass	*Thalassia testudinum*	Seagrass	Eco	(g, h)
Shoal Grass	*Halodule wrightii*	Seagrass	Eco	(g, h)
Manatee Grass	*Syringodium filiforme*	Seagrass	Eco	(g, h)
Algae	*Batophora* spp.	Macroalgae	Eco	(g)
Pacific Whiteleg Shrimp	*Litopenaeus vannamei*	Non-indigenous	Eco, Com	(i)
Lionfishes	*Pterois* spp.	Non-indigenous	Eco	(j)
Mayan Cichlid	*Cichlasoma urophthalamus*	Non-indigenous	Eco	(j)
Oscar	*Astronotus ocellatus*	Non-indigenous	Eco	(j)
Asiatic Clam	*Corbicula fluminea*	Non-indigenous	Eco	(k)
Zebra Mussel	*Dreissena polymorpha*	Non-indigenous	Eco	(k)

(a) Eco = ecologically important; Rec = recreationally important; Com = commercially important.
(b) Identified as species of special relevance and utility for monitoring and reporting the state of the Biscayne Bay by Browder et al. (2005-TN151)
(c) Documented in ER Rev 6 (FPL 2014-TN4058)
(d) Used by NPS (2006-TN183) to develop salinity targets for Western Biscayne Bay
(e) Representative marine species identified by Robles et al. (2005-TN198) to assess the condition of marine resources in Biscayne National Park
(f) Numerically abundant in Card Sound (EAI 2009-TN154)
(g) Abundant near Turkey Point site (EAI 2009-TN153)
(h) Common in Biscayne Bay (b).
(i) Non-indigenous crustacean species used in aquaculture (FAO 2012-TN155)
(j) Non-indigenous fish Species of Concern (NPS 2011-TN185)
(k) Non-indigenous mollusk species in freshwater systems (Ogden et al. 2005-TN196)

Game Fish

Examples of game fish common to Biscayne Bay in the vicinity of the Turkey Point site that could be affected by the construction and operation of proposed Units 6 and 7 include Common Snook, Tarpon, Spotted Seatrout, Red Drum, and Red Grouper (Table 2-27). Many of these species have been included in monitoring programs to assess the condition of Biscayne Bay, or were numerically abundant in recent collections near the Turkey Point site and are presented in Table 2-22. Unless otherwise noted, the following life history information was obtained from the Florida Museum of Natural History (FMNH 2012-TN167).

Common Snook (*Centropomus undecimalis*). Common Snook can tolerate a wide range of salinities but cannot tolerate water temperatures below 60°F. The lower lethal limit of water temperatures is 48.2 to 57.2°F for juveniles, and 42.8 to 53.6°F for adults. Primary prey of Common Snook include small fish, crabs, and mollusks (FFWCC 2011-TN159).

Tarpon (*Megalops atlanticus*). Tarpon are common in coastal waters from Virginia to central Brazil, inhabiting coastal waters, bays, estuaries, and mangrove-lined lagoons. Tarpon are also tolerant to a wide range of salinities (0 to 47 ppt) and low dissolved oxygen conditions but prefer water temperatures ranging from 72 to 82°F. Juveniles are planktiverous, and adults are carnivorous, and feed on a variety of smaller fish, shrimp, and crab. Only recreational Tarpon fishing is allowed in Florida (FFWCC 2011-TN159).

Spotted Seatrout (*Cynoscion nebulosus*). The geographical range of Spotted Seatrout is limited to the western Atlantic from Cape Cod, Massachusetts, to southern Florida and the Gulf of Mexico. In Biscayne Bay, adults, spawning adults, juveniles, larvae, and eggs are present in salinities ranging from 0.5 to >25 ppt (Nelson et al. 1991-TN174). During the summer months, seatrout are found in seagrass beds, and they move to deeper pockets of water in estuaries during the cooler months. Migration out of nursery estuaries is rare.

Red Drum (*Sciaenops ocellatus*). The Red Drum is a euryhaline species found along the Atlantic and Gulf of Mexico coasts from Cape Cod, Massachusetts, to Tuxpan, Mexico. Red Drum are found in a variety of habitats, including estuaries, river mouths, bays, and seagrass beds. Adults are generally found in salinities of 30 to 35 ppt, and are tolerant of temperatures ranging from 39 to 83°F. The Red Drum is harvested commercially, is a popular recreational species, and has been used in commercial aquaculture operations.

Red Grouper (*Epinephelus morio*). The Red Grouper is found in the western Atlantic Ocean from North Carolina to southern Brazil, including the Gulf of Mexico and the Caribbean Sea. This species can be found in depths ranging from 16 to over 1,000 ft on both rocky and muddy substrates. Juveniles are generally found in seagrass beds. Predators include larger fish, including sharks and Great Barracuda. Although Red Grouper are fished commercially and recreationally, they are considered overfished in the South Atlantic, and harvests in U.S. waters have decreased by 50 percent over the past 55 years.

Forage Fish

Aquatic areas within FPL property and in Biscayne Bay near the Turkey Point site support a diverse assemblage of forage fish that could be affected by the construction and operation of proposed Units 6 and 7. In addition to providing food for a variety of larger fish, turtles, birds, and marine mammals, many have been used as representative species to assess changes in Biscayne Bay. The following discussion focuses primarily on species common or numerically dominant in areas at or near the Turkey Point site based on the recent investigations discussed above, and those included in monitoring studies as indicator species. Unless otherwise noted, the following life history information was obtained from FMNH 2012 (TN167).

Gray Snapper. Gray Snapper are found in the western Atlantic Ocean from Massachusetts to Bermuda, and are abundant along the Florida coast. Robles et al. (2005-TN198) included this species as a surrogate for assessing the condition of marine resources in Biscayne Bay. Nelson et al. (1991-TN174) noted that Gray Snapper adults, juveniles, and larvae were abundant to highly abundant in Biscayne Bay in salinities ranging from 0.5 to >25 ppt. Young fish are found in nearshore seagrass beds and soft and sand-bottom habitats. Adults tend to remain in the same area for long periods of time. Predators include sharks, barracudas, groupers, moray eels, and other larger fish.

Mojarras (*Eucinostomus spp.*) and Silver Jenny (*E. gula*). Mojarras and Silver Jenny are forage fish common to Biscayne Bay and Card Sound. *Eucinostomus* spp. were identified by NPS (2006-TN183) as an indicator for developing salinity targets for Biscayne Bay; Silver Jenny were numerically abundant in nearby Card Sound during the 2008-2009 sampling by EAI (2009-TN154) and FPL (2014-TN4058). Optimal salinity ranges for Mojarras are considered to be approximately 10 to 20 ppt (NPS 2006-TN183).

Grunts (*Halemulon spp.*), Pipefishes (*Anarchopterus spp.*), and Pinfish (*Lagodon rhomboides*). Grunts, pipefishes, and Pinfish are common in the western Atlantic Ocean from South Carolina to Brazil, and are often found in mangroves, reefs, and seagrass beds. Juvenile grunts are abundant in turtle grass. Bluestriped and White Grunt (*H. sciurus*, *H. plumierii*), Fringed Pipefish (*A. criniger*), and Pinfish were numerically abundant during the 2008-2009 EAI sampling in Card Sound (Pinfish had the highest abundance) (EAI 2009-TN154). Predators include snappers, groupers, Spanish Mackerels, and sharks. Pinfish have also recently been considered as a candidate species for Florida aquaculture given their tolerance for a wide range of environmental conditions (Ohs et al. 2010-TN219).

Sheepshead Minnow, Killifishes (*Fundulus* spp.), Mosquitofish (Genus *Gambusia*), Sailfin Molly, and Needlefishes (*Strongylura* spp.). Sheepshead Minnow, Killifishes, Mosquitofish, Sailfin Molly, and Needlefishes are hardy forage fish that are tolerant of high salinities, and occurrences of these fish in the Turkey Point IWF are documented. Most are not common to Biscayne Bay, but Sailfin Molly are often found in shallow surface waters along the edges of marshes, ponds, and swamps. Silver Perch are found in seagrass beds, tidal creeks, rivers, and marshes, and are similar in appearance to Sand Seatrout (FFWCC 2011-TN159). The NPS (2006-TN183) included Silver Perch as an indicator species for establishing ecological targets for western Biscayne National Park.

Crustaceans and Mollusks

Pink Shrimp (*Farfantepenaeus duroarum*). Pink shrimp is an ecologically, recreationally, and commercially important species in Biscayne Bay. A commercial industry that harvests shrimp for live bait has existed in Biscayne Bay for many years, and collection of shrimp for human consumption is expanding. Juvenile pink shrimp immigrate to Biscayne Bay from offshore spawning areas and are found in seagrass beds near freshwater inputs (Browder et al. 2005-TN151). Nelson et al. (1991-TN174) indicate pink shrimp juveniles and larvae are highly abundant in Biscayne Bay in salinities ranging from 0.5 to >25 ppt; the NPS identified pink shrimp as an indicator species for Biscayne Bay with regard to evaluating and establishing salinity targets, and specified the optimal salinity range for juveniles to be from approximately 10 to 20 ppt (NPS 2006-TN183).

Caribbean Spiny Lobster (*Panulirus argus*). The Caribbean spiny lobster is the most common lobster in Biscayne Bay. In South Florida, spawning occurs from April through October, when water temperatures exceed 23°C (FFWCC 2010-TN162). Juvenile lobsters are found in nursery areas featuring seagrass meadows and algal beds; subadults and adults gradually migrate to offshore reef systems and ledges (NPS 2011-TN184). According to FFWCC (2010-TN4071), commercial landings of Caribbean spiny lobster in Florida have varied without trend since about 1970, with landings ranging from between 4.3 and 7.9 million pounds. Commercial landings are primarily from South Florida in Monroe, Miami-Dade, Collier, Palm Beach, and Broward Counties (FFWCC 2010-TN4071).

Blue Crab (*Callinectes sapidus*). In the western Atlantic, blue crab are found from Nova Scotia to Northern Argentina (FFWCC 2010-TN162). This species is commonly found in the south-central portion of Biscayne Bay, and blue crab represents an important ecological, recreational, and commercial resource. Optimum blue crab hatching takes place in salinities ranging from 23 to 28 ppt, and juveniles use seagrass habitats where salinities range from 2 to 21 ppt (Browder et al. 2005-TN151). Commercial blue crab landings in Florida reached more than 18 million pounds in 1987 and 1996, then dropped to less than 8 million pounds in 2001 and 2002. Landings in 2009 were approximately 5 million pounds (FFWCC 2011-TN2220).

American Oyster (*Crassostrea virginica*). The American oyster is present in south-central Biscayne Bay where suitable conditions are available. The presence of planktonic food and substrate for attachment of veligers is needed for oysters to survive and thrive; optimum salinity is between 12 and 28 ppt (Ogden et al. 2005-TN197; Ogden et al. 2005-TN196). Oyster reef systems are an important part of nearshore estuarine food webs and provide food for other species, substrate and habitat for benthic invertebrates and fish, and the ability to filter 4 to 34 L of water per hour that removes suspended materials (including phytoplankton, suspended organic carbon, and pollutants) from the water column (Ogden et al. 2005-TN196). Dozens to hundreds of species depend directly or indirectly on oyster reef systems for survival (Ogden et al. 2005-TN196). Because this species is sensitive to salinity and turbidity, it has been included in ecosystem conceptual models as an indicator species for water quality and was used as a species of interest by the NPS during the development of ecological targets for western Biscayne National Park (NPS 2006-TN183). Although oysters are capable of surviving in salinities of 4 to 40 ppt, the optimum salinity range for supporting reef systems is believed to be 10 to 20 ppt (NPS 2006-TN183).

Coral

In addition to the marine mammal, fish, and invertebrate species discussed above, coral reef systems are present in Biscayne Bay. These systems generally consist of a limited number of species in comparison to those present at offshore locations composing the Florida reef tract (Lirman et al. 2003-TN1519). Both staghorn (*Acropora cervicornis*) and elkhorn (*A. palmata*) corals are currently Federally threatened reef-building corals found primarily along the Atlantic coast of Florida and the Caribbean and occur in some portions of Biscayne Bay. In 2009, the Center for Biological Diversity Petition requested threatened or endangered listing of 83 species of coral occurring in U.S. waters of the Caribbean and Indo-Pacific (Center for Biological Diversity 2009-TN1518). In a subsequent 90-day finding published on February 10, 2010, NOAA determined that listing actions may be warranted for 82 of the 83 species (75 FR 6616) (TN1516). On August 27, 2014, NOAA listed 20 new coral species as threatened (NOAA Fisheries 2014-TN4022; 79 FR 53851 [TN4097]). Of these, the following are known to occur in the Florida Atlantic region:

- *Acropora cervicornis* (Staghorn coral)
- *Acropora palmata* (Elkhorn coral)
- *Mycetophyllia ferox* (Cactus coral)
- *Dendrogyra cylindrus* (Pillar coral)
- *Montastraea (Orbicella) annularis* (Boulder star coral)
- *Montastraea (Orbicella) faveolata* (Mountainous star coral)
- *Montastraea (Orbicella) franksi* (Star coral).

In its 2011 Status Review Report (Brainard et al. 2011-TN1517), NOAA indicated that all seven species have been reported in Biscayne Bay, and noted that temperature, acidification, disease, predation, land-based sources of pollution, and collection or trade as major threats to all coral species. Hard-bottomed areas near Turkey Point are generally considered a marginal habitat for coral, with fewer species occurring in the western portion of Biscayne Bay than in the central bay, east bay, and offshore locations. This is probably because of the variability in both temperature and salinity that occurs in these areas in comparison to conditions present in the central and eastern bay and offshore oceanic environments (Lirman et al. 2003-TN1519). Thus, the listed species described above are not likely to be present near Turkey Point.

Submerged Aquatic Vegetation

Submerged aquatic vegetation in Biscayne Bay includes a variety of seagrasses and calcareous algae. Seagrass beds play a key role in estuarine community dynamics, providing habitat and food sources to many vertebrate and invertebrate species, stabilizing bottom substrate, acting as nutrient and sediment traps, and contributing to primary and secondary productivity (Robles et al. 2005-TN198). At least seven seagrass species are found in Biscayne Bay, including turtle grass, shoal grass, manatee grass, widgeon grass, and three species of the genus *Halophila*, including Johnson's seagrass, a Federally protected species discussed below. As described by Robles et al. (2005-TN198), the distribution and health of seagrass beds in Biscayne Bay are influenced by a variety of natural and anthropogenic factors, including sediment depth, water depth, natural precipitation cycles, and light attenuation. In addition, the discharge of freshwater from canal systems and groundwater seepage into Biscayne Bay can influence distribution. For instance, turtle grass is often absent where groundwater seepage is present, and present where it is not (Browder et al. 2005-TN151). The general condition of Biscayne Bay seagrass communities, as reported by Robles et al. (2005-TN198) suggests some areas of the bay have experienced a slow decline in seagrass biomass, while other areas near freshwater canal outputs or areas where dredging has occurred have lost seagrass or experienced a shift to more freshwater-tolerant species, such as *Ruppia* spp. Seagrass studies conducted by EAI in August 2009 near the Turkey Point site found turtle grass and shoal grass were present at varying levels of coverage along all study transects (EAI 2009-TN153). Turtle grass was generally highest in areas immediately surrounding the Turkey Point peninsula, and generally decreased with increasing distance from shore. Shoal grass was much more restricted in distribution, occurring in the shallow-water areas near the peninsula. EAI (2009-TN153) also found that the algae *Batophora* spp. were abundant in the shallower areas along the periphery of the peninsula, and approached 100 percent coverage at some locations over small spatial scales.

<u>Non-Indigenous Species</u>

Non-indigenous species, including those identified by resource managers as exotic, non-native, alien, and introduced, are a growing concern in Florida, because their presence has the potential to alter existing food webs and alter species composition through competition, predation, or disease. As reported by Ogden et al. (2005-TN197), South Florida has one of the largest non-indigenous faunal communities in the world—more than 25 percent of the resident mammals, birds, reptiles, amphibians, and fish are classified as non-native. Non-indigenous species released into aquatic systems via the pet trade have the potential to use the existing canal systems to move into different aquatic environments, including nearshore areas of Biscayne Bay. Species used to support nearshore aquaculture industries may also be introduced intentionally or unintentionally into freshwater or nearshore ecosystems (Fuller and Nico 1999-TN172). An example of this is the introduction of Pacific whiteleg shrimp (*Litopenaeus vannamei*) into Biscayne Bay from commercial aquaculture enterprises (Ogden et al. 2005-TN197; FAO 2012-TN155). Fish Species of Concern to the NPS include the lionfish species (*Pterois volitans*, and *P. miles*) that are now common and increasing in occurrence in the bay, and Oscar (*Astronotus ocellatus*) and Mayan Cichlid (*Cichlasoma urophthalamus*), which are now found in canal systems (NPS 2011-TN185). Canal and freshwater systems are also susceptible to the spread of exotic bivalves, including the Asiatic clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) (Fuller and Benson 1999-TN171; Ogden et al. 2005-TN197). Asiatic clams have not been recognized as a nuisance to existing Turkey Point units (FPL 2014-TN4058). In recent years, the Argentine black-and-white tegu (*Tupanimbis merianae*) has been observed in southeastern Florida and is spreading rapidly in the vicinity of Turkey Point. This egg-eating reptilian omnivore has the potential to affect many species, including alligators and the endangered American crocodile, and is the subject of a multi-agency control effort (FFWCC 2014-TN4048; USGS 2014-TN4049).

Federally or State-Listed Species and Designated Critical Habitat

Based on information provided to FPL by the FWS and NOAA/NMFS (FPL 2010-TN272), information from the State of Florida (FFWCC 2013-TN3075), and examination of life history and distribution information, the review team identified one marine mammal, five species of sea turtles, two other aquatic reptiles, one fish species, and one seagrass species Federally and/or State-listed as threatened or endangered that could occur at or near the Turkey Point site (Table 2-28). The State listings in Table 2-28 reflect changes to threatened species rules that went into effect on November 8, 2010, stating that all Federally listed species that occur in Florida are now included on Florida's list as Federally designated endangered or Federally listed threatened (FFWCC 2013-TN3075). A number of other species included on the NMFS letter to FPL (2010-TN272) are either infrequent visitors to Biscayne Bay or are not reported to occur in the vicinity of the Turkey Point site. For instance, although blue whales (*Balaenoptera musculus*) finback whales (*B. physalus*), humpback whales (*Megaptera novaeangliae*), North Atlantic right whales (*Eubalaena glacialis*), sei whales (*B. borealis*), and sperm whales (*Physeter macrocephalus*) are occasionally sighted in Biscayne Bay, they are more commonly found in open-ocean or coastal environments and would not be present in the shallow waters near Turkey Point. Although the shortnose sturgeon (*Acipenser brevirostrum*) occurs in Florida waters, the southern limits of its range appear to be the St. Johns River near Jacksonville (FFWCC 2010-TN160). Likewise, the Atlantic and Caribbean coral species discussed above that are listed by NOAA may be found at offshore reef systems in Biscayne Bay, but are not known to occur at or near the Turkey Point site (NOAA Fisheries 2014-TN4022; 79 FR 53851 [TN4097]).

Table 2-28. Federally or State-Listed Species, Proposed Species, or Candidate Species Likely to Occur at or near the Turkey Point Site

Common Name	Scientific Name	Classification	Designation[(a)]
Florida manatee	*Trichechus manatus latirostris*	Marine mammal	Federally Endangered State Endangered
Green sea turtle	*Chelonia mydas*	Turtle	Federally Endangered State Endangered
Hawksbill sea turtle	*Eretmochlys imbricata*	Turtle	Federally Endangered State Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Turtle	Federally Endangered State Endangered
Loggerhead sea turtle	*Caretta caretta*	Turtle	Federally Threatened State Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Turtle	Federally Endangered State Endangered
American alligator	*Alligator mississippiensis*	Reptile	Federally Threatened (SOA)[(b)] Florida Threatened SOA)[(b)]
American crocodile	*Crocodylus acutus*	Reptile	Federally Threatened State Threatened
Smalltooth Sawfish	*Pristis pectinata*	Fish	Federally Endangered State Endangered
Johnson's seagrass	*Halophila johnsonii*	Seagrass	Federally Threatened

(a) Federally listed species that occur in Florida are now included on Florida's list as Federally designated endangered or Federally designated threatened FFWCC 2013-TN3075. See also January 9, 2009 letter from Teletha Mincey, NMFS, to FPL (SCA Appendix 10.7.1.3) (TN1897).
(b) SOA = similarity of appearance to threatened American crocodile.

Although the FWS communication identified only the American crocodile as likely to occur near the Turkey Point site, the review team included the American alligator in Table 2-28 because of its similarity in appearance to the American crocodile. The Florida manatee was also included, because it is known to occur in the vicinity of the Turkey Point barge channel, or in the nearby canal systems that discharge into Biscayne Bay. A brief description of the life histories of the species listed in Table 2-28 and a discussion of designated critical habitats, if defined, follow. Biological Assessments for FWS and NMFS are referenced in Appendix F.

Florida Manatee (*Tricechus manatus latirostris*)

The Florida manatee, a subspecies of the West Indian manatee, is a large marine mammal found in coastal and freshwater systems on both coasts of Florida. Manatees are Federally and State-listed as endangered, and their critical habitat includes “all waters of Card [Sound]… between portions of Biscayne Bay, Card Sound adjacent to the Turkey Point site, and the nearby streams, rivers, and canals” (41 FR 41914) (TN275) (Figure 2-31). Manatees have been observed in the barge-turning basin at the northern end of the Turkey Point site and in nearby state canals but not in the IWF (FPL 2014-TN4058). Areas defined by the FWS as “manatee consultation areas” include coastal regions of South Florida and large inland waterbodies such as Lake Okeechobee. Thus, the Turkey Point site would be included in the manatee consultation area (FPL 2012-TN1618). Manatees are general herbivores that are able to feed on a variety of vegetation types. They are tolerant of changes in salinity but sensitive to temperature variations because they lack a thick insulating layer of blubber common to other marine mammals (Smith 1993-TN218). Several anthropogenic activities pose threats to manatees. Deaths are attributable to the management of water-control structures and navigational locks, loss of habitat associated with coastal development (FWS 2001-TN223), and several other activities. During the winter of 2008-2009, researchers reported a disproportionately high number of manatee deaths related to cold stress; 261 carcasses were reported statewide and 1 death was reported in Biscayne Bay (FFWCC 2010-TN161). The number of deaths (51) due to watercraft strikes during the winter of 2008-2009 was also relatively high statewide. Approximately 33 percent and 31 percent of the total deaths occurred in the southeast and southwest regions, respectively (FFWCC 2010-TN161). Annual manatee deaths in Miami-Dade County from 2000 to 2012 ranged from 5 to 22, with the highest mortality observed in 2010. Of the 22 deaths reported in 2010, 1 was attributed to perinatal death, 3 were caused by watercraft, 2 were attributed to natural causes, and 16 were undetermined/unrecovered. FFWCC reported one manatee death in January 2013, the last reporting period available on their website (FFWCC 2014-TN3478). Causes of manatee deaths listed by the FFWCC (FFWCC 2014-TN3478) include collisions with watercraft, entrapment in flood gates and canal locks, cold stress, natural mortality, perinatal death, and undetermined causes.

FPL procedures for protecting manatees from collision during the construction of proposed Turkey Point Units 6 and 7 are described in the SCA Barge Delivery Plan (FPL 2009-TN169); potential construction-related impacts on this species are discussed in Chapter 4 of this EIS. Additional information about this species is found in the FWS Biological Assessment in Appendix F.

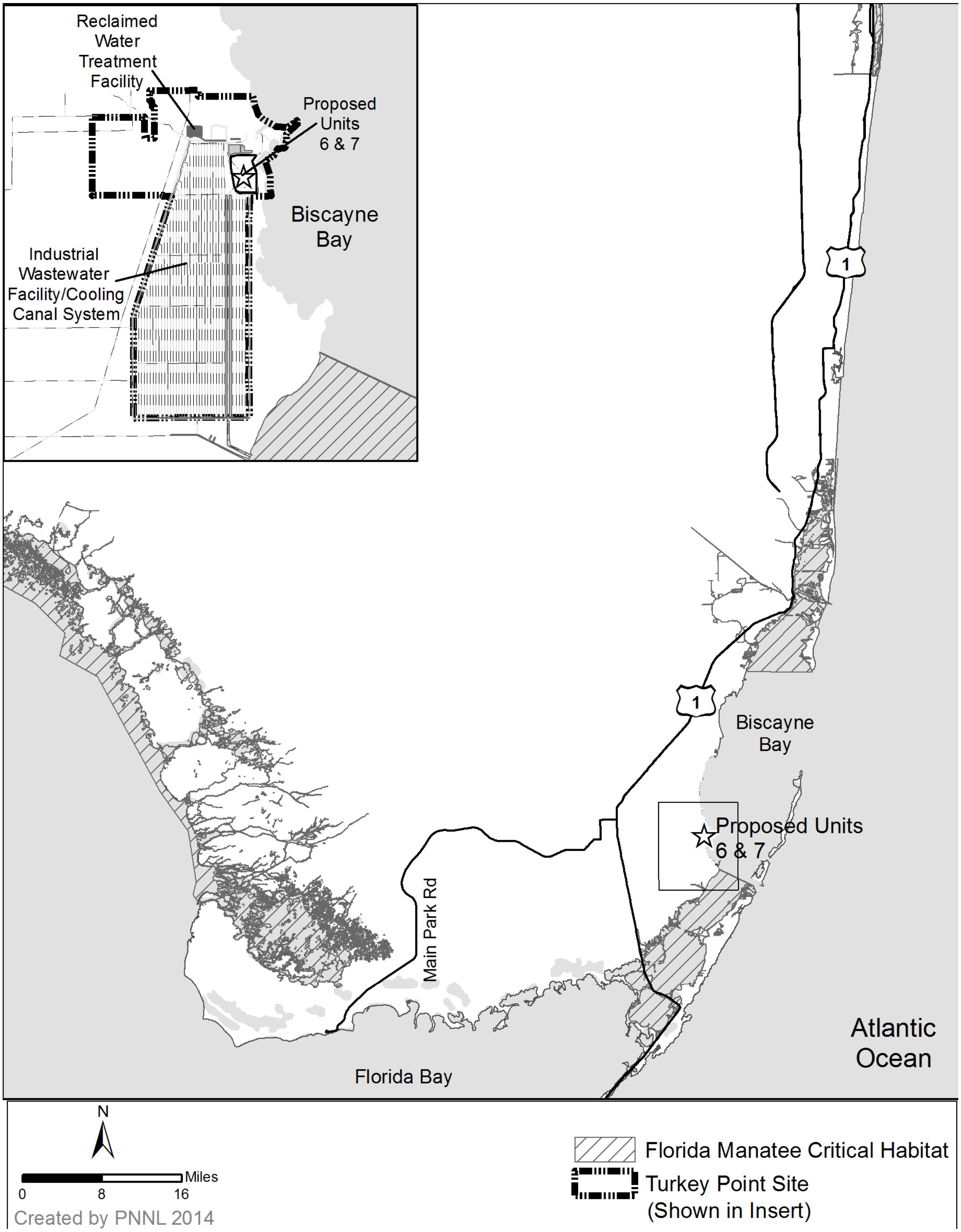


Figure 2-31. Critical Habitat for the Florida Manatee near the Turkey Point Site

Green Sea Turtle (*Chelonia mydas*)

The green sea turtle is the largest of the hard-shelled turtles and unique among sea turtles in that adults are exclusively herbivorous. The species is found in the open ocean and in coastal areas and uses beaches for nesting (NOAA 2010-TN179). Green sea turtles are relatively common in Biscayne Bay and Card Sound; they visit these areas at various times of the year to feed (FPL 2014-TN4058; FDEP 2010-TN156). Green turtles have not been reported in the IWF, but are commonly observed in Biscayne Bay. Nests have occasionally been reported on Elliott Key approximately 7 to 9 mi east and north of the Turkey Point facility (FFWCC 2014-TN3530). NMFS and FWS have joint jurisdiction for sea turtles; NOAA is the lead agency in marine environments, and FWS is the lead for nesting beaches. The green sea turtle was Federally listed under the ESA on July 28, 1978, and the Florida population is currently considered endangered by Federal and Florida resource agencies. Critical habitat was designated in 1998 to include the coastal waters around Culebra Island, Puerto Rico. General threats to green sea turtles that apply to all sea turtle species include loss of habitat associated with anthropogenic or natural stressors, harvest of eggs, and mortality associated with incidental capture or entanglement in fishing nets and gear (NOAA 2010-TN179). Additional information about this species, including information about its occurrence near Turkey Point, is found in the NMFS Biological Assessment in Appendix F.

Hawksbill Sea Turtle (*Eretmochelys imbricata*)

The hawksbill sea turtle is a medium-sized sea turtle most commonly found in coral reef systems, where the ledges and caves provide shelter (NOAA 2010-TN179). Hawksbill turtles were Federally listed under the ESA as endangered in 1970 and are currently listed as endangered by Federal and Florida resource agencies. As described above, NMFS and FWS have joint responsibility for this species. Critical habitat was designated in the coastal waters of Mona and Monito Islands, Puerto Rico, in 1998 (NOAA 2010-TN179). Hawksbill are less common in Biscayne Bay than green or loggerhead turtles, but nests have been recorded along the outer keys of the bay (FDEP 2010-TN156). Hawksbill turtles have not been reported in the IWF. Additional information about this species, including information about its occurrence near Turkey Point, is found in the NMFS Biological Assessment in Appendix F.

Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

Kemp's ridley sea turtles are the smallest marine turtle in the world; adults weigh less than 100 lb. This species is found primarily in neritic habitats containing muddy or sandy bottoms. Prey items include fish, jellyfish, and mollusks. Kemp's ridley turtles were first Federally listed under the ESA in 1973 and are currently considered endangered by Federal and Florida resource agencies; they are listed as State endangered in Monroe County but not in Miami-Dade County, Florida (FPL 2014-TN4058). Kemp's ridley turtles typically nest in large aggregations called arribadas, but no arribadas occur in Florida. In February 2010, NMFS and FWS were jointly petitioned to designate critical habitat for this species along the Texas coast and marine habitats in the Gulf of Mexico and Atlantic Ocean. This petition is currently under review (NOAA 2010-TN179). Kemp's ridley turtles have been observed in Biscayne Bay (FDEP 2010-TN156) but have not been found in the IWF. Additional information about this species, including information about its occurrence near Turkey Point, is found in the NMFS Biological Assessment in Appendix F.

Loggerhead Sea Turtle (*Caretta caretta*)

The loggerhead sea turtle is commonly found near the Turkey Point site (FPL 2014-TN4058). The loggerhead's large head and powerful jaws enable the turtle to feed on hard-shelled prey, including whelks and conchs. A circumpolar species, loggerheads occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans, and loggerheads make extensive migrations between feeding and nesting grounds. In the southwestern United States, approximately 80 percent of nesting occurs in six Florida counties (NOAA Fisheries 2014-TN4028). Loggerhead turtles are also known to nest on Elliot Key in Miami-Dade County. Suitable beach habitat for nesting apparently does not exist in the vicinity of the Turkey Point site (FPL 2014-TN4058). The loggerhead was first Federally listed under the ESA as threatened throughout its range on July 28, 1978, and the most recent status review was published in 2009 (NOAA 2010-TN179). In 2010, the loggerhead turtle listing was changed to identify nine distinct population segments (DPSs), with four DPSs listed as threatened and five listed as endangered. The loggerhead population in Biscayne Bay is included in the Northwest Atlantic DPS and considered Federally threatened (75 FR 12598) (TN2763). In 2014, NOAA designated critical habitat for the loggerhead sea turtle which includes oceanic areas east of Biscayne Bay, but does not include nearshore areas near Turkey Point (79 FR 39855) (TN4032). Loggerhead turtles are of particular interest to the Biscayne National Park because they are the most common sea turtle observed within park boundaries (NPS 2011-TN195). Loggerhead turtles have not been reported in the IWF, but nests have been reported on Elliott Key approximately 7 to 9 mi east and north of the Turkey Point facility (FFWCC 2014-TN3530). Additional information about this species, including information about its occurrence near Turkey Point, is found in the NMFS Biological Assessment in Appendix F.

Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback sea turtle is the largest reptile in the world, reaching an adult weight of 2,000 lb and a total length exceeding 6 ft. This species is unique in that it lacks a hard, bony shell. Leatherback turtles are common in open-ocean environment but also forage in coastal waters, eating soft-bodied prey. Leatherback turtles were listed under the ESA as endangered in 1970 and are currently classified as endangered by Federal and Florida resource agencies. Critical habitat that included the coastal waters adjacent to Sandy Point, St. Croix, in the U.S. Virgin Islands, was designated in 1998; NMFS is also proposing to revise the critical habitat to include areas off the U.S. West Coast (NOAA 2010-TN179). Leatherback turtles have not been reported in the IWF, and nests have been observed on Miami Beach and Key Biscayne (FDEP 2010-TN156). Leatherback turtles have been observed in Biscayne Bay but have not been observed in the IWF. Additional information about this species, including information about its occurrence near Turkey Point, is found in the NMFS Biological Assessment in Appendix F.

American Alligator (*Alligator mississippiensis*)

The American alligator is found in swamps, rivers, streams, lakes, and ponds throughout the southeastern United States where fresh or brackish water is present. Alligators are found in both Biscayne Bay and Card Sound, but are not known or expected to be in the IWF (FPL 2014-TN4058). Alligators are considered Federally threatened because of their resemblance to American crocodiles and are listed as a Species of Concern in the State of Florida. Alligators are opportunistic feeders eating fish, turtles, wading birds, snakes, frog, and small mammals (SREL 2012-TN221). Threats to this species include habitat loss, pollution, and interactions with humans. Alligators can be harvested only by individuals with approved licenses and permits (FFWCC 2012-TN163). Additional information about the potential effects of the proposed action on the American alligator may be found in the FWS Biological Assessment (Appendix F-2).

American Crocodile (*Crocodylus acutus*)

American crocodiles are commonly found in coastal areas throughout the Caribbean Sea in both brackish and saltwater habitats, including ponds, coves, creeks, and mangrove swamps. Crocodiles are opportunistic feeders, eating a variety of fish, snails, crustaceans, crabs, turtles, snakes, birds, and mammals. South Florida is considered the northern edge of their range (FFWCC 2012-TN164). Optimum nesting requirements include the presence of elevated, well-drained substrate near water >1 m deep, salinity ranging from 10 to 20 ppt, and locations that are protected from wind and wave action and free from human disturbance and predators. The use of artificial substrates to promote nesting has contributed to the increase of nests in South Florida and at the Turkey Point site (FPL 2009-TN974). This species was downlisted by FWS from Federally endangered to threatened for the Florida DPS in 2007 (72 FR 13027) (TN274) and is currently State endangered (FFWCC 2011-TN158). The designated critical habitat for American crocodile includes the majority of the Turkey Point IWF and other adjacent canals and aquatic habitats west and south of the Turkey Point site as well as a major portion of the proposed Units 6 and 7 site (Figure 2-32) (41 FR 41914) (TN275). Additional information about the potential effects of the proposed action on the American crocodile may be found in the FWS Biological Assessment (Appendix F-2), and in correspondence with FWS listed in Appendix F.

Crocodiles were first observed at the Turkey Point site in 1976, and nesting was first documented in 1978. FPL subsequently developed a crocodile monitoring plan that described activities for creating and enhancing crocodile habitat, and for monitoring reproductive success, growth, and survival of hatchlings (FPL 2010-TN272). The current plan describes monitoring procedures as well as maintenance procedures for the IWF, including timing the method of vegetation clearing to result in minimal disturbance of nests, hatchlings, and adults (FPL 2014-TN4058). As discussed in Chapter 4, FPL has also developed a threatened and endangered species evaluation and management plan to ensure construction-related effects on listed species are minimized (FPL 2010-TN170). As described in the 2006 Biological Opinion by FWS (FWS 2006-TN832), FPL's 5,900 ac IWF has become particularly important nesting habitat for this species, and nesting activity has increased since it was first documented in 1978. FWS concluded in their Biological Opinion that the crocodile nests within FPL property make up roughly one-third of the annual nest production in all of South Florida (FWS 2006-TN832).

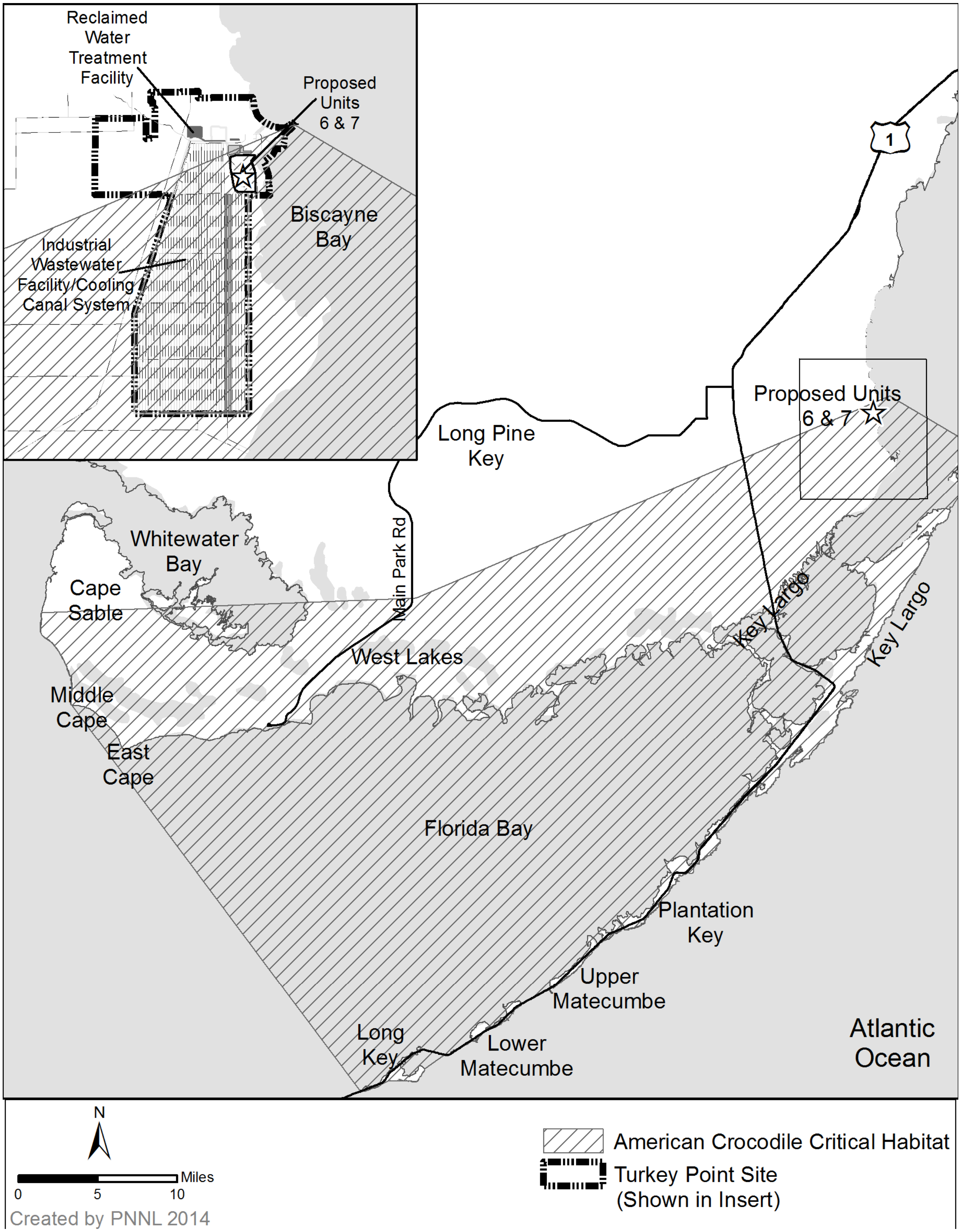


Figure 2-32. Critical Habitat for the American Crocodile near the Turkey Point Site

As requested by the review team, FPL provided crocodile monitoring reports from 2000 to 2015. Table 2-29 summarizes the number of nests observed and hatchlings captured during that time. Successful nests from 2000 to 2015 have ranged from a low of 14 in 2001 to a high of 28 in 2008; hatchlings captured have ranged from 134 in 2004 to 548 in 2009. The general conclusions of the 2009 monitoring report were (1) the record numbers of hatchlings in 2009 may be a result of FPL's efforts or an increase in clutch size of the more mature females, and (2) the population of the crocodiles may be stabilizing as a result of younger reproductive females moving offsite and finding suitable nesting habitat elsewhere (FPL 2009-TN210). FPL attributes the reduction in observed nests and hatchlings captured in 2010 to the record low temperatures recorded in South Florida during the winter of 2009-2010. The cold winter may have caused a delay in successful courtship interactions or prohibited females from storing enough energy to reproduce (FPL 2010-TN211). In 2013 and 2014, 25 successful nests produced 429 and 409 tagged hatchlings, respectively. FPL considers these results encouraging, as the nesting activity observed in the IWF was similar to that observed in the Everglades National Park (FPL 2013-TN3232). However, the 2015 monitoring report described lower observed nesting with only 9 successful nests and 119 tagged hatchlings (FPL 2016-TN4606). FPL attributed the decline in nests and hatchlings to the increased levels of salinity and presence of algae in the CCS.

Table 2-29. American Crocodile Monitoring Results at the Turkey Point Site, 2000−2015

Year	Nests Identified	Hatchlings Captured and Tagged	Citation
2000	17	298	FPL 2000-TN202 RAI 5704 ML11168A043
2001	14	227	FPL 2003-TN168 RAI 5704 ML11168A043
2002	17	291	FPL 2003-TN203 RAI 5704 ML11168A043
2003	17	295	FPL 2003-TN204 RAI 5704 ML11168A043
2004	18	134	FPL 2004-TN205 RAI 5704 ML11168A043
2005	24	282	FPL 2005-TN206 RAI 5704 ML11168A043
2006	24	340	FPL 2006-TN207 RAI 5704 ML11168A043
2007	21	305	FPL 2007-TN208 RAI 5704 ML11180A084
2008	28	510	FPL 2008-TN209 RAI 5704 ML11180A084
2009	24	548	FPL 2009-TN210 RAI 5704 ML11180A084
2010	16	196	FPL 2010-TN211 RAI 5704 ML11180A084
2011	15	268	FPL 2011-TN2471
2012	18	229	FPL 2012-TN2470
2013	25	429	FPL 2013-TN3232
2014	25	409	FPL 2014-TN4607
2015	9	119	FPL 2016-TN4606

With regard to crocodile nest distribution within the IWF, information provided by FPL shows that from 1978 to 2010, the majority of the nesting sites were in the southern end of the canal system (identified as Zones 4 and 5 in yearly monitoring reports) and throughout the return canal. In addition, clusters of nests were observed just south of the proposed location for proposed Units 6 and 7 (Figure 2-33). Nesting information from 2011 to 2015 also shows nests located near the proposed Units 6 and 7 plant area and along the IWF Grand Canal where muck disposal would occur (Figure 2-34).

The primary threats to this species in South Florida include destruction or modification of nesting habitat, changes in nesting behavior or nest location from repeated interactions with humans, dramatic changes in weather patterns or temperature extremes, and fatal encounters with motor vehicles along major highways. Deaths occurring in 2005-2006 on the Turkey Point site resulted in increased signage warning drivers to watch for crocodiles on the roads at all times and to observe posted speed limits. A crocodile death was reported in November 18, 2011. The November 2011 death involved a young crocodile found onsite in the vicinity of the current work on the exploratory UIC well. The cause of death was determined to be physical trauma (NRC 2011-TN4121). Another death was reported on July 25, 2014. The 2014 death involved an adult crocodile discovered inside the intake well for Units 3 and 4 within the IWF. Based on visual evidence of no physical injury or trauma, the crocodile's death was not attributed to plant operations (NRC 2014-TN3718). In both cases, the Federal FWS and the FFWCC were notified. A third dead American crocodile was also reported on an access road outside of the Turkey Point controlled area in July 2014, and was attributed to a vehicle collision. Additional American crocodile deaths were reported inside the Turkey Point controlled area in August of 2015 (NRC 2015-TN4594), November of 2015 (NRC 2015-TN4595), January of 2016 (NRC 2016-TN4596), and February of 2016 (NRC 2016-TN4597). These deaths were not caused by existing Turkey Point plant operations.

<u>Smalltooth Sawfish (*Pristis pectinata*)</u>

The Smalltooth Sawfish is a tropical marine and estuarine fish with a circumtropical distribution. This species is currently Federally endangered. The largest populations in the United States are south and southwest of Florida, from Charlotte Harbor to the Dry Tortugas. Peninsular Florida has the largest number of capture records within U.S. waters and probably contained the largest historic populations (NOAA 2010-TN1724). The preferred habitat of Smalltooth Sawfish is shallow nearshore areas with muddy or sandy bottoms. Limited life history information is available for this species. Smalltooth Sawfish have been observed in Biscayne Bay and Card Sound and at nearshore locations near Turkey Point (FPL 2014-TN4058; FFWCC 2014-TN3530) but have not been observed in the IWF. Primary threats to this species are incidental catch in commercial and recreational fisheries and habitat loss or degradation (74 FR 45353) (TN271). Critical habitat for the Smalltooth Sawfish consists of two units: the 221,459 ac Charlotte Harbor Estuary Unit, and the 619,013 ac coastal habitat of the Ten Thousand Islands/Everglades Unit, both located on the west coast of Florida. No critical habitat for this species has been designated in Biscayne Bay or Card Sound (NOAA 2010-TN179). A complete description of this species, including documented occurrences in Biscayne Bay near the Turkey Point site, is found in the NMFS Biological Assessment in Appendix F.

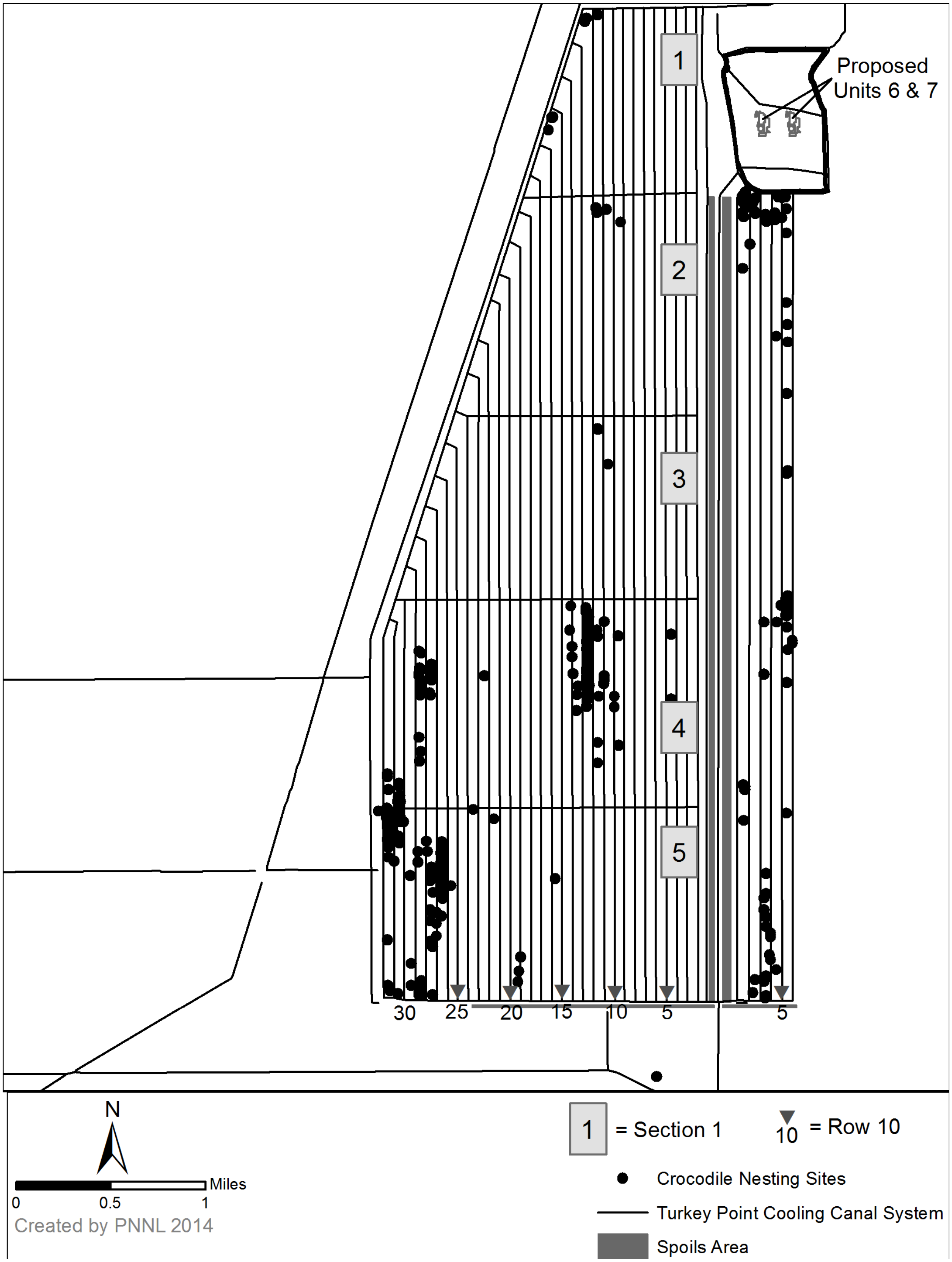


Figure 2-33. Locations of Crocodile Nests in the Turkey Point IWF, 1978−2010

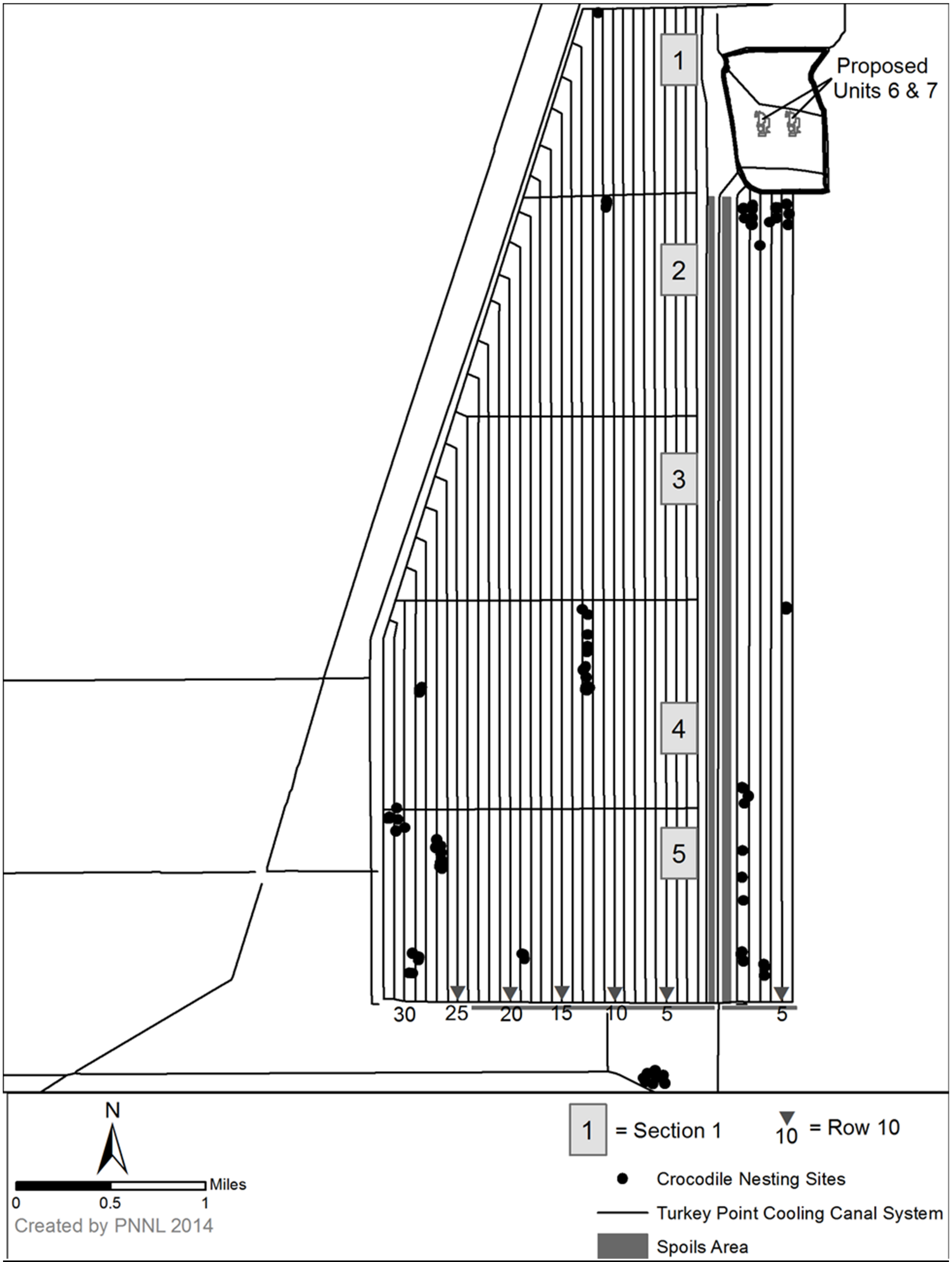


Figure 2-34. Location of Crocodile Nests in the Turkey Point IWF, 2011–2015

<u>Johnson's Seagrass (*Halophila johnsonii*)</u>

Johnson's seagrass is a Federally threatened species that is known to occur near Sebastian Inlet to Virginia Key (NOAA 2007-TN187). This species may occur near Key Biscayne north and east of Turkey Point and to the south in Card Sound, but it has not been observed near the Turkey Point site or in the IWF (FPL 2014-TN4058). Physical habitat requirements for this species are variable, including both shallow intertidal and deeper subtidal zones in water that is clear and deep or shallow and turbid (NOAA 2010-TN180). In tidal channels, this seagrass is found in coarse sand substrates. Johnson's seagrass was not reported to occur near the Turkey Point peninsula by EAI (2009-TN153). Primary threats include propeller and anchor scouring, effects of dredging, overwater structure construction and shading, water pollution, and shoreline development. Critical habitat for Johnson's seagrass designated on April 5, 2000 in Florida includes the central portion of Biscayne Bay extending from Virginia Key north to Miami (65 FR 17786) (TN273).

A Johnson's Seagrass Recovery Plan was prepared in 2002 by the Johnson's Seagrass Recovery Team for NOAA/NMFS (NOAA 2002-TN173). Actions included the identification and protection of populations and habitat, range-side mapping and monitoring, studies to understand life histories, genetic traits, development of management and restoration techniques, and education and outreach. Recovery goals were designed to ensure (1) the present geographic range remains stable or increases for at least 10 years, (2) self-sustaining populations are present throughout the range at distances that allow for stable vegetative recruitment and genetic diversity, and (3) long-term protection on populations and supporting habitat (NOAA 2002-TN173). In 2007, a 5-year review was completed. The major findings suggested that although the populations in the northern range of the species appeared to be stable and self-sustaining, longer-term monitoring data were needed to confirm the status and stability of the population in the southern range (Jupiter Inlet to Biscayne Bay). The final conclusions of the report stated that Johnson's seagrass populations continue to remain vulnerable to natural and anthropogenic stressors, and the species continues to meet the definition of threatened under the ESA because it is still likely to become endangered in the foreseeable future throughout its range (NOAA 2007-TN187).

Federal or State Species of Concern or Proposed for Listing

Information provided to FPL by NMFS (FPL 2010-TN272) includes a list of fish and invertebrate Species of Concern, which are not protected under the ESA but may warrant listing in the future. Table 2-30 lists species likely to occur at or near the Turkey Point site. None of these species are known or expected to occur in the IWF but could occur in nearshore locations in Biscayne Bay and Card Sound. A brief life history description for each follows.

<u>Mangrove Rivulus (*Rivulus marmoratus*)</u>

The Mangrove Rivulus is a small fish that occurs in marine and brackish-water habitats and is able to tolerate a wide salinity range from 0 to 68 ppt (FMNH 2010-TN165). Its diet includes terrestrial and aquatic invertebrates, including mosquito larvae, polychaete worms, and copepods (NOAA 2009-TN176). Along the east coast of Florida, it occurs in marsh habitats above the intertidal zone and is often found in the burrows of great land crabs. This species was once listed as threatened in the Gulf of Mexico but has been downlisted in Florida as a

Species of Special Concern (FFWCC 2011-TN158). Habitat degradation and fragmentation related to the destruction of mangroves are considered the greatest threats to this species (NOAA 2009-TN176). This species has not been reported on the Turkey Point site but is known to occur in the vicinity where suitable habitat is available (FPL 2014-TN4058).

Table 2-30. Federally or State-Listed Species of Concern Likely to Occur at or near the Turkey Point Site

Common Name	Scientific Name	Classification	Designation
Mangrove Rivulus	*Rivulus marmoratus*	Fish	Federal Species of Concern[(a)] Florida Species of Special Concern[(b)]
Dusky Shark	*Carcharhinus obscurus*	Fish	Federal Species of Concern[(a)]
Opossum Pipefish	*Microphis brachyurus lineatus*	Fish	Federal Species of Concern[(a)]
Sand Tiger Shark	*Carcharias taurus*	Fish	Federal Species of Concern[(a)]
Speckled Hind	*Epinephelus drummondhayi*	Fish	Federal Species of Concern[(a)]
Nassau Grouper	*Epinephelus striatus*	Fish	Federal Proposed for Listing[©]
Warsaw Grouper	*Epinephelus nigritus*	Fish	Federal Species of Concern[(d)]
Ivory Tree Coral	*Oculina varicosa*	Coral	Federal Species of Concern[(d)]

(a) FPL 2010-TN272
(b) FFWCC 2011-TN158
(c) 77 FR 61559 (TN3238)
(d) NOAA 2013-TN4099

Dusky Shark (*Carcharhinus obscurus*)

The dusky shark is included as a Species of Concern by NMFS (FPL 2010-TN272). This cosmopolitan species occurs in tropical and temperate waters from Nova Scotia to Cuba. Its range includes shallow inshore waters, but adults tend to avoid areas of low salinity and are rarely found in estuaries. Young sharks are found in shallow-water nursery areas from New Jersey to Cape Hatteras (FMNH 2010-TN166). This species has also been documented in the waters within Biscayne National Park (NPS 2011-TN184). Globally, dusky shark populations are considered to be at risk, and the World Conservation Union (IUCN) considers the species “near threatened.” An ongoing decline in numbers indicated by low catch rates in the western North Atlantic has prompted a ban on the harvesting of dusky sharks by U.S. commercial fishermen and has led to this regional population being placed on the 2000 IUCN's Redlist of threatened species (FMNH 2010-TN166).

Opossum Pipefish (*Microphis brachyurus lineatus*)

The opossum pipefish is designated by NMFS as a Federal Species of Concern (FPL 2010-TN272). There is evidence of three western Atlantic metapopulations, and the North Atlantic and Caribbean metapopulations are present in waters of the United States. Little is known about population size or variations because this species is difficult to survey (NOAA 2009-TN188). Opossum pipefish has been reported in the waters within Biscayne National Park (NPS 2011-TN184).

<u>Sand Tiger Shark (*Carcharius taurus*)</u>

The sand tiger shark is commonly found in all warm and temperate seas except the eastern Pacific Ocean. Preferred habitats include surf zones, shallow bays (including Biscayne Bay), and around coral or rocky reefs. Increased exploitation of this species along the U.S. East Coast in the 1980s and 1990s reportedly reduced abundance by up to 90 percent from historical populations (NOAA 2010-TN190). This species has not been reported in the waters of Biscayne National Park. A status update by the Southeast Science Center of NMFS in February 2009 concluded that while the population decline was not as severe as previously reported, the sand tiger shark should be retained as a Species of Concern due to low productivity and uncertainty with regard to abundance trends (NOAA 2010-TN190).

<u>Speckled Hind (*Epinepheuls drummondhayi*)</u>

The speckled hind derives its name from the tiny white spots covering its body. Adults are found in offshore rocky habitats in waters up to 1,300 ft deep; juveniles can occur in shallow water (NOAA 2009-TN189). Speckled hind is known to occur in the waters of Biscayne National Park (NPS 2011-TN184), and its distribution is believed to be from the Carolinas to Texas (NOAA 2009-TN189). Direct threats to this species are as bycatch from the deep-water snapper/grouper fisheries off the Atlantic and Gulf coasts, and both recreational and commercial fisheries are regulated in the South Atlantic. Speckled hind are considered a Species of Concern by NMFS, and a review of its status is currently under way (NOAA 2009-TN189).

<u>Nassau Grouper (*Epinephelus striatus*)</u>

The Nassau Grouper is designated as a Federal species proposed for listing under the ESA (77 FR 61559) (TN3238). This species is considered a top-level predator, occurs in water depths of up to 330 ft, and is known to occur in Biscayne Bay. Adults are often found in coral reef or rocky bottom habitats (NOAA 2009-TN191). Fishing pressure in the twentieth century led to the commercial extinction of the species in the U.S. Caribbean by the mid-1980s; Florida populations declined from the 1950s to very low levels in the early 1990s (Sadovy and Eklund 1999-TN200). Currently, Nassau Grouper are considered overfished in Florida, and fishing for this species is prohibited within U.S. waters (NOAA 2009-TN191). This species is a solitary, diurnal predator that is found from inshore water to depths of about 100 m in waters of the South Atlantic Ocean and Caribbean Sea and is known to occur in Biscayne Bay. Nassau Grouper reach maturity at about 5 years of age, and may live several decades, reaching a maximum size of about 39 in (100 cm) (Sadovy and Eklund 1999-TN200). Prey items include a wide variety of fish and invertebrates. This species is primarily gonochoristic (exhibiting separate sexes), and is known to congregate in very large numbers at specific nearshore locations to spawn. Although Nassau Grouper were not reported in the environmental studies sponsored by FPL to support the proposed Units 6 and 7 project, this species has been reported in Biscayne Bay and likely occurs near the Turkey Point site. A complete description of this species, including documented occurrences in Biscayne Bay near the Turkey Point site, is found in the NMFS Biological Assessment in Appendix F

<u>Warsaw Grouper (*Epinephelus nigritus*)</u>

The Warsaw Grouper is NOAA Species of Concern that occurs from North Carolina to the Gulf of Mexico. This large sea bass is generally found near rough, irregular sea bottoms and steep cliffs at water depths ranging from 180 to 1,700 ft. Juveniles are occasionally found in shallower waters. The reproductive habits of this species are not well understood, but it is assumed that eggs and larvae are pelagic. Warsaw Grouper are believed to reach sexual maturity between 4 and 9 years of age, may live over 40 years, and reach a maximum size of approximately 7.7 ft and 440 pounds. Prey items include fish and crustaceans (75 FR 59690) (TN4100).

Ivory Tree Coral (*Oculina varicosa*)

The ivory tree coral is a NOAA Species of Concern that occurs in the Caribbean, the Gulf of Mexico, Florida, and the Bahamas in water depths ranging from 2 to 152 m. Colonies are generally found on limestone rubble and outcroppings, and soft-bottom sloping habitats. This species is believed to be tolerant of a wide range of temperature and light intensity. The major threats to this species include damage from mechanical fishing gear, including dredges, trawls, and anchors, and climactic changes that create temperature extremes that lead to bleaching and susceptibility to disease (Aronson et al. 2014-TN4101).

Species with Designated Essential Fish Habitat

The Sustainable Fisheries Act of 1996 (16 U.S.C. § 1801 et seq.) (TN1060) amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act (16 U.S.C. § 1801 et seq.) (TN1061) to create a program to protect essential fish habitat (EFH) and to identify habitat areas of particular concern (HAPCs). The South Atlantic Fisheries Management Council (SAFMC) and NMFS are responsible for designating EFH for each life stage of Federally managed marine fish and shellfish species. Based on information provided in the *Federal Register* and interagency meetings involving the NRC and Federal and State resource agencies, NMFS identified EFH and HAPCs that could be affected by the construction and operation of proposed Turkey Points Units 6 and 7 in a letter to the NRC (NOAA 2010-TN835). Table 2-31 provides a summary of species included in the EFH Assessment (in Appendix F), the applicable fishery management plan, and EFH habitat designations. A brief discussion of EFH and HAPCs follows.

Table 2-31. Designated Essential Fish Habitat Likely to Occur near the Turkey Point Site

			Essential Fish Habitat Designation[a]	
Common Name	**Scientific Name**	**Applicable Fishery Management Plan**	**Mangrove**	**Seagrass and Unconsolidated Bottom**
Gray Snapper	*Lutjanus griseus*	Snapper-Grouper	X	X
Dog Snapper	*L. jocu*	Snapper-Grouper	X	
Mutton Snapper	*L. analis*	Snapper-Grouper		X
Bluestriped Grunt	*Haemulon sciurus*	Snapper-Grouper	X	
White Grunt	*H. plumieri*	Snapper-Grouper		X
Spiny lobster	*Panulirus argus*	Spiny Lobster	X	X
Pink shrimp	*Farfantepenaeus duorarum*	Shrimp Fishery	X	X

(a) Biscayne Bay and Biscayne National Park are also EFH-HAPC for coral, coral reefs, and hard-bottom communities.

Source: NOAA 2010-TN835

Snapper-Grouper Fishery Management Plan

The Snapper-Grouper Fishery Management Plan includes 17 species (SAFMC 1998-TN212). Based on the information described above, five species belonging to this group have designated EFH near the Turkey Point site. Mangrove habitat is identified as EFH for Gray Snapper; seagrass and unconsolidated bottom are identified as EFH for both adult and juvenile Gray Snapper, juvenile Mutton Snapper, and adult White Grunt (NOAA 2010-TN835). EFH for the snapper-grouper group includes coral reef systems, hard-bottom substrates, submerged aquatic vegetation, and artificial reefs and outcroppings from shore to at least 600 ft (2,000 ft for Wreckfish [*Polyprion americanus*]), where annual water temperature is sufficient to maintain adults. EFH also includes spawning areas in the water column above adult habitat and additional pelagic environments. With regard to specific life stages of this group, EFH includes areas inshore of the 100 ft contour and includes macroalgae, seagrass beds, salt and brackish marshes, tidal creeks, mangrove fringes, oyster reefs, shell banks, and soft- or hard-bottom substrates. HAPCs for the snapper-grouper species complex include medium- to high-profile hard-bottom areas and all designated nursery areas (SAFMC 1998-TN212).

Spiny Lobster

As described by NOAA (2010-TN835), both mangrove and seagrass/unconsolidated bottom habitats are EFH for the spiny lobster. EFH for spiny lobster includes nearshore shelf and oceanic waters, shallow subtidal bottom, seagrass habitat, soft sediment, and coral, hard-bottom, sponge, algal and mangrove communities (SAFMC 1998-TN212). Juvenile and adult spiny lobster may be present near the Turkey Point site (EAI 2009-TN154).

Pink Shrimp

The SAFMC's Shrimp Fishery Management Plan includes five species: brown shrimp (*Farfantepenaeus aztecus*), pink shrimp, rock shrimp (*Sicyonia brevirostris*), royal red shrimp (*Pleoticus robustus*), and white shrimp. Of these, the pink shrimp is considered the most common to Biscayne Bay, is expected to occur near the Turkey Point site, and was specifically identified by NMFS as a species with designated EFH near the Turkey Point site (Nelson et al. 1991-TN174; EAI 2009-TN154; NOAA 2010-TN835). Juvenile and adult shrimp are omnivorous bottom feeders; they eat polychaetes, amphipods, nematodes, other small crustaceans, and organic debris or detritus. This species is most commonly found on hard sand and shell bottom habitats. Rates of growth for all penaeid shrimp are highly variable and influenced by water salinity and temperature; low temperatures and high salinity inhibit growth (SAFMC 1998-TN212). EFH for penaeid shrimp includes inshore estuarine nursery areas, offshore marine habitats, and all interconnecting waterbodies. Inshore nursery areas include tidal freshwater, estuarine and marine wetland systems, nearshore mangrove and seagrass habitats, and intertidal and subtidal non-vegetated flats.

Habitat Areas of Particular Concern

HAPCs identified by NOAA (2010-TN835) near the Turkey Point site included mangrove and seagrass habitats described above for the snapper-grouper complex, and Biscayne Bay for spiny lobster. Biscayne Bay and Biscayne National Park are also EFH-HAPC for coral, coral reefs, and hard-bottom communities.

2.4.2.4 Aquatic Monitoring

This section describes the analysis and evaluation of the proposed aquatic monitoring program. Unless otherwise noted, the summary below was developed from information provided by FPL (2014-TN4058), which also includes information about study design and results. Information is also provided in FPL 2009 (TN201); EAI 2009 (TN97); EAI 2009 (TN153); and EAI 2009 (TN154).

Pre-Application Monitoring

Surveys of onsite surface-water habitats that could be affected by the construction and operation of proposed Units 6 and 7 were conducted in August and November 2007. Survey areas included hypersaline mudflats, remnant canals, channels, dwarf mangrove wetlands, and open water areas within the Turkey Point site. Other than the American crocodile, no Federally or State-listed aquatic or semi-aquatic species were observed within the area proposed for the construction of Units 6 and 7. Florida manatee and Smalltooth Sawfish may occur, however, in nearshore areas of Biscayne Bay adjacent to the Turkey Point site, including the proposed location for the radial collector well system and the equipment barge-unloading facility. During the summer of 2009, fish surveys occurred in areas of the site that would be affected by construction, including two remnant canals, the dead-end canal area where construction laydown would occur, pools within the mangrove areas where buildings and parking areas were planned, a portion of the return canal, shallow flats in the east-central part of the nuclear island, and two locations along the cooling canals within the IWF (FPL 2009-TN201).

Because modifications to the existing barge-turning basin and equipment barge-unloading area were expected to be needed to support construction of the proposed Units 6 and 7, a survey of seagrass presence in that area was conducted in 2008 (FPL 2010-TN272). Manatees have also been observed in this area, necessitating a manatee protection plan, as previously described. In addition to the barge-turning basin seagrass survey, and a seagrass survey around the Turkey Point peninsula (EAI 2009-TN153), a 1-year baseline aquatic characterization study was completed in March 2009 to characterize aquatic biota in Card Sound and the Card Sound Canal and included studies of benthic invertebrates (EAI 2009-TN97) and fish and shellfish (EAI 2009-TN154).

Building, Preoperational, and Operational Monitoring

As described in its ER, FPL (2014-TN4058) does not consider preoperational and operational monitoring to be necessary, however, the State of Florida is requiring pre-building, building, preoperational, and operational monitoring under the conditions of certification (State of Florida 2014-TN3637). Federally listed species occur in the vicinity of the Turkey Point site, and building activities may cause some species to temporarily leave the area. Barge and tug traffic may, but is unlikely to, result in fatal or non-fatal collisions with some species. FPL also states that aquatic species in the regional canals along the roads and corridors for transmission and reclaimed and potable water are common to South Florida. Cooling water for Units 6 and 7 will primarily be reclaimed water supplied by the MDWASD. A backup source of cooling water will be from subsurface radial wells located on the Turkey Point peninsula. Because Units 6 and 7 will not have a conventional intake to withdraw surface water FPL has determined that additional preoperational or operational monitoring is not required because no aquatic species would be exposed to impingement or entrainment during the procurement of cooling water. Because the cooling water would be discharged into UIC (or deep-injection) wells, FPL has also determined that additional preoperational or operational monitoring is not required because no aquatic species would be exposed to cooling-water discharge from the proposed Units 6 and 7. The review team notes that this statement is unsubstantiated because no published biological studies on the deep-aquifer communities in this area are available.

Building activities would be conducted under stormwater permits requiring the use of Best Management Practices. Additional monitoring may be warranted if required by Federal resources areas with appropriate jurisdiction. The review team's assessment of aquatic impacts related to the building and operation of the proposed units is provided in Chapters 4 and 5, respectively.

Existing Monitoring Programs or Procedures

As part of the SCA submission, FPL provided information about a variety of monitoring programs related to the Turkey Point site in the SCA (FPL 2010-TN272). Programs pertinent to aquatic resources are described below, including the terms and conditions regarding crocodile monitoring and protection related to the operation of Units 3 and 4, as described in FWS 2006-TN832.

<u>Barge Delivery Plan</u>

The Turkey Point Barge Delivery Plan (FPL 2010-TN272) describes the minimum requirements and procedures that would be used during the delivery of major equipment and components needed for the building of proposed Units 6 and 7. The plan supplements an existing operations manual developed for fuel-oil transfer at the existing barge-unloading facilities at the northern end of the Turkey Point site adjacent to Biscayne Bay. Included in the Barge Delivery Plan is a section that describes approved procedures associated with in-water work within the barge-turning basin and entrance channel to protect manatees. The plan requires dedicated observers on all vessels used during in-water work, the maintenance of a logbook detailing sightings, collisions, or injuries to manatees; and the prohibition on movement of work barges, other associated vessels, or any in-water work after sunset or before sunrise, when the potential for spotting manatees is negligible. As described in FPL (2016-TN4579), Turkey Point Unit 2 was converted to synchronous condenser mode in January 2013, and Unit 1 is scheduled for conversion in October 2016. Conversion of these fossil-fuel units is expected to greatly reduce or eliminate the need for fuel-oil deliveries.

<u>Threatened and Endangered Species Evaluation and Management Plan</u>

The FPL Turkey Point Units 6 and 7 Threatened and Endangered Species Evaluation and Management Plan (FPL 2010-TN170) provides a description of the proposed project, and the expected extent of impacts on aquatic, wetland, and terrestrial communities within site boundaries. The Threatened and Endangered Species Evaluation and Management Plan also describes the American crocodile management program, including the current status of the species, likely effects of the proposed action, proposed mitigation activities, and assessment of potential cumulative effects. Specific activities described in the plan include the following:

- crocodile habitat preservation and creation
- use of exclusion zones at known nest sites
- daytime and nighttime monitoring surveys to document nests in the cooling canals and IWF
- hatchling capture and tagging using microchip technologies
- relocation of hatchlings to low-salinity habitats to improve survival
- recapture, monitoring, and release of individuals to assess growth and survival.

As described in the plan, crocodile monitoring occurs throughout the year, and specific activities are based on known seasons for mating, egg incubation, and hatching. The plan also describes strategies for reducing the risk of vehicle/crocodile collisions during routine maintenance activities onsite and during construction events. Section 7 of the plan describes specific actions that would be taken during preconstruction, construction, and post-construction to ensure minimal disturbance of this species.

<u>Sea Turtle and Smalltooth Sawfish Construction Conditions</u>

In addition to the above plans, NMFS (2006-TN3077) has established procedures to protect sea turtles and Smalltooth Sawfish during nearshore construction activities. Activities to protect these species include training construction personnel in ESA requirements, ensuring siltation barriers do not entangle species, “no-wake” operation of vessels, and potential cessation of construction activities if species are sighted within 50 ft of moving equipment.

<u>American Crocodile Monitoring and Protection Related to Operation of Unit 3 and 4</u>

As described in FWS 2006 (TN832) the terms and conditions regarding American crocodile monitoring and protection are as follows:

- The installation of four warning signs labeled as “Slow Crocodile Crossing” along Bechtel Road near the test canals on the Turkey Point site.
- Distribution of an informational bulletin on the American crocodile to all employees at the Turkey Point site every 6 months that includes photographs of a crocodile, information about hatchlings, and reminders to use caution when driving or conduction actives on the site.
- Inclusion of a presentation on American crocodiles twice a year at monthly safety meetings attended by all plant personnel. The presentations are to be made during the crocodile mating season when the activity of crocodiles at the site is greatest.
- FWS notification if a dead or injured crocodile is found.

2.5 Socioeconomics

This section describes the socioeconomic baseline of the proposed site. It describes the characteristics of the 50 mi region surrounding the Turkey Point site, including population demographics, density, and use to form the basis for assessing the potential social and economic impacts from building and operating the proposed two new nuclear units. There are four counties within the 50 mi region surrounding the Turkey Point site: Miami-Dade, Broward, Monroe, and Collier Counties.

The analytical area is a 50 mi radius circle centered midway between the two new proposed units and includes all of Miami-Dade County and portions of Broward, Collier, and Monroe Counties. Table 2-32 provides population information for each county and Figure 2-35 shows the 50 mi analytical area.

Table 2-32. Population of Counties within 50 Miles of the Proposed Site

County	Resident Population (2000)[(a)]	Resident Population (2010)[(b)]	Resident Population (2012)[(c)]
Miami-Dade County	2,253,362	2,496,435	2,512,219
Broward County	1,623,018	1,748,066	1,761,993
Collier County	251,377	321,520	323,548
Monroe County	79,589	73,090	73,475

(a) USCB 2000-TN470
(b) USCB 2010-TN4087
(c) USCB 2012-TN4098

The main data sources used in this section to describe the current population in the 50 mi region are the United States Census Bureau (USCB) 2008–2012 American Community Survey (ACS) 5-Year Estimates. These were the latest data for which poverty estimates were available at the block group level. Poverty data at the block group level are important for the environmental justice analysis (see Section 2.6). For consistency, the 2008–2012 ACS 5-Year Estimates are used to describe current population throughout the document, referred to as USCB 2012 (TN4098). Population data in the 50 mi region were estimated by overlaying the 2012 census block data on the 50 mi area shown in Figure 2-35, using ArcMap 10 geographic information system (GIS) software (ESRI 2012-TN1469). In addition, the review team analyzed the economic, employment, and population trends for the region using additional U.S. Census data sets and population projections from the Office of Economic and Demographic Research of the Florida Legislature and from the Bureau of Economic and Business Research of the University of Florida.

This section discusses all four counties in the 50 mi region but emphasizes the socioeconomic characteristics of Miami-Dade County, the economic impact area, where the proposed site is located and in which the majority of the demographic and socioeconomic impacts would occur (NRC 2000-TN614). The review team expects the workforce to be principally drawn from Miami-Dade County for two reasons. First, county-to-county worker flow data from the U.S. Census Bureau Longitudinal Employer-Household Dynamics program (USCB 2011-TN4078) show that 79.0 percent of the workers of Miami-Dade County resided in Miami-Dade County, another 12.0 percent resided in Broward County, and only 0.4 percent in each of Collier and

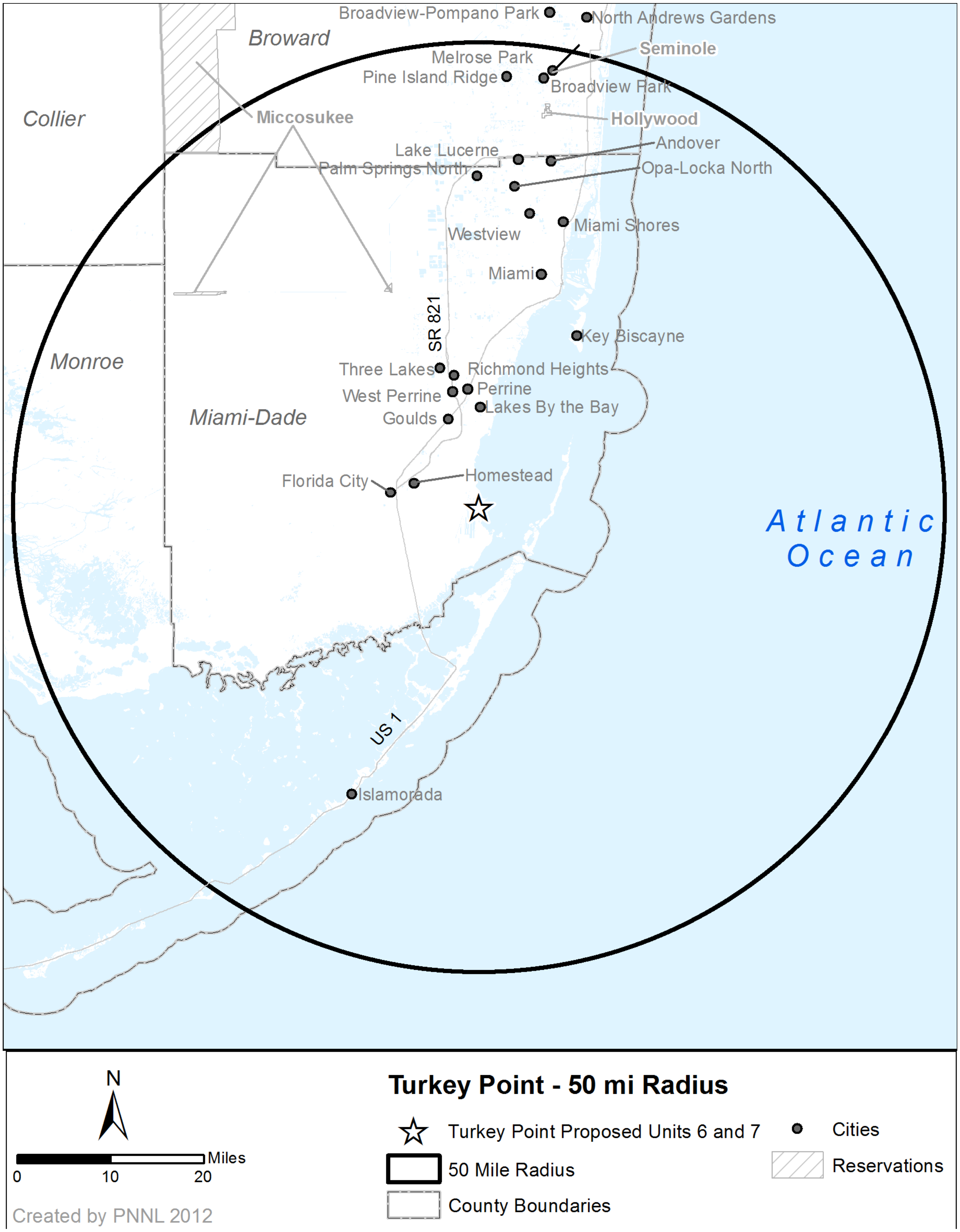


Figure 2-35. Map of South Florida, Showing Counties Potentially Affected by Proposed Units 6 and 7 (Source: ESRI 2012-TN1469)

Monroe Counties (Table 2-33). Because the proposed site is located approximately 40 mi south of the Broward County border, the commute time from Broward County to the proposed site would be longer than the average commute time of workers residing in Broward County (Table 2-33). Second, more than 83 percent of Turkey Point plant's current workforce resides in Miami-Dade County. Another 11.3 percent of the current workforce resides in the three other counties that surround Miami-Dade County and that intersect with the 50 mi region: Broward, Monroe, and Collier. The remaining current workforce resides in counties beyond the 50 mi region surrounding the Turkey Point site (Table 2-33).

Table 2-33. Commuting Characteristics of Workers in the 50-Mile Region

County	Average Commute Time of Workers Residing in County[(a)]	Percent of Working Residents, by County of Residence, that Commute to Miami-Dade County[(b)]	Percent of Miami-Dade Workers by County of Residence[(b)]
Miami-Dade	29 minutes	79.0%	74.5%
Broward	27 minutes	12.0%	14.7%
Monroe	19 minutes	0.4%	0.6%
Collier	23 minutes	0.4%	0.4%

(a) USCB 2012-TN4088
(b) USCB 2011-TN4078

Most of the data and analysis in this section are concerned with Miami-Dade County. In addition, particular attention is given to the Homestead and Florida City area, the nearest small communities where, based on Table 2-34, a considerable share of the building and operations workforce is expected to reside.

Table 2-34. Distribution of Turkey Point Plant Employees

County	City	Total Number of Current Turkey Point Plant Employees in Residence	Percent of Total Number of Employees
Miami-Dade		814	83.3%
	Homestead	*391*	*40.0%*
	Miami	*380*	*38.9%*
	Florida City	*27*	*2.8%*
	Other	*16*	*1.6%*
Broward		63	6.4%
Monroe		47	4.8%
Collier		1	0.1%
Other		52	5.3%
Total		977	100%

Source: FPL 2014-TN4058

The scope of the review of community characteristics is guided by the magnitude and nature of the expected impacts of building, maintaining, and operating the proposed plants and by those site-specific community characteristics that can be expected to be affected by these impacts.

2.5.1 Demographics

Miami-Dade County is the most populous of the three counties—Miami-Dade, Broward, and Palm Beach—that constitute the Miami-Fort Lauderdale-Pompano Beach Metropolitan

Statistical Area (MSA), the seventh most populous MSA in the United States. It is also the most populous county in the State of Florida (USCB 2011-TN472). However, north of the plant along the coast is highly urbanized, while the rest of Miami-Dade County is more agricultural or parkland. Population density is greater in the proximity of the City of Miami, in the northeast portion of the county, and along US-1 and the Florida Turnpike, than in the rest of the county, including the areas to the west and south of Homestead and Florida City.

For historical perspective, Miami-Dade County has grown at a lower rate than the State of Florida as a whole in the last few decades. Although its population roughly doubled between 1970 and 2010, population growth rates have been declining (Table 2-35). In 1992, Hurricane Andrew hit Miami-Dade County and the greatest damage occurred in the Homestead and Florida City area. An estimated 350,000 residents were driven from their homes, most from South Dade (Homestead and Florida City area). An estimated 40,000 did not return to Miami-Dade County (Smith and McCarthy 1996-TN467). An important employer in South Dade, the Homestead Air Force Base, was destroyed by the hurricane and not rebuilt. The location today supports a smaller Air Reserve Base. For the purposes of this analysis, the review team divided the total population within the analytical area into three major groups: residents who live permanently in the area, transient people who may temporarily live in the area but have a permanent residence elsewhere, and migrant workers who travel into the area to work and then leave after their job is done. Transients and migrant workers are not fully characterized by the U.S. Census, which generally captures only resident populations.

Table 2-35. Population Growth in Miami-Dade and Florida, 1970−2030

	Miami-Dade		Florida	
Year	Population	Annual Growth Rate in Decade Prior to Indicated Year	Population	Annual Growth Rate in Decade Prior to Indicated Year
1970	1,267,792	NA	6,789,447	NA
1980	1,625,509	2.5%	9,746,961	3.7%
1990	1,937,194	1.8%	12,938,071	2.9%
2000	2,253,779	1.5%	15,982,824	2.1%
2010	2,496,435	1.0%	18,801,310	1.6%
2020	2,788,100	1.1%	21,149,700	1.2%
2030	3,056,700	0.9%	23,609,000	1.1%

Source: BEBR 2004-TN438 (for years 1970-2000), USCB 2010-TN4087 (for year 2010), and BEBR 2014-TN4077 (for years 2020-2030)

2.5.1.1 Resident Population

The 2012 estimate for the resident population within 50 mi of the center of the proposed Turkey Point site is 3,466,602 (USCB 2012-TN4098).(2) The nearest population concentrations are the cities of Florida City, 8 mi west of the site with a population estimate of 11,313, and Homestead, 9 mi northwest of the site with a population estimate of 59,866 (USCB 2012-TN4098). Both

(2) Estimate obtained using ArcMap 10 and based on census block group data. Block groups were included if they were totally or partially within the 50 mi radius.

communities are on the southern end of the Miami urbanized area that extends from Florida City and Homestead north and northeast to Miami, Fort Lauderdale, and Pompano Beach and crosses Miami-Dade, Broward, and Palm Beach Counties. To the south and southwest of the site lie the Florida Keys in Monroe County. Because the proposed site is located on the coast, much of the 50 mi radius around the site is on the sea and unpopulated. Everglades National Park is another unpopulated area and occupies much of the land between 20 and 50 mi west of the site.

The population for Miami-Dade County projected to 2030 is shown in Table 2-35 with projections for the State of Florida provided for comparison. The sources of projections are the Florida Legislature's Office of Economic and Demographic Research (EDR) and the University of Florida's Bureau of Economic and Business Research (BEBR).(3) BEBR projections are based on U.S. Census data from 2000 and 2010, as well as data from the Florida Department of Health's Office of Vital Statistics.(4) In most Florida counties, migration has typically been the major determinant of population growth (EDR 2011-TN454). The projections in Table 2-35 show that the EDR and BEBR expect the population growth in Miami-Dade County to slow, mainly due to a slowdown in migration.

Table 2-36 shows resident population estimates in the 50 mi radius projected to 2030, by county. Estimates for the 2012 resident population are the 2008–2012 ACS 5-Year Estimates, calculated for the 50 mi radius using GIS to capture the data from the relevant census block groups. To estimate the population in the 50 mi radius in 2015, 2020, 2025, and 2030, the review team compared data from the 2008–2012 ACS survey with data from projections for all four counties included in the 50 mi radius. The review team then calculated the growth rate of the resident population for each county between 2012 and 2015, 2020, 2025, and 2030. These growth rates were applied, by county, to the population in the 50 mi radius.

Table 2-36. Resident Population in the 50-Mile Radius, Projected to 2030, by County

Year	Total 50 mi Radius	Miami-Dade	Broward	Collier	Monroe
2012	3,466,602	2,512,219	931,797	1,025	21,561
2015	3,558,523	2,589,844	946,153	1,078	21,447
2020	3,736,407	2,740,009	973,914	1,184	21,300
2025	3,902,440	2,881,819	998,210	1,285	21,125
2030	4,048,422	3,003,975	1,022,087	1,381	20,979

Source: USCB 2012-TN4098; projections based on BEBR 2014-TN4077

2.5.1.2 Transient Population

Regulatory Guide 4.7 (NRC 1998-TN1008), Section C.4, defines transient populations as people (other than those just passing through the area) who work, reside part-time, or engage in recreational activities in a given area, but are not permanent residents of the area. Under this definition, transients include people in

(3) County projections are done by BEBR under contract to EDR and are made to be consistent with EDR State projections.
(4) For a detailed methodology, see BEBR 2011-TN437.

- workplaces
- places where people reside part-time, such as hotels and motels and seasonal housing
- recreational areas or at special events.

Transient population estimates within 20 mi of the proposed site were obtained based on (1) commuter data from the U.S. Census Bureau Longitudinal Employer-Household Dynamics program (USCB 2011-TN4078) to estimate the number of employees commuting from outside municipalities in the 20 mi radius; and (2) FPL-provided estimates for other transient population based on internet searches, overhead imagery (for counting of parking spaces), and direct phone calls to major recreational facilities and marinas and to lodging facilities, including hotels, motels, and seasonal housing.

The review team estimated the number of commuters from outside municipalities in the 20 mi radius using data from the U.S. Census Bureau Longitudinal Employer-Household Dynamics program (USCB 2011-TN4078). For municipalities partially located within the 20 mi radius commuters were assumed to reside in or outside the 20 mi radius depending on whether the majority of the land area of the municipality was inside or outside the 20 mi radius. The review team reached an estimate of 143,763 transient workers in the 20 mi radius.

For other transient population, FPL's research included the Biscayne National Park, Black Point Park, Black Point Marina, Camp Owaissa Bauer, Coral Castle Museum, Harris Field, Kevs Gate Golf Club, Larry & Penny Thompson Memorial Park, Prime Outlets of Florida City, Southland Mall, Homestead Bayfront Marina/Herbert Hoover Marina and Park, and a list of lodging facilities. From phone call interviews, FPL gathered information about the extent to which visitors were local residents or from out of the affected area (transients). When no information about the number of visitors was available, FPL obtained estimates by counting parking spaces with overhead imagery and assuming two or three occupants per vehicle, depending on the facility. FPL reached an estimate for other transient population of 19,055 (FPL 2014-TN4058). The review team received a detailed explanation of the procedures adopted and found them to be reasonable. The estimate did not, however, include large racing events. The review team met with the City of Homestead representatives who indicated that racing events occur several times a year at the Homestead-Miami Speedway. Large racing events (e.g., NASCAR [National Association for Stock Car Auto Racing]) could add 65,000 to the other transient population, for a total of approximately 85,000 people.

Adding the number of transient employees (143,763) and the number of other transient population (19,055), the total transient population within 20 mi of the proposed site is estimated to be 162,818, with the exception of those days when large events are being held at the Homestead-Miami Speedway (65,000), when the estimate surpasses 220,000.

2.5.1.3 Migrant Labor

The U.S. Census Bureau defines a migrant laborer as someone who is working seasonally or temporarily and moves one or more times from one place to another to perform seasonal or temporary work. Migrant laborers are often agricultural or construction workers.

The 2012 Census of Agriculture provides some information regarding the migrant farm labor population within Miami-Dade County. Of the 9,045 hired farm workers in Miami-Dade County, 1,296 (14.3 percent) were migrant workers. In addition, farms in Miami-Dade County reported 228 migrant contract workers for a total of 1,524 migrant workers in Miami-Dade County (USDA 2012-TN4081).

Turkey Point Units 3 and 4 are currently in operation and function on an 18-month refueling cycle. During each refueling event, between 600 and 1,000 temporary workers are employed during a period of 25 to 35 days (FPL 2014-TN4058). A portion of these are migrant workers who come from outside the economic impact area.

2.5.2 Community Characteristics

Miami-Dade County's economy has been transitioning from mixed service and industrial in the 1970s to one dominated by services, primarily due to the expansion in international trade, the tourism industry, and health services. The Miami-Dade County government projects wholesale trade and retail trade will become stronger economic forces in the local economy. This reflects the county's position as a wholesale center in Southeast Florida, which serves a large international market. The tourism industry remains one of the largest sectors in the local economy (Miami-Dade County 2012-TN462).

The remainder of this section addresses community characteristics including the regional economy, transportation networks and infrastructure, taxes, aesthetics and recreation, housing, community infrastructure and public services, and education.

2.5.2.1 Economy

In 2012, Miami-Dade County's total personal income ranked first in the State of Florida and accounted for 12.7 percent of the State's total personal income reported. The county's per capita personal income was 95 percent of the State average (BEA 2014-TN4075). Miami-Dade County includes highly urbanized and suburban areas surrounding the City of Miami along the Atlantic Coast; rural agricultural areas further south; and portions of the Everglades, including Everglades National Park, in the western half of the county. Near Turkey Point, the non-wetland area centered around the Homestead and Florida City area is primarily agricultural. The region's subtropical climate allows the winter production of green beans, tomatoes, strawberries, and squash for distribution throughout the United States, as well as year-round production of tropical fruits and vegetables such as avocados, passion fruit, malanga, and boniato. Another sector of the agricultural industry is Asian specialties such as Thai guava, Thai basil, Thai eggplant, lemon grass, bitter melon, and various herbs and spices (FPL 2014-TN4058).

Miami-Dade County's economy is largely based on services. Major sectors of current employment include healthcare and social assistance, retail trade, administrative and waste services, accommodation and food service, professional, scientific, and technical services, local government, and real estate, rental and leasing (BEA 2012-TN4074). Table 2-37 shows employment by industry in Miami-Dade County from the Bureau of Economic Analysis (BEA). Workers are most often employed in service sectors such as retail trade, healthcare and social assistance, and in government. Employment in transportation and warehousing and in wholesale trade is affected by the importance of Miami as an international trade center. There were 57,345 full-time and part-time jobs in construction in Miami-Dade County in 2012.

Table 2-37. Employment by Industry, Miami-Dade County, 2012

	Miami-Dade		Florida
Industry	**Jobs**	**Percent of Total**	**Percent of Total**
Total	*1,515,304*	*100.00*	*100 (10,359,941 persons)*
Farm employment	7,444	0.49	0.82
Nonfarm employment	1,507,860	99.51	99.18
Private employment	*1,359,457*	*89.72*	87.90
Forestry, fishing, related activities, and other	2,702	0.18	0.64
Mining	898	0.06	0.19
Utilities	3,270	0.22	0.23
Construction	57,345	3.78	4.77
Manufacturing	41,279	2.72	3.37
Wholesale trade	83,241	5.49	3.49
Retail trade	155,494	10.26	11.11
Transportation and warehousing	87,923	5.80	3.13
Information	23,820	1.57	1.64
Finance and insurance	86,044	5.68	6.12
Real estate and rental and leasing	101,615	6.71	6.49
Professional, scientific, and technical services	104,017	6.86	6.69
Management of companies and enterprises	8,986	0.59	0.95
Administrative and waste services	118,994	7.85	7.85
Educational services	37,971	2.51	1.94
Health care and social assistance	169,064	11.16	11.18
Arts, entertainment, and recreation	28,177	1.86	2.99
Accommodation and food services	117,377	7.75	8.32
Other services, except public administration	131,240	8.66	6.80
Government and government enterprises	148,403	9.79	11.28
Federal, civilian	19,921	1.31	1.28
Military	7,300	0.48	0.94
State and local	121,182	8.00	9.05
State government	17,361	1.15	1.98
Local government	103,821	6.85	7.07

Source: BEA 2012-TN4074

The U.S. Department of Labor Bureau of Labor Statistics (BLS) disaggregates construction workers by occupation type in the Miami-Miami Beach-Kendall Metropolitan Area (Table 2-38). The most common construction occupations in 2013 in this area were construction laborers, carpenters, supervisors, electricians, equipment operators and operating engineers, plumbers, pipefitters and steamfitters, and painters. The top four employers in Miami-Dade County are

Table 2-38. Construction and Extraction Occupation in the Miami-Miami Beach-Kendall Metropolitan Area, 2013

Occupation Title	Employment
Construction and Extraction Occupations	22,510
First-Line Supervisors/Managers of Construction Trades and Extraction Workers	2,780
Brickmasons and Blockmasons	90
Carpenters	3,190
Tile and Marble Setters	300
Cement Masons and Concrete Finishers	720
Construction Laborers	3,750
Paving, Surfacing, and Tamping Equipment Operators	170
Pile-Driver Operators	150
Operating Engineers and Other Construction Equipment Operators	1,240
Drywall and Ceiling Tile Installers	390
Electricians	2,380
Glaziers	340
Insulation, Workers, Floor, Ceiling, and Wall	NR
Painters, Construction and Maintenance	1,170
Pipelayers	380
Plumbers, Pipefitters, and Steamfitters	1,180
Plasterers and Stucco Masons	NR
Roofers	NR
Sheet Metal Workers	770
Structural Iron and Steel Workers	NR
Helpers – Carpenters	NR
Helpers – Electricians	630
Helpers – Pipelayers, Plumbers, Pipefitters, and Steamfitters	200
Helpers, Construction Trades, All Other	90
Construction and Building Inspectors	640
Elevator Installers and Repairers	NR
Hazardous Materials Removal Workers	40
Highway Maintenance Workers	180
Septic Tank Servicers and Sewer Pipe Cleaners	80
Construction and Related Workers, All Other	190
Earth Drillers, Except Oil and Gas	NR

NR = Not Released.

Source: BLS 2013-TN4086

governmental entities: Miami-Dade County Public School District, Miami-Dade County, Federal government, and Florida State government. The largest private employers are Baptist Health South Florida, the University of Miami, American Airlines and Publix Super markets (Beacon Council 2013-TN4076). Table 2-39 lists the largest employers in the county.

Table 2-39. Major Employers in Miami-Dade County, by Number of Employees, 2013

Employer	Private/Public	Number
Miami-Dade County Public School District	Public	33,477
Miami-Dade County	Public	25,502
Federal Government	Public	19,600
Florida State Government	Public	18,300
Baptist Health South Florida	Private	13,376
University of Miami	Private	12,720
Jackson Health System	Public	8,208
American Airlines	Private	9,000
Publix Super Markets	Private	4,604
Florida International University	Public	3,534
Miami-Dade College	Public	2,356
City of Miami	Public	3,656
Carnival Cruise Lines	Private	3,500
Mount Sinai Medical Center	Private	3,000
Miami Children's Hospital	Private	2,800
Sedanos Supermarkets	Private	2,600
Miami V A Health Care System	Public	2,385
Royal Caribbean International/Celebrity Cruises	Private	2,051
Bank of America Merrill Lynch	Private	2,000

Source: Beacon Council 2013-TN4076

The Turkey Point site currently employs approximately 977 employees supporting the operations of the existing Units 1 through 5. In addition, Units 3 and 4 are on 18-month refueling cycles and, during each refueling event, employ an additional 600 to 1,000 outage workers for a period of 25 to 35 days (FPL 2014-TN4058).

Table 2-40 shows the number of workers employed and the unemployment rates for Miami-Dade County and for the State of Florida in 2000, 2010, and 2013. These data show that both the labor force and the number of employed workers in Miami-Dade County grew more slowly than the labor force and number of employed workers in the state. As of 2013, the Miami-Dade unemployment rate was above the unemployment rate for Florida and above the national average: 8.4 percent for Miami-Dade County compared to 7.2 percent for Florida and 7.4 percent for the country as a whole (BLS 2013-TN4085; BLS 2014-TN3674).

Table 2-40. Employment and Unemployment Statistics for Miami-Dade County and Florida, Annual Averages

Place	Year	Labor Force	Employment	Unemployment	Unemployment Rate
Miami-Dade	2000	1,103,485	1,046,900	56,585	5.1%
	2010	1,231,368	1,077,442	153,926	12.5%
	2013	1,287,348	1,179,118	108,230	8.4%
Annualized Growth Rate, 2000-2013		1.19%	0.92%		
Florida	2000	7,869,690	7,569,406	300,284	3.8%
	2010	9,182,506	8,121,770	1,060,736	11.6%
	2013	9,432,295	8,749,590	682,705	7.2%
Annualized Growth Rate, 2000-2013		1.40%	1.12%		

Source: BLS 2013-TN4085

2.5.2.2 Taxes

Several types of taxes would be affected by proposed Units 6 and 7. The following subsections describe major taxes, their structure, and annual dollar yield. Taxes included in this discussion include corporate income taxes, sales and use tax and other taxes on sales and services, and property taxes.

Personal and Corporate Income Taxes

The State of Florida does not levy a personal income tax on individuals. In fiscal year (FY) 2011 (July 1, 2010–June 30, 2011), the State of Florida received $1.87 billion (6.3 percent of its total tax revenue of $29.7 billion) from corporate income and excise taxes (FDOR 2011-TN460). The tax is based on 5.5 percent of the Federal taxable income with specific adjustments for the State of Florida and a $25,000 exemption (FDOR 2012-TN450).

Sales and Use Taxes

The State sales tax rate for Florida is 6 percent of the sale price of taxable goods and services. Non-taxable goods and services include groceries and services provided by Federal, State, County, and city governments and some nonprofit organizations. A 6 percent use tax is also applied to out-of-state purchases imported into the State, but a credit is given for sales taxes paid in another State. In FY 2011, the State of Florida received $19.35 billion (65.2 percent of its total tax revenue) from sales and use taxes (FDOR 2012-TN450). Counties may also impose a discretionary sales surtax on items or services delivered into the county, often only applied to the first $5,000 of sales. In Miami-Dade the surtax is 1 percent (FDOR 2012-TN456). In FY 2011-2012, Miami-Dade's adopted budget in FY 2011-2012 shows $282.7 million in sales and use taxes (Table 2-41).

Table 2-41. Miami-Dade County Adopted Budget Revenues by Major Sources, FY 2011-2012, $Thousands

Revenue Source	FY 2011-2012 General Fund	FY 2011-2012 Proprietary and Other Funds	Total
Property Taxes	957,913	285,089	**1,243,002**
Sales Taxes	120,458	162,245	**282,703**
Misc. State Revenues	83,480	-	**83,480**
Gas Taxes	62,120	-	**62,120**
Utility and Communications Taxes	113,365	-	**113,365**
Fees and Charges	5,892	2,774,738	**2,780,630**
Miscellaneous Revenues	11,677	70,679	**184,356**
State and Federal Grants	-	443,225	**443,225**
Interagency Transfers	-	347,645	**347,645**
Fund Balance/Carryover	110,241	484,371	**594,612**
Total	**$1,567,146**	**$4,567,992**	**$6,135,138**

Source: Miami-Dade County 2012-TN462, Appendix A

Other Taxes on Sales and Services

In FY 2011, the State of Florida received 7.7 percent of its total tax revenues from a Communications Services Tax and 3.9 percent from a Documentary Stamp Tax. The Communications Services Tax is imposed on all communications—cable and direct-to-home satellite services. The State tax rate is 9.17 percent (13.17 percent for direct-to-home satellite) and local taxing jurisdictions may add their own rates. In Miami-Dade County, the rates currently vary between 0.5 percent and 6.72 percent depending on place (FDOR 2012-TN457).

The Documentary Stamp Tax is applied to the value of Florida real property whenever a transfer is made or to written obligations to pay such as bonds and mortgages when documents are executed or delivered in Florida. The rate in Miami-Dade County rate is 60 cents per $100 (or portion thereof) on all documents, plus 45 cents per $100 surtax on documents transferring anything other than a single-family residence (FDOR 2010-TN458).

Property Taxes

Florida does not have a State-level property tax. Private property owners pay property taxes to the county and a local school district and may also pay taxes to special taxing units. Property values are set by the County property appraisers and some exemptions may apply. The tax rate (millage) is set by each taxing unit. County and school district governments may levy taxes up to 10 mills each (1 percent) (FDOR 2012-TN459). For FY 2011-2012, the overall millage rate for Miami-Dade County is 9.7405 mills (Miami-Dade County 2012-TN462).

Miami-Dade County budgeted property taxes for FY 2011-2012 were $1,243,002,000 (Table 2-41). These taxes fund four separate taxing jurisdictions: Countywide, the Unincorporated MSA, the Fire Rescue District, and the Library System. These latter two appear in Table 2-42 under the "proprietary and other funds column."

Table 2-42 shows Florida's FY 2010-2011 tax revenues by major sources and Table 2-41 shows Miami-Dade County budgeted revenues for FY 2011-2012.

Table 2-42. Florida Tax Revenues by Major Sources, FY 2010-2011

Revenue Source	$ millions	Share of Total
Sales and Use Tax	19,353.0	65.2%
Communications Services Tax	2,307.1	7.7%
Corporate Income and Excise Tax	1,869.9	6.3%
Documentary Stamp Tax	1,176.8	3.9%
Other Sources	4,984.6	16.9%
Total Revenue Administered Taxes	**29,691.4**	**100%**

Source: FDOR 2011-TN460

Miami-Dade Public School District is a taxing entity separate from Miami-Dade County. The Florida Education Finance Program (FEFP) is the primary mechanism for funding the operating costs of Florida school districts. Funding comes from local, State, and Federal government sources. Local funding is from property taxes on properties located within the school district. State funding is by legislative appropriation and the major source of revenue is the State sales tax. Federal funding is coordinated by the Florida Department of Education. School districts receive funds from the Federal government directly and through the State as an administering agency. Under FEFP, funding is based on the number of full-time equivalent students, and considers variations in several factors when determining funding for each district: local property tax bases, education program costs, costs of living, and costs for equivalent educational programs due to the student population's density and distribution (FPL 2014-TN4058). As a result of legislative action in 2004, State funding for the Miami-Dade Public School District has declined as a share of total funding from 53.4 percent in 2000-2001 to 28.2 percent in 2009-2010. In the same period, the local portion has risen from 37.2 percent to 54.0 percent (FPL 2014-TN4058). Miami-Dade County Public School District 2011-2012 budget included approximately $3,612 million in new revenues, of which $2,068 million (57.2 percent) were local revenues, $1,556 million of which from local property taxes (M-DCPS 2011-TN1494).

Under Florida law, both real property (land and permanent buildings) and tangible personal property (primarily business equipment) are subject to property tax. FPL pays real property taxes to Miami-Dade County and the Miami-Dade School District. In 2011, taxes were $6.7 million on the nuclear units and $9.2 million on the fossil-fuel units, for a total of $15.9 million. The County received 55 percent of this tax, while the school district received 45 percent of the tax revenue. FPL also paid personal property taxes for the existing units to Miami-Dade County, the Miami-Dade School District, and several special taxing districts. These include the Florida Inland Navigation District, the SFWMD, the Everglades Construction Project, the Children's Trust Authority, and the Library District. In 2011, FPL paid $15.3 million in tangible personal property taxes on its Turkey Point property (FPL 2014-TN4058).

Table 2-43 shows revenues for Homestead. In FY 2012, the City of Homestead had budgeted revenues of almost $156 million. Most of these revenues were associated with proprietary funds, particularly the City of Homestead owned and operated electric utilities, as well as water and wastewater utilities and fees associated with stormwater and solid waste management. Tax revenues are included in Table 2-43 under Property Taxes and other General Fund revenues. In addition to property taxes, these include local option gas taxes, communication service taxes and utility service taxes. About 57 percent of General Fund revenues are budgeted to fund police services.

Table 2-43. City of Homestead Adopted Budget, FY 2012

Revenue Source	Value $
Property Taxes	$10,225,371
Other General Fund Revenues	26,556,523
Electric Utility Revenues	61,811,741
Other Utility Revenues	27,822,562
Other	29,550,045
Total	**155,966,242**

Source: City of Homestead 2012-TN1465

2.5.2.3 Transportation

The Turkey Point site's transportation network includes U.S. and interstate highways, multilane divided State highways, and local streets. The County operates public transportation services including rail, express bus, and buses that have multiple stops. Rail freight service in Miami-Dade County is provided by CSX Corporation. Rail passenger service is provided by Amtrak and TRI-Rail. The county also includes air transportation infrastructure including airports, heliports, and a seaplane base; a seaport for commercial freight and passenger service; and an intermodal transportation hub for air, rail, and ship. The county is also served by private airstrips, heliports (including the FPL corporate and Turkey Point heliports), and seaplane bases (FPL 2014-TN4058).

Roads

The major Federal highways in Miami-Dade County are US-1, which bisects the county from north to south and continues to the Florida Keys south of Miami-Dade County, and Interstates 75 and 95 (I-75 and I-95), which also have a north-south direction. Both of the Interstate highways terminate in Miami. These U.S. and Interstate highways are shown in Figure 2-36. Two of the major State highways in the county are the Florida Turnpike and SR-997.

Florida's Turnpike is a multilane divided toll road that traverses much of Florida, linking I-75 in the interior south of Ocala to Miami. The Homestead extension of Florida's Turnpike terminates at US-1 north of Florida City. SR-997 connects US-1 in Homestead with US-27 northwest, skirting the western fringes of the Miami metropolitan area and terminating in Homestead where the road changes names to Krome Avenue. Krome Avenue continues south and terminates at US-1 south of Florida City. These highways are shown in Figure 2-36.

Access to the Turkey Point site is currently through road SW 344th Street/Palm Drive that intersects both US-1 and SR-997 approximately 8 mi west of the site. SW 344th Street/Palm Drive is a four-lane road that narrows to two lanes as it leads to Turkey Point (at its intersection with SW 137th Avenue/Tallahassee Road). SW 344th Street/Palm also provides access to Homestead-Miami Speedway and Homestead Bayfront Park. The speedway hosts premier motorsports events including NASCAR and IndyCar races, and has parking for more than 30,000 vehicles and 1,300 recreational vehicles (FPL 2014-TN4058). Figure 2-37 shows streets in the vicinity of the site, as well as existing Miami-Dade County traffic count stations. The station near the Speedway on SW 344th Street/Palm Drive west of SW 137th Avenue/Tallahassee Road (9,956) estimated, in October of 2008, an available peak hour capacity of 2,799 trips. Traffic counts and estimated available peak hour capacity for all three traffic count stations are shown in Table 2-44.

In its visit to the site, the review team confirmed the current low use of the roads in the vicinity of site through interviews conducted with local and County authorities and in a driven tour of the roads.

Figure 2-36. Transportation Infrastructure within the 50-Mile Radius of the Site (Source: FPL 2014-TN4058)

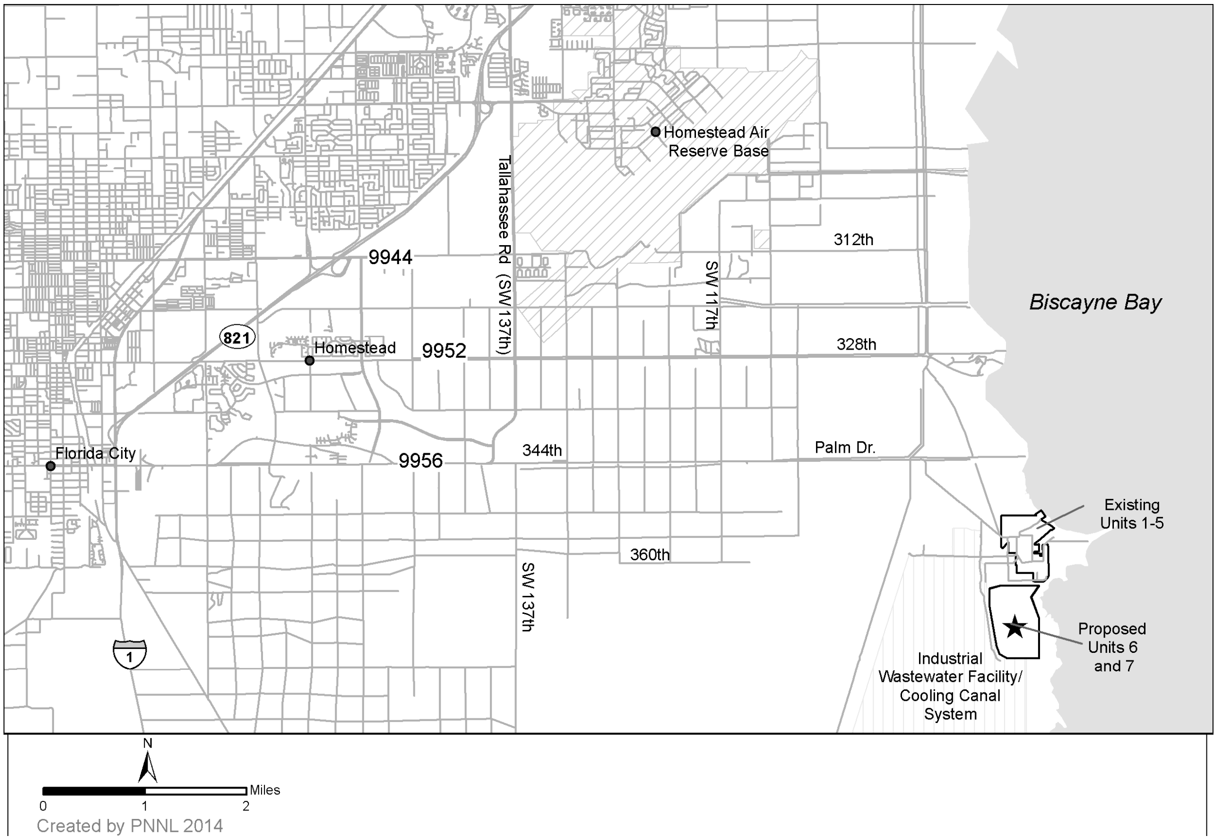


Figure 2-37. Highways, Streets, and Traffic Count Stations in the Vicinity of the Site (Source: Traf Tech 2009-TN1266)

Table 2-44. Available Peak Hour Capacity at Traffic Count Stations, 2008

Traffic Count Station	Location	Peak Hour Capacity	Peak Hour Trips	Available Peak Hour Capacity
9956	SW 344 St. W. of SW 137th Ave/Tallahassee Rd.	3,030	231	2,799
9952	SW 328th St. W. of SW 137th Ave./Tallahassee Rd.	2,600	254	2,346
9944	SW 312th St. E. of Florida Turnpike	3,350	2,061	1,289

Source: Traf Tech 2009-TN1266

Rail

Rail passenger service is provided to Miami by Amtrak and TRI-Rail; neither rail service travels to locations south of Miami. Rail freight service in Miami-Dade County is provided by CSX operating Class 1 rail lines and services the Port of Miami. The rail line terminates in Homestead. There is no rail service to the Turkey Point site.

Waterways

The Port of Miami is in Miami and offers passenger and freight services. The Atlantic Intracoastal Waterway traverses the eastern coastline of Florida and intersects with the Port of Miami. The existing equipment barge-unloading area at Turkey Point is accessed via the

Atlantic Intracoastal Waterway to receive shipments of oil and equipment. Fuel oil is currently delivered to Turkey Point by barge from a terminal at the Port of Miami on Dodge Island.

Air

Miami-Dade County operates five airports including Miami International, a major commercial airport in Miami, and the Homestead General Aviation Airport. Homestead is also host to the Homestead Air Reserve Base, the closest airport to Turkey Point. Miami-Dade has many privately owned heliports, including the FPL Helistop and the FPL Turkey Point Heliport (FPL 2014-TN4058).

2.5.2.4 Aesthetics and Recreation

The Turkey Point site lies in an unincorporated area in Miami-Dade County, Florida, approximately 8 mi east of Florida City and 4.5 mi east of the southeastern municipal limits of Homestead. The Units 1 and 2 emissions stacks are the tallest structures on the site, approximately 400 ft tall. There are some resources in the vicinity (within 6 mi) of the site that, because of their residential or recreational use, could be sensitive to the visual presence of an industrial plant. These resources include residential neighborhoods in Homestead; a portion of Biscayne National Park, including the visitor's center to the north and east; and Homestead Bayfront Park to the north. The privately owned Homestead-Miami Speedway is approximately 5 mi northwest of the Units 6 and 7 proposed site. Although the topography surrounding the site is relatively flat and sparsely populated with trees, there is sufficient vegetation to screen the existing units from area roadways and recreational areas on land. SW 344th Street/Palm Drive and SW 328th Street/North Canal Street provide the best opportunity for the public to view the existing units from roadways. However, trees and scrub growth aid in screening the units, including the emissions stacks, from area roadways. Because of the vegetation, the existing units and emission stacks are not visible from most points in Biscayne National Park and Homestead Bayfront Park. The emission stacks may be visible from some upper level seats in the grand stand at the Homestead-Miami Speedway. The existing units are fully visible from Biscayne Bay. Beyond the 6 mi radius, on land, the existing units are not visible. Over the waters in Biscayne Bay however, the units can be clearly seen (FPL 2014-TN4058). An outdoor light monitoring study conducted in 2008 concluded that light from existing Turkey Point units is visible from several locations surrounding the site such as Homestead-Miami Speedway and Biscayne Bay. Sky glow was observed from urban areas such as Homestead and Miami (FPL 2014-TN4058).

Many public and private recreational opportunities and facilities are present in Miami-Dade County, often close to the City of Miami, including festivals, zoos, botanical gardens, museums, sports venues, beaches, and parks. The Florida Keys are known for sport fishing and other water events. Everglades National Park offers recreational opportunities for camping, hiking, boating, and wildlife viewing. Homestead and Florida City host several festivals throughout the year and offer 21 local parks (FPL 2014-TN4058). Table 2-45 lists major parks and wildlife areas within 50 mi of the Turkey Point site.

Table 2-45. Wildlife Management Areas, National Wildlife Refuges, Preserves, and State Parks within 50 Miles of the Turkey Point Site (2007-2008)

Name	County	Acres	Annual Visitors	Distance to the Site (mi)
Wildlife Management Areas, National Wildlife Refuges, and Preserves (open to the public)				
Big Cypress National Preserve	Broward, Collier, Miami-Dade, and Monroe	720,561	822,864	44
Biscayne National Park	Miami-Dade	172,971	517,442	Adjacent
Cross Key	Monroe	124	NA	15
Crocodile Lake National Wildlife Refuge	Monroe	6,692	NA	12
Everglades National Park	Collier, Miami-Dade, and Monroe	1,508,533	1,074,764	29
Florida Keys Wildlife and Environmental Area	Monroe	3,089	NA	31
Mary Krome Bird Refuge	Miami-Dade	2	NA	10
Tarpon Basin	Monroe	598	NA	21
State Parks				
Bill Baggs Cape Florida State Park	Miami-Dade	432	893,543	20
Curry Hammock State Park	Monroe	1,000	60,544	26
Dagny Johnson Key Largo Hammock Botanical State Park	Monroe	2,421	11,372	12
Indian Key Historic State Park	Monroe	110	18,295	43
John Pennekamp Coral Reef State Park	Monroe	63,836	878,939	17
John U. Lloyd Beach State Park	Broward	311	495,609	47
Lignumvitae Key Botanical State Park	Monroe	10,818	23,416	42
Oleta River State Park	Miami-Dade	1,033	357,178	36
San Pedro Underwater Archaeological Preserve State Park	Monroe	644	712	45
The Barnacle Historic State Park	Miami-Dade	10	31,545	21
Windley Key Fossil Reef Geological State Park	Monroe	32	11,087	36

Source: FPL 2014-TN4058

The Biscayne National Park is adjacent to FPL property and its visitor center and entrance are approximately 2 mi north of the site proposed for Units 6 and 7. The park covers an area of approximately 172,000 ac, 95 percent of which is water. Water areas of the park are just over 2,000 ft to the east of the proposed Units 6 and 7 plant area. Activities accessible to the public include wildlife viewing, snorkeling, scuba diving, canoeing, camping, hiking, and fishing. The park receives approximately 500,000 visitors per year (NPS 2012-TN465).

Also, 1.5 mi north of the proposed site for Turkey Point Units 6 and 7, and just next to Biscayne National Park, is the Homestead Bayfront Park, including a public beach with picnic tables, barbeque grills, shelters, food/drink concession stands, restrooms, showers, and fishing (FPL 2014-TN4058). According to information obtained from a direct call to the park, days with most visitors are on weekends, when an average of 2,000 people visit the park (FPL 2014-TN4058).

The Homestead-Miami Speedway is located 5 mi from the proposed plant area in Homestead and hosts race car and motorcycle events throughout the year, including one of the region's major sporting events, the Grand Prix of Miami, which features an estimated 85,000 spectators over 3 days and capacity for 65,000 seated spectators (FPL 2014-TN4058).

2.5.2.5 Housing

Approximately 83.3 percent of FPL employees (814) reside in Miami-Dade County, of which over 98 percent (798) reside in Homestead (391), Florida City (27), or Miami (380). Another 6.4 percent (63) reside in Broward County and 4.8 percent (47) in Monroe County, and about 5 percent (51) resided in other counties or out of state (Table 2-34).

Table 2-46 provides the number of housing units and vacancies in Miami-Dade County and the Cities of Homestead and Florida City. In 2000, there were a total of 852,278 housing units in Miami-Dade County. This number grew by an estimated 16 percent to reach an estimated 989,364 housing units in 2012. Vacancy rates grew considerably in the same period and were estimated to be 16.5 percent in 2012, compared to the 8.9 percent vacancy rate of 2000. Of the occupied housing units in Miami-Dade County in 2012, 56.8 percent of the units were owner-occupied and 43.2 percent of them were renter-occupied. Of the 163,185 vacant housing units in Miami-Dade County in 2012, 22.0 percent (35,884) were for rent; 11.2 percent (18,325) were for sale; 40.0 percent (66,346) were for seasonal, recreational, and occasional use; and 0.2 percent (290) were for migrant workers; the remaining units were rented or sold but not occupied or for other uses (USCB 2012-TN4089).

Table 2-46. Baseline Housing Information

Place	Total Housing Unit	Occupied	Owner-Occupied	Renter-Occupied	Vacant Housing	Percent Vacant
Miami-Dade County (2000)	852,278	776,774	449,325	327,449	75,504	8.9%
Miami-Dade County (2012)	989,364	826,179	468,997	357,182	163,185	16.5%
Homestead (2012)	22,825	18,567	7,635	10,932	4,258	18.7%
Florida City (2012)	3,390	2,720	1,027	1,693	670	19.8%

Sources: USCB 2012-TN4089 and USCB 2000-TN470

In Homestead and Florida City there were a total of 26,215 housing units in 2012. Approximately 18.8 percent (4,928) of these units were vacant. Of the vacant units, approximately 37.0 percent (1,821) were for rent, 21.8 percent (1,072) were for sale, 8.1 percent (339) were for seasonal or recreational use, and 2.4 percent (118) were for migrant workers; the remaining units were rented or sold but not occupied or for other uses (USCB 2012-TN4089).

There are 9 recreational vehicle parks or campgrounds in Miami-Dade County, including 1,587 spaces with full hookups (water, sewer, and electricity) for private recreational vehicles. Approximately 68 percent of these spaces are in the Homestead and Florida City area (FPL 2014-TN4058).

In 2011, there were 361 hotels/motels with approximately 47,642 rooms available in Miami-Dade County. In the South Dade region, which includes the Homestead and Florida City area, 27 hotels/motels with approximately 1,928 rooms were available in 2011. The average room rate for South Dade in 2011 was $75.76 (FPL 2014-TN4058).

2.5.2.6 Public Services

Water Supply and Waste Treatment

There are five major public water-supply systems in Miami-Dade County, as listed in Table 2-47: the MDWASD, Florida City, Homestead, North Miami, and North Miami Beach systems. MDWASD is the main supplier in the county and includes Homestead among its wholesale customers. It is formed by three water-treatment plants: Alexander Orr, Hialeah Preston, and South Dade. Table 2-47 shows the daily average demand in 2007, facility capacity, and daily demand as percent of capacity for public water suppliers. In the Homestead and Florida City area, the two water systems serve approximately 86,252 people, meeting a daily average demand of 14.80 Mgd with a combined capacity of 20.90 Mgd.

Current water demand from major public suppliers in Miami-Dade County is below capacity. If demand grew at the rate of 33 percent in 20 years, as predicted for total water demand by SFWMD, demand for water from public suppliers would still be below capacity after the 20-year period (from Table 2-47). Current water-management strategies for the Miami-Dade County plan include a more coordinated use of conservation and alternative water-supply projects, such as reverse osmosis plants, and reclaimed wastewater systems. In total, these strategies could provide 98.3 Mgd of additional water supply to Miami-Dade County by the year 2025 (FPL 2014-TN4058).

The major water-supply sources for all of the existing water-treatment systems in Miami-Dade County are the Biscayne and Floridan aquifers. Groundwater from the Floridan aquifer is used to blend brackish water and freshwater at water-treatment plants to extend the water supply (FPL 2014-TN4058). In 2005-2006, the SFWMD analyzed water use by type and projected Miami-Dade total water demand to increase by 33 percent, from 526.22 Mgd in 2005 to 699.1 Mgd in 2025. In 2005, 72 percent of overall demand came from public water utility and domestic self-supply, while thermoelectric power use is approximately one-half of 1 percent. Thermoelectric demand for power use is projected to increase from 2.1 Mgd (four-tenths of one percent of total demand) to 69.8 Mgd (about 10 percent of total demand) from 2005 to 2025, respectively (FPL 2014-TN4058). Table 2-48 shows projected demands for water to 2025.

Table 2-47. Major Public Water Suppliers in Miami-Dade County, 2007

System Name	Population Served	2007 Daily Average Demand (Mgd)	Facility Capacity (Mgd)	Daily Demand as Percent of Capacity, 2007
Total from Major Suppliers, Miami-Dade County	2,621,700	393.03	545.81	72.93
MDWASD	2,250,944	347.81	483.61	71.92
Florida City	15,000	2.33	4.00	58.13
Homestead	71,252	12.47	16.90	73.78
North Miami	97,504	8.50	9.30	91.40
North Miami Beach	187,000	26.93	32.00	84.15

Sources: FPL 2014-TN4058; CDM 2008-TN442

Table 2-48. Miami-Dade County Projected Water Demands, 2005−2025

Selected Categories	2005 (Mgd)	2025 (Mgd)	Percent of Overall Demand in 2005	Percent of Overall Demand in 2025
Public Water Utility and Domestic Self-Supply	380.92	483.10	72.39	69.10
Commercial/Industrial Self-Supply	41.70	41.70	7.92	5.96
Recreational Self-Supply	8.80	15.10	1.67	2.16
Thermoelectric Power Self-Supply	2.1	69.8	0.40	9.98
Agricultural Self-Supply	92.70	90.20	17.62	12.90
Total	**526.22**	**699.10**	**100**	**100**

Source: FPL 2014-TN4058

Reclaimed Water Baseline

The wastewater created in Miami-Dade County is either treated at public wastewater-treatment facilities, or is handled by privately owned and operated septic systems (FPL 2014-TN4058). MDWASD is divided into two wastewater districts, north and south. The proposed new nuclear units would be a served by the MDWASD SDWWTP. Table 2-49 summarizes current treatment capacities and flows.

Table 2-49. Wastewater-Treatment Systems in Miami-Dade County

Selected Categories	Plant Capacity (Mgd)	Daily Average Annual Flow (Mgd)	Flow as Percent of Design Capacity
MDWASD South District	112.5	98.53	88%
MDWASD North District	112.5	91.39	81%
Central District	143	115	80%
City of Homestead	6.0	6.13	102%

Source: FPL 2014-TN4058

The wastewater-treatment facility for Homestead is at 102 percent capacity and Homestead uses the MDWASD system as backup. Homestead's proposed 10-Year Water Supply Facilities Work Plan identifies and details the construction of a 3.45 Mgd high-level disinfectant wastewater-treatment plant upgrade (SFRPC 2008-TN1497). The proposed expanded wastewater-treatment plant would have the capacity to handle 9.45 Mgd, which would provide capacity to satisfy the projected demand through at least 2030 (FPL 2014-TN4058). MDWASD SDWWTP handles Florida City's wastewater and it is currently at 88 percent capacity (FPL 2014-TN4058).

Miami-Dade County is currently assessing the large-scale use of treated wastewater (reclaimed water) for various purposes (e.g., industrial, agricultural). As of 2007, approximately 16.2 Mgd of wastewater were reused in MDWASD's system, mostly for process water and irrigation at the existing wastewater-treatment plants (Miami-Dade County 2007-TN1496). Miami-Dade County is currently expanding its water-reclamation program and evaluating several water-reclamation projects, including a high-level disinfection project and a SDWWTP (Miami-Dade County 2011-TN461). A 2007 reuse feasibility study projected approximately 374 Mgd of wastewater to be generated by 2025 in Miami-Dade County. In analyzing the feasibility of several bundles of potential projects for the use of reclaimed water in Miami-Dade County, the study concluded that the projects analyzed that were considered technically feasible could use between 25 percent and 33 percent (93.5 Mgd to 123 Mgd) of the projected wastewater generated in 2025 (Miami-Dade County 2007-TN1496). These estimates did not include use of reclaimed water by nuclear facilities.

Police, Fire, and Medical Services

The Miami-Dade County Police Department serves the entire county including all the municipalities. In 2010, 2,980 total sworn officers and 1,383 civilians were employed by the Miami-Dade County Police Department for a total of 4,363 total law enforcement employees (FPL 2014-TN4058). In 2009, the national average was 3.5 law enforcement employees (including civilians) per 1,000 residents (FBI 2009-TN4082). Miami-Dade County has approximately 1.8 law enforcement employees (including civilians) per 1,000 residents. In 2010, 135 total sworn officers and 53 civilians were employed by police departments in the Homestead and Florida City areas for a total of 191 total law enforcement employees. The Homestead and Florida City area has approximately 2.6 law enforcement employees (including civilians) per 1,000 residents (FPL 2014-TN4058). Table 2-50 summarizes the number of law enforcement personnel in Miami-Dade County, Homestead, and Florida City.

Table 2-50. Law Enforcement and Fire Protection in Miami-Dade County and the Homestead and Florida City Area, 2010

Selected Categories	Miami-Dade County	Homestead and Florida City Area
Law Enforcement Personnel	4,363	188
Officers	2,980	135
Civilians	1,383	53
Fire Protection Personnel	3,500	
Active Firefighters	3,500	69
Civilians	0	
Fire Stations	96	

Source: FPL 2014-TN4058

In Miami-Dade County, there are 3,500 total active firefighters and 718 residents per active firefighter (FPL 2014-TN4058). The Homestead and Florida City area is served by Miami-Dade County Fire and Rescue. As of 2010, approximately 69 firefighters were active throughout three fire stations located in the area of Homestead and Florida City (FPL 2014-TN4058). Table 2-51 provides fire protection personnel data for Miami-Dade County as of 2010.

The Insurance Services Office, an advisory organization that serves the property and casualty insurance industry, uses a fire-suppression rating schedule to grade the public fire protection of a city, town, or area. The rating schedule classifies communities from 1 (the most preferred) to 10 (the least preferred). Communities are graded on water distribution, fire department equipment and manpower, and fire alarm facilities, among other things. The overall public protection classification rating for Miami-Dade County is 4, as is the overall public protection classification for the Homestead and Florida City area (FPL 2014-TN4058).

Table 2-51 presents hospital-use data for Miami-Dade County. Miami-Dade County has 10,497 physicians, 31 hospitals, and 8,420 staffed beds. Most (23) of the hospitals located in Miami-Dade County are classified as “General and Surgical” hospitals. Three hospitals are listed as rehabilitation hospitals, while two are long-term acute care hospitals. One hospital specializes in children’s general care, and one in eye, ear, nose, and throat care.

Education

The State of Florida divides the school districts by county. The Miami-Dade Public School District (M-DCPS) has a total of 450 schools that supported a 2011-2012 enrollment of 349,945 students (Table 2-52) (Miami-Dade County Public Schools 2012-TN463). Student public school enrollment has consistently decreased since 2002-2003, but there has been a reversal in the last two school years (2010-11 and 2011-12). Annual changes in enrollment between 2002-2003 and 2011-2012 have averaged 3,891 students, or approximately 1 percent of enrollment in the previous year (Miami-Dade County Public Schools 2012-TN463). There are also 272 private schools covering pre-kindergarten through 12th grade where 61,597 students were enrolled in 2007-2008. There are 12 colleges or universities that are accredited to award various certificates and degrees ranging from associate to doctoral and there are also a large number of vocational schools that offer professional and paraprofessional training (FPL 2014-TN4058).

An amendment to the Florida Constitution approved in 2002 set limits to the number or students in core classes (e.g., math, science) in public schools. These limits are shown in Table 2-53 below. Florida law requires that these class sizes be met for core courses by the average district class size in FY 2003-2004 through 2005-2006, by the average school class size in FY 2006-2007 and 2007-2008; and by each individual classroom from FY 2008-2009 onwards (FLDOE 2012-TN1490). Mandated class sizes are met by Miami-Dade County public schools on average, with a very small share of full-time equivalent (FTE) students in classes over the mandated size (Table 2-53).

Currently, portable units are often used by public schools in Miami-Dade County to supplement permanent school facilities. Miami-Dade County’s 2012-2013 Work Plan lists capital outlay projects needed to ensure availability of classrooms to accommodate projected school enrollments through 2016-2017 school year. These projects include the addition of 110 classrooms and 2,440 student stations (M-DCPS 2012-TN1493).

In the Homestead and Florida City area, 17 traditional (non-Charter) public schools supported an enrollment of 14,884[(5)] students in 2011-2012 (M-DCPS 2012-TN1493). FTE students in classes over the mandated size were 123.26 in that same year (FLDOE 2012-TN1490), or less than 0.8 percent of those actually enrolled in that school year. No new student stations or classrooms are proposed for the Homestead and Florida City Area in Miami-Dade County School District’s 2011-2012 Work Plan (M-DCPS 2012-TN1493). In addition, there were 8,373 students attending 27 charter schools (M-DCPS 2012-TN1493). There are also 16 private schools covering pre-kindergarten through grade 12 where 2,263 students were enrolled in 2009-2010 (FPL 2014-TN4058).

(5) Full-time equivalent

Table 2-51. Medical Facilities and Personnel in Miami-Dade County, 2006

Facility Name	Staffed Beds	Admissions[a]	Census[b]	Outpatient Visits[c]	Personnel[c]	Service Classification
Aventura Hospital and Medical Center	390	15,956	246	76,540	892	General & Surgical
Coral Gables Hospital	188	NA	NA	NA	NA	General & Surgical
Doctors Hospital	148	6,994	105	61,204	740	General & Surgical
Kindred Hospital South Florida – Coral Gables	53	NA	NA	NA	NA	Other Specialty
Hialeah Hospital	220	NA	NA	NA	NA	General & Surgical
Palm Springs General Hospital	190	NA	NA	NA	NA	General & Surgical
Palmetto General Hospital	190	NA	NA	NA	NA	General & Surgical
Homestead Hospital	116	7,284	86	68,452	631	General & Surgical
Baptist Hospital of Miami	551	NA	NA	NA	NA	General & Surgical
Bascom Palmer Eye Institute – Anne Bates Leach Eye Hospital	22	174	2	186,118	570	Eye, Ear, Nose & Throat
Cedars Medical Center	350	17,933	301	51,153	1,179	General & Surgical
Healthsouth Rehabilitation Hospital	60	NA	NA	NA	NA	Rehabilitation
Jackson Memorial Hospital	1,776	66,192	1,472	626,140	11,193	General & Surgical
Jackson South Community Hospital	233	NA	NA	NA	NA	General & Surgical
Kendall Regional Medical Center	296	16,428	210	80,098	1,217	General & Surgical
Meadowbrook Rehabilitation Hospital of West Gables	60	NA	NA	NA	NA	Rehabilitation
Mercy Hospital	367	19,790	291	93,699	2,065	General & Surgical
Miami Children's Hospital	252	13,297	195	266,010	2,266	Children's General
Miami Jewish Home and Hospital for the Aged	32	NA	NA	NA	NA	General & Surgical
North Shore Medical Center	357	NA	NA	NA	NA	General & Surgical
Pan American Hospital	146	NA	NA	NA	NA	General & Surgical
Select Specialty Hospital of Miami	40	NA	NA	NA	NA	Long-Term Acute Care
Sister Emmanuel Hospital for Continuing Care	29	NA	NA	NA	NA	Long-Term Acute Care
South Miami Hospital	324	21,062	233	180,214	1,813	General & Surgical
University of Miami Hospital and Clinics	40	1,428	24	175,234	757	General & Surgical

Table 2-51. (contd)

Facility Name	Staffed Beds	Admissions[a]	Census[b]	Outpatient Visits[c]	Personnel[c]	Service Classification
Veterans Affairs Medical Center	347	6,623	270	542,111	2,402	General & Surgical
Westchester General Hospital	172	5,976	142	22,129	561	General & Surgical
Mount Sinai Medical Center	685	24,319	433	173,691	2,837	General & Surgical
St. Catherine’s Rehabilitation Hospital	272	NA	NA	NA	NA	Rehabilitation
Parkway Regional Medical Center	392	NA	NA	NA	NA	General & Surgical
Larkin Community Hospital	122	NA	NA	NA	NA	General & Surgical
Total	**8,420**	**223,456**	**4,010**	**2,602,793**	**29,123**	NA

(a) Total during a recent 12-month period (2005-2006).
(b) Average daily census during a recent 12-month period.
(c) Hospital personnel list does not include doctors that serve patients in the hospital, but are employed by the hospital.

Source: FPL 2014-TN4058

Table 2-52. Public School Statistics in Miami-Dade County and Homestead and Florida City

Grade Levels	Miami-Dade County		Homestead and Florida City	
	Schools	Enrollment	Schools	Enrollment
Elementary	205		10	
Middle Schools	80		4	
K-8 Schools	68		1	
High Schools	73		2	
Other[(a)]	24		-	
Total	450	349,945	17	14,884

(a) Special and combined schools

Source: Miami-Dade County Public Schools 2012-TN463

Table 2-53. Class Sizes in Miami-Dade County, 2010-2011

Grade Levels	Florida Department of Education Mandated Size[(1)]	Average Class Size[(2)]	FTE[(a)] Over Capacity[(2)]	FTE[(a)(3)]	Percentage of FTEs over Capacity
Pre-K − 3	18	13.9	909.1	106,354.1	0.9%
4 − 8	22	16.6	656.4	136,193.4	0.5%
9 − 12	25	20.2	630.0	102,828.1	0.6%

(a) FTE stands for full-time equivalent and is a measure of enrollment based on the number of full-time students that it would take to fulfill the number of classes offered

Sources: 1 − FLDOE 2012-TN1490; 2 − FLDOE 2011-TN1491; 3 −FLDOE 2012-TN1492.

2.6 Environmental Justice

Environmental justice refers to a Federal policy established under Executive Order 12898 (59 FR 7629) (TN1450), which requires each Federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.[(6)] The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997-TN452). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040) (TN1009). The review team's environmental justice analysis is guided by the NRC's ESRP and the additional guidance document, Revision 1 of *Addressing Construction and Preconstruction Activities*, *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-TN9).

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

This section describes the existing demographic and geographic characteristics of the proposed site and its surrounding communities. It offers a general description of minority and low-income populations within the region surrounding the site. The characterization in this section forms the analytical baseline from which potential environmental justice effects would be determined. The characterization of populations of interest includes an assessment of "populations of particular interest or unusual circumstances" (NRC 2000-TN614), such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations such as American Indian settlements.

2.6.1 Methodology

The review team first examined the geographic distribution of minority and low-income populations within 50 mi of the Turkey Point site. This information was obtained using ArcMap 10 software (ESRI 2012-TN1469) and the 2008–2012 United States Census Bureau American Community Survey Five-Year Summary Files (USCB ACS) to identify minority and low-income populations at the census block group level.(7) The review team also verified its analysis by conducting field inquiries of numerous agencies and groups (see Appendix B for list of organizations contacted).

The first step in the review team's environmental justice methodology was to examine each census block group that is fully or partially included within the 50 mi region surrounding the Turkey Point site to determine for each block group whether it should be considered an environmental justice (EJ) population of interest. If either of the two criteria discussed below was met for a census block group, that census block group was considered an EJ population of interest warranting further investigation. The two criteria are whether

- the minority or low-income population that resides in the block group exceeds 50 percent of the total population for that census block group, or
- the percentage of the minority or low-income population in the census block group is at least 20 percentage points greater than the same minority or low-income population's percentage in the respective state.

The identification of census block groups that meet at least one of the above two criteria is not sufficient for the review team to conclude that a disproportionately high and adverse impact exists. Likewise, the lack of a census block group meeting the above criteria cannot be construed as evidence of no disproportionately high and adverse impacts. To reach an EJ conclusion, the review team conducts an active public outreach and on-the-ground investigation in the region of the proposed site to determine whether any additional EJ populations of interest may exist in the region that are not identified in the census mapping exercise. In addition, starting with the identified populations of interest, the review team must investigate all populations in greater detail to reveal key pathways that may have disproportionately high and adverse impacts on EJ populations of interest. To determine whether disproportionately high and adverse effects may be present, the review team considers the following:

(7) A census block is the smallest geographic area that the U.S. Census Bureau collects and tabulates sample data. A block group is the next level above census blocks in the geographic hierarchy and is a subdivision of a census tract or block numbering area.

- Health Considerations
  1. Are the radiological or other health effects significant or above generally accepted norms?
  2. Is the risk or rate of hazard significant and appreciably greater than that for the general population?
  3. Do the radiological or other health effects occur in groups affected by cumulative or multiple adverse exposures to environmental hazards?
- Environmental Considerations
  1. Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?
  2. Are there any significant adverse impacts on a group that appreciably exceed or [are] likely to appreciably exceed those on the general population?
  3. Do the environment effects occur in groups affected by cumulative or multiple adverse exposure to environmental hazards? (NRC 2007-TN4).

If this investigation in greater detail does not yield any pathways by which EJ populations of interest could be disproportionally affected by adverse impacts, the review team may conclude that there are no disproportionately high and adverse impacts. If the review team finds any potential pathways for disproportionately high and adverse impacts, the review team must characterize the nature and extent of that impact and consider possible mitigation measures that may be used to lessen that impact. The remainder of this section discusses the results of the search for potentially affected populations of interest.

2.6.1.1 Minority Populations

The minority population is expressed in terms of the number and/or percentage of people that belong to minority races or ethnicities in an area. Persons of Hispanic/Latino origin are considered an ethnic minority and may be of any race, including white. The review team considers the aggregate minority population to be the sum of the white Hispanic/Latino and the racial minority populations.

U.S. Census Bureau data (USCB 2012-TN4098) present the Florida population as containing the following:

- 0.3 percent American Indian or Alaskan Native
- 2.5 percent Asian
- 0.1 percent Native Hawaiian or other Pacific Islander
- 15.9 percent Black or African American
- 2.6 percent other single race
- 2.2 percent multi-racial
- 22.5 percent Hispanic ethnicity
- 42.2 percent aggregate minority.

This provides the following threshold values for the second (20 percent) criterion:

- 20.3 percent American Indian or Alaskan Native
- 22.5 percent Asian
- 20.1 percent Native Hawaiian or other Pacific Islander
- 35.9 percent Black or African American
- 22.6 percent other single race
- 22.2 percent multi-racial
- 42.5 percent Hispanic ethnicity
- 62.2 percent aggregate minority.

2.6.1.2 Low-Income Populations

The low-income population is expressed in terms of the number and/or percentage of people that are at or below the poverty level. The share of Florida's total population at or below the poverty level in 2012 was 15.3 percent (USCB 2012-TN4098). Therefore, the low-income threshold level for this analysis is 35.3 percent.

Table 2-54 shows the overall representation of the populations of interest in the 50 mi region surrounding the Turkey Point site and the State of Florida as a whole. Because Hispanics/ Latinos can be of any race, the sum of Hispanics/Latinos and all of the minority race categories will typically be more than the number of aggregate minorities.

Table 2-54. Regional Minority and Low-Income Populations by Block Group Analysis Results

Category	Number of Block Groups	Percent of Total
Total	2,116	100.0
Aggregate Minority	1,681	79.4
Hispanic or Latino	1,219	57.6
American Indian or Alaskan Native	2	0.1
Asian	10	0.5
Native Hawaiian or Other Pacific Islander	0	0.0
Black or African American	440	20.8
Persons Reporting Some Other Race	39	1.8
Two or More Races	4	0.2
Low-Income Population	240	11.3

Source: USCB 2009-TN1462

The review team identified 2,116 census block groups wholly or partially within the 50 mi region. Using the individual comparison criteria (comparing the block group to the State of Florida), GIS analysis found 1,219 block groups with Hispanic groups exceeding either the 20-percentage points or 50 percent criterion, 1,681 block groups with aggregate minority populations, 440 block groups with African-American populations, 10 block groups with Asian populations, and 240 with low-income populations. There were no block groups with Hawaiian and Pacific Islander populations and only two with American Indian or Alaskan Native populations. Figure 2-38 through Figure 2-41 illustrates the findings of the data.

Further research, phone and field consultations with local organizations (listed in Appendix B), and information in FPL's ER revealed additional information about the existence and location of minority and low-income groups.

There is a Seminole Tribe of Florida Reservation in Hollywood, Broward County, within the 50 mi region. The reservation includes various commercial enterprises, including a hotel and casino, a second casino and a recreational Indian Village area with various tourist attractions (Seminole Tribe of Florida 2012-TN466). Four Miccosukee Indian reservations—Tamiami Trail (Miami-Dade County), Alligator Alley (Broward County), and two at Krome Avenue (Miami-Dade County)—also lie within 50 mi of the site. There are approximately 650 people enrolled in the Miccosukee Tribe. The Tamiami Trail Reservation, which consists of four parcels of land, is 40 mi west of Miami and is now the site of most Tribal operations and the center of the Miccosukee Indian population. One parcel was under a NPS 50-year use permit, which expired on January 24, 2014. The other three parcels were originally dedicated to the Miccosukee by the State of Florida and have since acquired Federal reservation status. These areas are used for commercial development. The Tribe also has a perpetual lease from the State of Florida for 189,000 ac, which is part of the SFWMD's Conservation Area 3A South. The Tribe is allowed to use this land for hunting, fishing, frogging, subsistence agriculture, and to carry on the traditional Miccosukee way of life. Alligator Alley is the largest of the Miccosukee Tribe's reservations, comprising approximately 75,000 ac. This land consists of 20,000 ac with potential for development and 55,000 ac of wetlands. The reservation contains a modern service station plaza, a police substation, and 13,000 ac of land that is leased for cattle grazing. Two reservation areas are located at the intersection of Krome Avenue and Tamiami Trail. One (25 ac) is the site of the Miccosukee Indian gaming facility and the Miccosukee resort and convention center. The second reservation area (less than 1 ac) is the site of the Miccosukee tobacco shop (Miccosukee Tribe of Indians of Florida 2011-TN464; FPL 2011-TN435). Figure 2-38 displays the location of the Miccosukee Tribe's reservation in relation to the 50 mi region.

Migrant agriculture workers are also present and tend to be members of the minority and low-income communities (Hispanic). They are described in further detail in Section 2.6.4 below.

Based on the information above the review team determined that because there are minority and low-income communities in close proximity to the proposed site, impacts on these communities must be considered in greater detail, as discussed in Section 2.6.2. The result of the review team's analyses can be found in Sections 4.5 and 5.5 of this EIS.

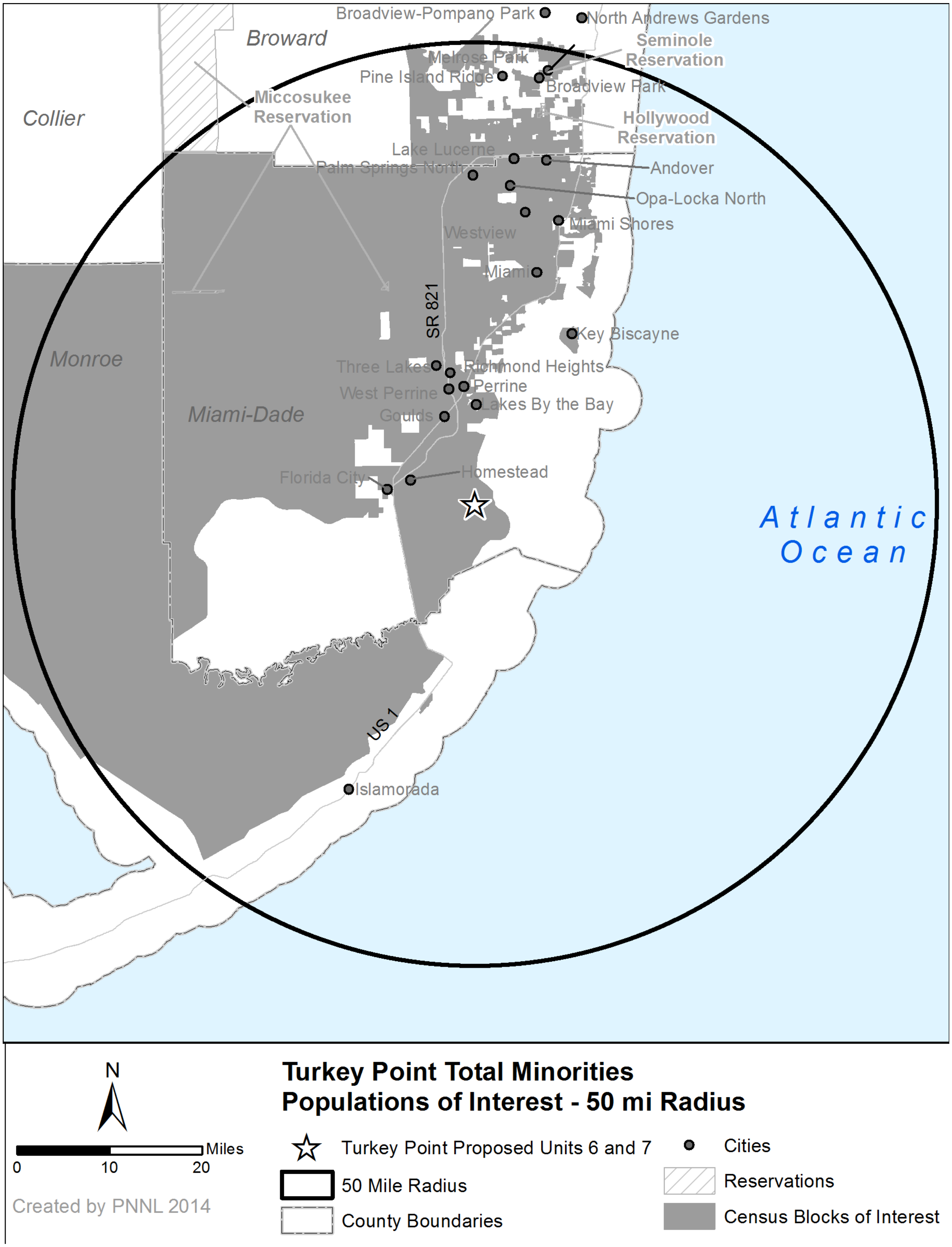


Figure 2-38. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria

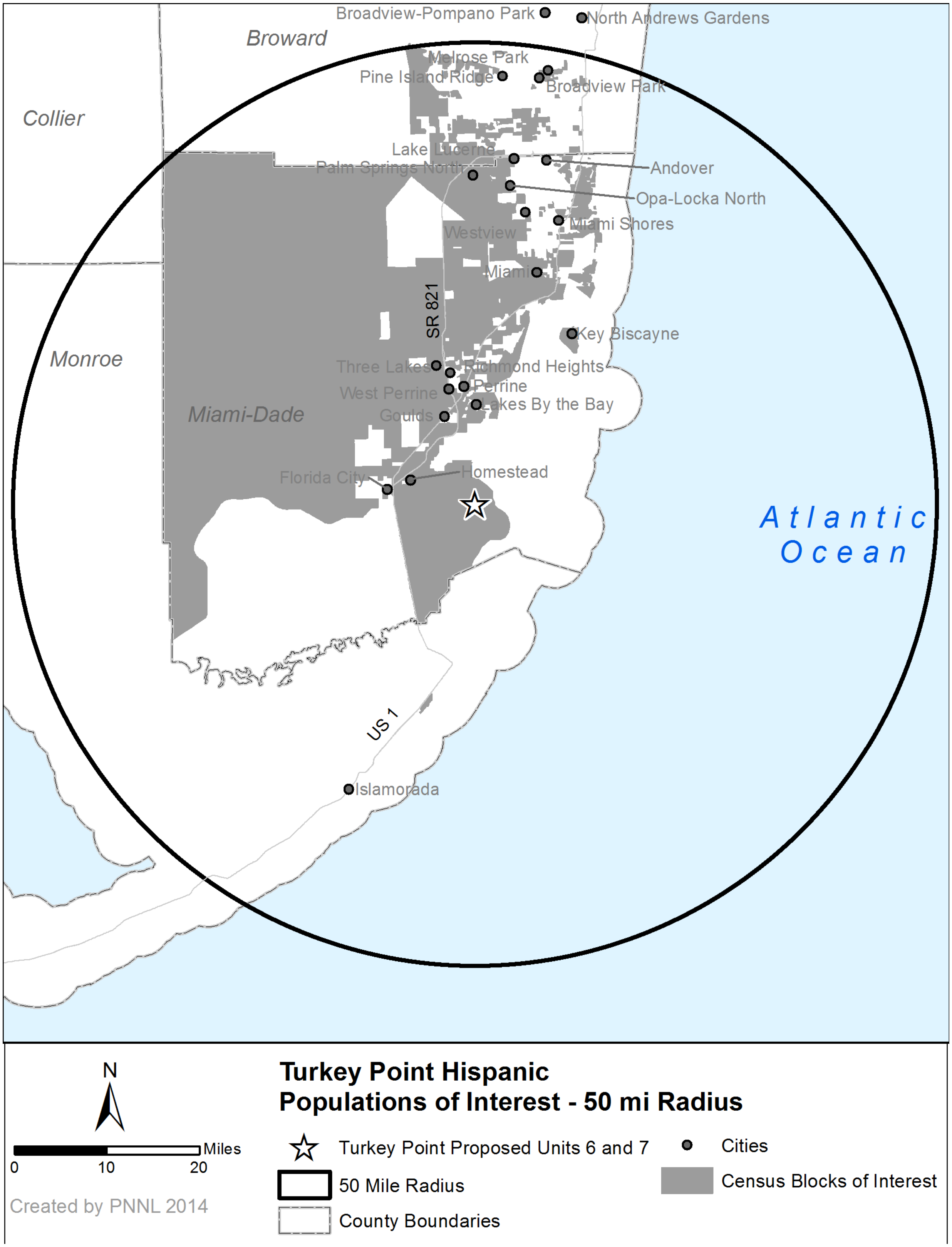


Figure 2-39. Hispanic Populations in Block Groups that Meet the Environmental Justice Selection Criteria

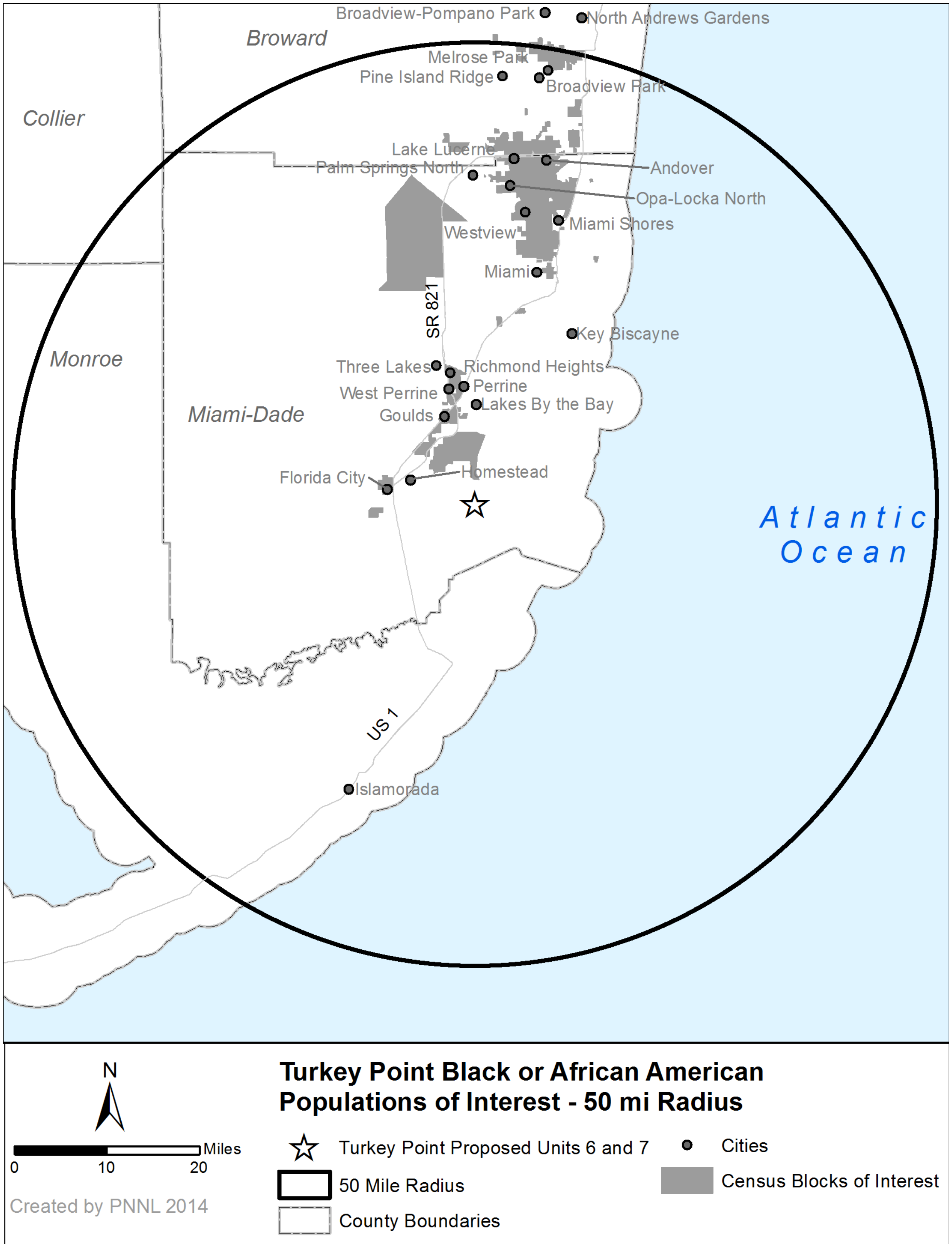


Figure 2-40. African-American Populations in Block Groups that Meet the Environmental Justice Selection Criteria

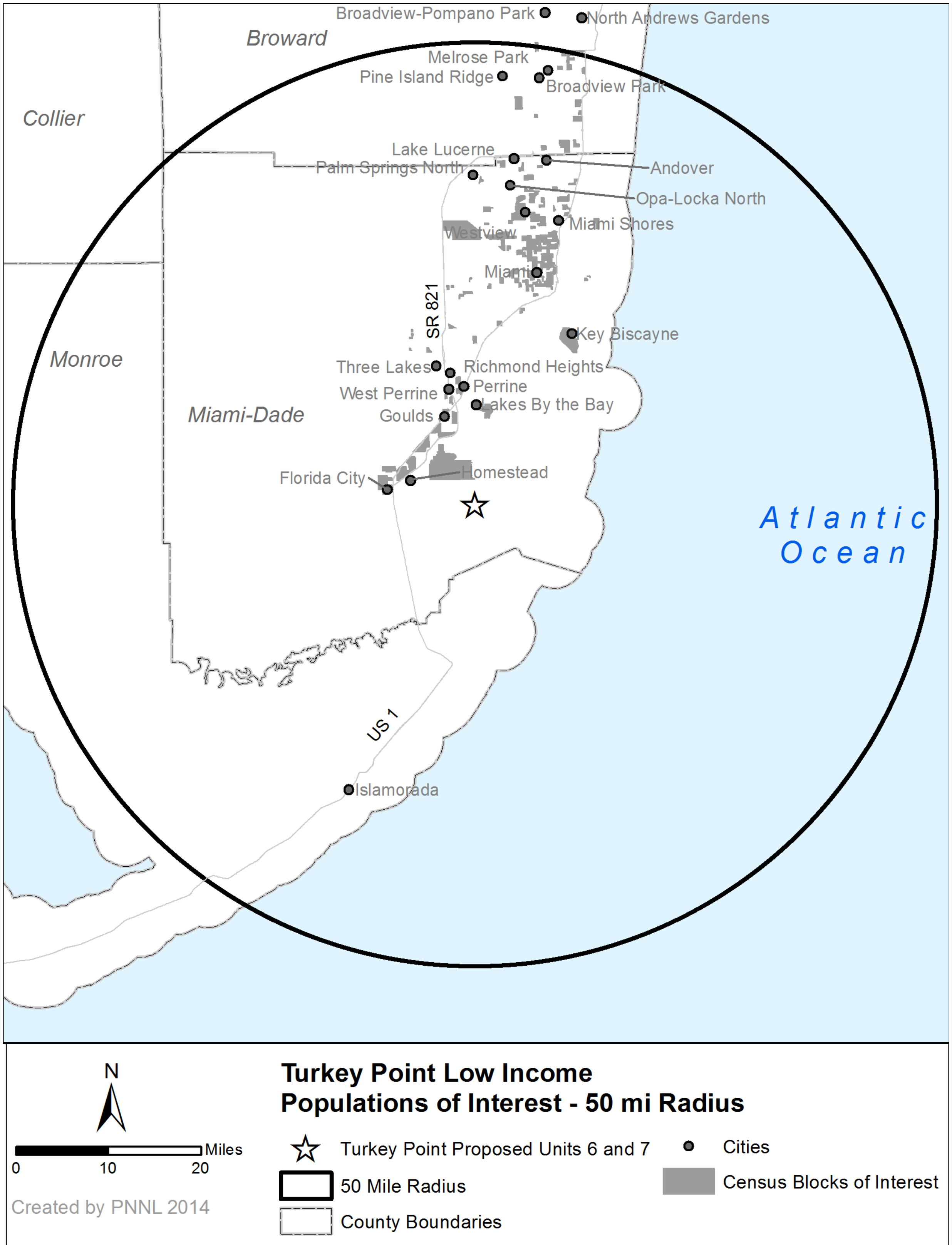


Figure 2-41. Aggregate Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria

2.6.2 Analysis

For each of the identified EJ populations of interest, the review team determined whether any of the populations appeared to have a unique characteristic that could cause a disproportionately high and adverse effect. Examples of unique characteristics include lack of vehicles, sensitivity to noise, close proximity to the plant, or subsistence activities. However, such unique characteristics need to be demonstrably present in the population and relevant to the potential environmental impacts of the plant. If the impacts from the proposed action would adversely affect an identified EJ population of interest more than the general population because of one of these or other unique characteristics, then a determination would be made whether the impact is disproportionately high when compared to the general population. Through phone and field consultations with local organizations and review of FPL's ER, the review team concluded that subsistence activities such as subsistence fishing are typically not conducted by any identified EJ group. The main low-income group identified with potentially unique pathways for exposure to environmental effects was migrant agricultural workers (see discussion in Section 2.6.4).

The review team assesses the impacts on the populations of interest in Sections 4.5.5 and 5.5.4 of this EIS.

2.6.3 Scoping and Outreach

During the development of its ER, FPL interviewed community leaders of the minority populations within the economic impact area. The review team built upon this base and performed additional interviews with local, State, and County officials, business leaders, and key members of minority communities within the economic impact area to assess the potential for disproportionately high and adverse socioeconomic effects that may be experienced by minority or low-income communities during construction and operation of a project with the magnitude of the proposed new Turkey Point Units 6 and 7. The review team also consulted with local Tribal governments in the region and is discussed in Section 2.7. In accordance with NRC guidance, the review team provided advance notice of public hearings for EIS scoping purposes (see Appendix D). These activities did not identify any additional groups of minority or low-income persons not already identified in the GIS analysis of census data.

2.6.4 Migrant Populations

Available information about migrant populations in the area is described in Section 2.5.1.3. Based on phone and field consultations with local organizations (listed in Appendix B), the review team concluded that migrant agricultural workers tend to be Hispanic and spend most of the day outdoors, making them potentially more exposed to air and noise pollution during construction. Although members of this group would also seem to present unique characteristics that could make them disproportionately vulnerable to environmental impacts, they tend to be located in the more rural, agricultural areas of Miami-Dade County and not in proximity to the Turkey Point site.

2.6.5 Environmental Justice Summary

The review team found many low-income, Hispanic, and African-American minority populations that exceeded the percentage criteria established for EJ analyses within the 50 mi region.

Further, the review team identified migrant agricultural workers as being present in the area, of low-income status, Hispanic, and potentially vulnerable to environmental air and noise pollution due to their extended presence outdoors. Therefore, the review team performed additional analyses before making a final EJ determination. The results of the analyses can be found in Sections 4.5.4 and 5.5.4.

2.7 Historic and Cultural Resources

At the outset of the COL review process, and in accordance with Title 36 of the *Code of Federal Regulations* Part 800, Section 8c (36 CFR 800.8(c) (TN513), the review team elected to use the process set forth in NEPA (42 U.S.C. § 4321 et seq.) (TN661), to comply with the obligations imposed under Section 106 of the National Historic Preservation Act (NHPA) (54 U.S.C. § 300101 et seq.) (TN4157). Subsequently, however, and as outlined in letters dated October 23, 2014 (NRC 2014-TN4055; NRC 2014-TN4057; NRC 2014-TN4059) the NRC and USACE determined that the USACE would be the lead Federal agency for Section 106 of the NHPA and for consultation with Federally recognized tribes and cultural resource issues. The USACE followed the consultation process outlined in its Procedures for the Protection of Historic Properties, as set forth in Title 33 of the *Code of Federal Regulations*, Part 325, Appendix C. The NRC served as lead agency for the NEPA review.

For the COL review under NEPA, the review team will use the Section 106 Area of Potential Effect (APE) for the project. The direct-effects APE for the COL review is the area at the power plant site and the immediate environs that may be physically affected by land-disturbing activities associated with constructing and operating two new nuclear generating units. The indirect-effects APE for the Turkey Point site is the area that may be visually and/or auditory affected. The indirect-effects APE is determined by the maximum distance from which the tallest structures associated with proposed Units 6 and 7 can be seen from offsite locations. In the case of the Turkey Point site, the indirect-effects APE was determined to be one-half mile from the facility.

This section discusses the historic and cultural background in the region surrounding the Turkey Point site. It also details the efforts that have been taken to identify cultural resources in the physical and visual APEs and the resources that were identified. A description of the consultation efforts is also provided. The assessments of effects from building and operating the proposed new units are found in Sections 4.6 and 5.6, respectively.

2.7.1 Cultural Background

This section provides an overview and summary of the cultural history of the Turkey Point site and region. The discussion of precontact[8] history is summarized from the cultural resources investigation completed for the Turkey Point site (FPL 2011-TN1512; FPL 2011-TN95). The region around the Turkey Point site has a rich cultural history and a record of significant prehistoric and historic resources with evidence of continuous settlement in the area for more than 12,000 years.

(8) Of or related to the period before contact of an indigenous people with an outside culture.

Prehistoric occupation of the area is typically divided into three periods, as summarized below:

- Paleoindian (12,000-7500 BC) – The prevailing view of Paleoindian culture is that of a nomadic hunting and gathering existence, in which now-extinct Pleistocene megafauna[(9)] were exploited. Settlement patterns were restricted by the availability of freshwater and access to high-quality stone from which the specialized Paleoindian tool assemblages were made. Most sites of this time period are found near karst sinkholes or spring caverns. The majority of Paleoindian sites in Florida consist of surface finds. The most widely recognized Paleoindian tool in Florida is the Suwannee point, typically found along the springs and rivers of northern Florida. Other points, including Simpson and Clovis points, are found in fewer numbers. Some of these, and other Paleoindian lanceolate points, were hafted by attaching them to an ivory shaft that was, in turn, attached to a wooden spear shaft. Other tools include bifacial and hump-backed unifacial scrapers, blade tools, and retouched flakes.
- Archaic (7500-500 BC) – The Archaic period is divided into Early (7500–5000 BC), Middle (5000–3000 BC), and Late (3000–500 BC). The latter is subdivided into the Preceramic Late Archaic phase (3000-2000 BC) and the Orange phase (2000-500 BC). These phases are defined on the basis of increasingly sedentary settlement patterns and changing diagnostic projectile point typologies. During the Early phase, there is evidence of reduced nomadism and seasonal camp sites, often expressed by the presence of large middens (i.e., refuse piles of archaeological material). The Middle phase is marked by a noticeable change in lithic technology, an increase in overall population, and a shift to a more diverse subsistence base, and particularly a shift to fish and shellfish. The change in lithic technology is more noticeable from the Early to Middle Archaic phases than it is from the Paleoindian period to Early Archaic phase, likely representing a major change in the resources used. The Late Archaic phase is marked by an increased reliance on marine resources, and the first occurrence of pottery at the onset of the Orange phase (2000 BC). The presence of this pottery likely represents a shift to a more sedentary lifestyle with a need for food and material storage. This pottery was molded and fiber-tempered with vegetable fibers. The latter portion of the Archaic period is marked by the appearance of regional ceramics and evidence of increasingly larger village sites and associated middens.
- Formative (500 BC–1513 AD) – Locally, this period is known as the Glades culture, and it is divided into multiple phases based largely on changes in ceramic style. Although the terminus of this period is shown as 1513 AD, occurring with the arrival of Europeans, Glades culture persisted for several centuries beyond that. During the Formative Period, people appear to have become more sedentary and particularly adept at exploiting resources found within their environment, resulting in an overall increase in population growth. There is increased pottery production, showing regional or cultural affiliation. Post-Archaic cultures are distinguished by the use of burial mounds and cultivated plants to supplement wild foods. There is evidence of a decrease in stone tools and an increase in utilitarian tools, such as containers and ornaments fashioned from bone or shell.

The history of the East Coast of Florida from its discovery in 1513 to the end of World War II is summarized from the cultural resources investigation completed for the Turkey Point site (FPL 2011-TN1512; FPL 2011-TN95).

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(9) Large-bodied mammals weighing more than 100 pounds from the Pleistocene era.

Official credit for the discovery of Florida by Europeans is credited to Juan Ponce de León, whose voyage of 1513 took him along the east coast of the peninsula. Other Spanish explorers followed, and over the next 50 years the Spanish government and private individuals financed expeditions in hopes of establishing a colony in Florida. Jesuit missions were established in the Central Peninsular Gulf Coast and Glades archaeological regions, but these efforts were abandoned in 1570s. Franciscan mission efforts began in the 1570s but focused predominantly on the northern areas of Florida. Consequently, for the remainder of the initial Spanish Period (up to 1763), the area surrounding the Turkey Point site and vicinity was virtually ignored as the Spanish concentrated their efforts in the northern half of the peninsula. Between 1500 and 1800 possession of Florida changed several times between Spain and Great Britain.

By the beginning of the eighteenth century, the Native American population of South Florida had declined considerably as a result of European colonization resulting in the loss of Tribal lands due to disease, slave raids, and intertribal warfare. Many who survived integrated into the Seminole Tribe, the Seminoles were descendants of Creek Indians who moved into Florida during the early eighteenth century to escape the political and population pressures of the expanding American colonies to the north. Groups of fugitive African-American slaves had also settled among the Seminoles by the early nineteenth century.

In 1821, Spain ceded Florida Territory to the United States as a result of the Transcontinental, or Adams-Onis Treaty. The population of the territory at that time was still centered in the northern area of the state. As more North American settlers moved into the region, conflicts arose with the Seminole people over available land. Pressure was placed on the government to remove the Seminoles from North Florida and to relocate them farther south. The Treaty of Moultrie Creek of 1823 restricted the Seminole people to approximately four million acres of land in the middle of the state. This treaty was unpopular with the Seminoles, because they were reluctant to move from their established homes to an area that they felt could not be cultivated. Equally unpopular among the Seminoles were the later treaties of Paynes Landing of 1832 and Fort Gibson of 1833, which called for Seminole migration to the western territories. These three treaties helped foster Seminole resentment of settlers and outbreaks of hostility that culminated in the Second Seminole War in 1835. At the beginning of the Second Seminole War, the conflict was centered in the central portion of the state, but soon expanded south to the Lake Okeechobee and Everglades regions, and Fort Dallas (located in present day Miami) became a base of operations.

The Second Seminole War had a detrimental effect on new settlement in Florida. To encourage settlement in the middle portion of the territory after the war, the Armed Occupation Act of 1842 (5 Stat. 502-TN4113) offered settlers 160 ac of land at no cost. This Act, plus the end of the Second Seminole War, created a small wave of immigration by settlers to central Florida, most of whom were farmers and cattle ranchers.

The onset of the Civil War disrupted development in Florida. Most of the state did not have daily contact with battles, but Florida contributed troops and supplies to the Confederate Army. Although Florida was not the site of many Civil War battles, Union forces established control of the Florida coastline in 1863. Like the other former Confederate States, Florida suffered economic devastation at the Civil War's end.

In the 1880s, interest in South Florida's resources intensified and outside businessmen saw Florida's potential and began purchasing the land for large projects. As a part of this land acquisition, projects were initiated to drain and reclaim land, and to dig canals between lake systems. This work helped change large portions of Florida from wilderness into an area ripe for investment, which enabled expansion of railroad lines and increased settlement.

The early twentieth century saw rapid and widespread growth in Florida. Large expanses of the Everglades were drained and thousands of miles of railroad tracks were laid at this time. While agriculture, especially the citrus industry, was the main source of Florida's economy, manufacturing and industry grew during the beginning of the century. Tourism, too, increased. The City of Homestead, the closest city to the Turkey Point site, was incorporated during this period, in 1913. The community served as a stop along a new rail line extending to Key West, and quickly became an important agricultural area.

During World War I, several training facilities were set up in the state and protecting the coastlines was a priority at this time. Although the conflict only lasted until November of 1918, the economy was boosted by the war, primarily through shipbuilding and industrialization of port cities. After World War I, Florida experienced unprecedented growth. Many people had relocated to Florida during the war to work in wartime industries or had been stationed in the state as soldiers. Bank deposits increased, real estate companies opened in many cities, and state and county road systems expanded quickly. Earlier land reclamation projects had created thousands of new acres of land to be developed. Real estate activity increased steadily after the war's end and drove up property values. Prices on lots were inflated to appear more enticing to out-of-state buyers. Every city and town in Florida had new subdivisions platted (platting is the splitting of one larger piece of land into several smaller pieces of land) and lots were selling and reselling for quick profits. Southeast Florida, including cities such as Miami and Palm Beach, experienced the most activity, although the boom affected most communities in central and southern Florida.

This boom period began to decline in 1925, and by the time the stock market collapsed in 1929, Florida was already suffering from an economic depression, brought on by a grossly inflated real estate market, two hurricanes, and a fruit fly infestation that devastated the agricultural industry. By 1929, construction activity had halted and industry had dramatically declined. Subdivisions platted several years earlier remained empty and buildings stood on lots partially finished and vacant. As a result of the hard economic times, President Franklin D. Roosevelt initiated several national relief programs. Important New Deal-era programs in Florida were the Works Progress Administration and the Civilian Conservation Corps. Their efforts included the construction or improvement of many roads, public buildings, parks, and airports in Florida, as well as improvement and preservation projects on forests, parks, and agricultural lands.

From the end of the Great Depression until after the close of the post-war era, Florida's history was inextricably bound to World War II and its aftermath. It became one of the nation's major training grounds for the various military branches including the Army, Navy, and Army Air Corps. Up until that time, tourism had been the State's major industry, but tourism ceased as tourist and civilian facilities such as hotels and private homes were placed into wartime service. The influx of thousands of servicemen and their families increased industrial and agricultural production in Florida and also introduced these new residents to the warm weather and tropical beauty of Florida. At the conclusion of World War II, Florida's economy was almost fully recovered. Tourism quickly rebounded and became the major source of the State's economy. In addition, former military personnel found the local climate amenable and remained in Florida permanently after the war. These new residents greatly increased the population during the late 1940s and 1950s. In 1947, immediately after the war, Everglades National Park was established, thereby increasing tourism to the area.

2.7.2 Historic and Cultural Resources at the Site and in the Vicinity

To identify the historic and cultural resources at the Turkey Point site, the staff reviewed the following information:

- Janus Research, Inc. Technical Report – Preliminary Cultural Resources Report for the Turkey Point 6 and 7 Associated Linear Facilities (FPL 2009-TN1513; FPL 2011-TN95)
- NRC Site Visit and Audit – NRC staff consulted with the Florida State Historic Preservation Office (SHPO) and also conducted an on-the-ground visit to the Turkey Point site in June of 2010 (NRC 2010-TN1457)
- Janus Research, Inc. Technical Report – Cultural Resources Assessment Survey for the Turkey Point Units 6 and 7 Site, Associated Non-Linear Facilities, and Spoils Areas on Plant Property (FPL 2011-TN1512; FPL 2011-TN95)
- FPL letter to NRC dated November 5, 2013 – Proposed Turkey Point Units 6 and 7 COLA ER Supplemental Transmission Corridor Information (FPL 2013-TN2941)
- NRC government-to-government consultation meeting with the USACE and the Seminole Tribe of Florida, June 2015 (USACE and NRC 2015-TN4735)
- NRC government-to-government consultation meeting with the USACE and the Miccosukee Tribe of Indians of Florida, June 2015 (USACE and NRC 2015-TN4736)
- Turkey Point Nuclear Plant COL ER (FPL 2014-TN4058).

The reports by Janus Research, Inc. (FPL 2009-TN1513; FPL 2009-TN1514; FPL 2009-TN1515; FPL 2011-TN1512; FPL 2011-TN95) are available at the Florida SHPO for qualified investigators.

The following sections describe archaeological resources, above-ground resources, and traditional cultural properties that are located within the indirect- and direct-effects APE for the Turkey Point site. The APEs and research methodology have been generally defined by FPL in consultation with the Florida SHPO, included as Appendix 2.5A in the ER (FPL 2014-TN4058).

The direct-effects APE, which includes physical impacts on known resources resulting from the construction and operation of the Turkey Point site and is referred to as the Units 6 and 7 project area, was defined in the ER (FPL 2014-TN4058) and the Janus Research, Inc. report (FPL 2011-TN1512; FPL 2011-TN95) as follows:

- the Units 6 and 7 plant area
- administration and training buildings and a parking area
- radial collector wells

- FPL RWTF and delivery pipelines
- FPL-owned fill source
- equipment barge-unloading area
- heavy-haul road on the site
- spoils areas on the site.

The indirect-effects APE, which takes into account viewshed impacts on above-ground resources and traditional cultural properties, has been defined by FPL in consultation with the SHPO as a 0.5 mi APE from the project site (FPL 2011-TN1512; FPL 2011-TN95; FPL 2014-TN4058).

2.7.2.1 Archaeological Resources

Over the last 30 years, several archaeological investigations have been completed in the area around the proposed project direct-effects APE, as described by Janus Research, Inc. (FPL 2011-TN1512; FPL 2011-TN95). Between 1980 and 2005, five cultural resource studies were conducted within or within the vicinity of the Turkey Point site (not counting the studies conducted for the current project). Files maintained by the Florida Division of Cultural Resources, a department of the Florida SHPO, show that no cultural resources—including archaeological sites, above-ground resources, and traditional cultural properties—have been recorded within or within 100 ft of the APE (FPL 2011-TN1512; FPL 2011-TN95; FPL 2014-TN4058). Prior to 1963, the area surrounding the site was undeveloped and much of it was inundated.

A Phase I archaeological investigation of the above-listed APE areas was conducted for the application for the Turkey Point COL (FPL 2011-TN1512; FPL 2011-TN95). The investigation involved both systematic pedestrian surveys as well as limited subsurface test excavations. No archaeological sites were identified within the APE. Furthermore, both the field investigation and historical and paleoenvironmental research indicate that, in the past, the area was frequently inundated and has a low potential for containing archaeological resources. This assessment received Florida SHPO concurrence, as documented in a letter dated July 10, 2009, from Florida SHPO to FPL (FPL 2014-TN4058, Appendix 2.5A).

2.7.2.2 Above-Ground Resources

Background research for above-ground resources was completed by qualified staff (FPL 2011-TN1512; FPL 2011-TN95). This research included correspondence with the SHPO, a search of the Florida Master Site File database, review of historic aerial photographs and plat maps, a search of Government Land Office records, and a review of local historical site inventories (FPL 2011-TN1512; FPL 2011-TN95; FPL 2014-TN4058). An above-ground resources survey of the direct-effects and indirect-effects APE revealed no structures older than 50 years. This 50-year minimum age is necessary for eligibility of standing structures in the National Register of Historic Places (NRHP).

2.7.2.3 Traditional Cultural Properties

No traditional cultural properties were identified in either the direct- or indirect-effects APE by the Phase I work (FPL 2011-TN1512; FPL 2011-TN95). In a letter to FPL dated July 10, 2012, the Florida SHPO concurred with FPL's conclusion concerning the Turkey Point site (FPL 2014-TN4058). By letters dated December 15, 2009, the Miccosukee Tribe of Indians of Florida, the Muscogee (Creek) Nation of Florida, the Seminole Tribe of Florida, the Poarch Band of Creek Indians, and the Seminole Nation of Oklahoma were contacted by FPL describing the proposed Turkey Point project and requesting input (FPL 2014-TN4058). These five tribes were also contacted by the NRC through letters and phone calls regarding the proposed project to invite them to participate in the identification of historic and cultural properties (see Appendix C). The Seminole Tribe of Florida responded to both the NRC (Seminole Tribe of Florida 2010-TN1452) and FPL (2014-TN4058) stating it had no objection to the findings at that time, but requested that it be kept apprised of the project's status and be informed if cultural resources relevant to the Tribe were discovered during the construction process. By letter dated October 5, 2015, the Seminole Tribe of Florida indicated the presence of a sacred site within the vicinity of the eastern transmission line corridor (Seminole Tribe of Florida 2015-TN4587).

2.7.2.4 Historic and Cultural Resources in Transmission Line Corridors and Offsite Areas

A description of the transmission line corridors, offsite water pipeline corridors, and associated access roads is included in Section 2.2.2. The direct-effects APE for these offsite linear facilities consists of a 200 ft corridor. For purposes of the review team's analysis, a preliminary indirect-effects APE, which only applies to the transmission lines because the other facilities would be at or below the ground surface, was set at 500 ft on either side of the centerline of the alignment, for a total of 1,000 ft. Ultimately, in accordance with NHPA Section 106, the final APE will be determined by the USACE in consultation with the Florida SHPO. A work plan for a Phase I investigation of these facilities and a schedule for this Phase I work, as well as desktop cultural resources investigations have been completed for the proposed transmission lines (FPL 2009-TN1513; FPL 2009-TN1515; FPL 2011-TN95; FPL 2013-TN2941).

A search of the records at the Florida SHPO showed that numerous cultural and historic resources are recorded in the area. For the eastern transmission line corridor, 25 previous cultural resources studies have been conducted within the direct- and indirect-effects APEs. Two archaeological sites, 191 historic structures, 2 bridges, and 13 resources groups occur in or adjacent to the APE. One of the archaeological sites has been determined ineligible for the NRHP, while the other has not been evaluated. Of the 191 buildings, 3 have been listed on the NRHP, 9 have been found ineligible, and the rest of the buildings have not been evaluated for significance. Two of the resource groups—Calle Ocho and the MacFarlane Homestead Historic District—are listed in the NRHP. Three of them have been determined ineligible for the NRHP, and the rest of the 13 groups have not been evaluated (FPL 2009-TN1513; FPL 2011-TN95).

For the original West Preferred transmission line corridor, 25 previous cultural resources studies have been conducted within the direct- and indirect-effects APE. Three archaeological sites, two historic structures, and three resources groups occur in or adjacent to the APE. The two structures and one of the archaeological sites have been found ineligible for the NRHP, while the remaining resources have not been evaluated (FPL 2009-TN1513; FPL 2011-TN95). The analysis of the revised West Consensus corridor (FPL 2013-TN2941), which includes a small shift in a portion of the transmission line route, shows similar results. Indeed, three resources, an archaeological site and two linear resource groups, occur in both. In addition, the APE for the West Consensus corridor contains three additional archaeological sites (for a total of six archaeological sites). One of these is part of an archaeological zone designated by Miami-Dade County. The other two have not been evaluated for NRHP eligibility. The West Consensus corridor also contains those resources present within the portion of the West Preferred corridor that is identical to the West Consensus corridor, including the two historic structures and the remaining resource group (for a total of three resource groups).

For the remaining offsite linear facilities—the reclaimed wastewater and potable water pipeline corridors and the haul road rights-of-way—a total of 12 cultural resources studies have been conducted in the APE and no cultural resources have been identified (FPL 2009-TN1513; FPL 2011-TN95).

In addition to the desktop research for the transmission line APE, and as documented in the Turkey Point Nuclear Plant COL ER (FPL 2014-TN4058), FPL also conducted a search of records maintained by the National Park Service, Florida Division of Historical Resources, Miami-Dade County, and the City of Homestead for a distance of 1.2 mi from the eastern and western transmission line corridors. The research for the offsite linear facilities identified 359 resources and 16 resource groups located with 1.2 mi of these facilities. Fifty-eight of these resources are archaeological sites, of which six have been destroyed. Forty-two are prehistoric sites, three are historic sites, four are multicomponent prehistoric and historic sites, and nine are unidentified. Site types include prehistoric artifact scatters, prehistoric habitation sites, a quarry, human burial sites, and historic road segments. Fifteen of the sites, 13 prehistoric and 2 multicomponent, contain known human remains (FPL 2014-TN4058).

Most of the archaeological sites are located in the northern portion of the offsite area, near the northern segment of the proposed transmission line. Many of these also occur in the indirect-effects APE. This area falls in unincorporated Dade County west of the developed metropolitan area from Everglades National Park in the south, and north to the area around Pennsuco substation. Other archaeological sites are found in Aladdin City, Florida City, Goulds, Hialeah, Hialeah Gardens, Homestead, Medley, Miami, and Pennsuco. In addition, the northern-most portion of the eastern transmission line is located within the North Bank and West Bank Archaeological zones, and within 500 ft of the South Bank Archaeological Zone, as designated by the City of Miami (FPL 2014-TN4058).

Of the 58 archaeological sites, 3 are ineligible for the NRHP and the rest have not been evaluated, although 5 are noted by the Florida SHPO as potentially eligible. In addition, nine of the sites are listed as significant by the Miami-Dade Historic Preservation Board (FPL 2014-TN4098).

The FPL search of this larger 1.2 mi study area also identified 303 historic structures, one of which has been destroyed, likely by hurricanes. Based on available information, most of the historic structures are residences, although public and commercial buildings are present as well. Four of the structures are listed in the NRHP, and 21 are listed by the Miami-Dade Historic Preservation Board. In addition, one historic cemetery—an early twentieth century African-

American cemetery located in Miami—falls within 1.2 mi of the offsite area. The cemetery is included on a list of significant resources by the Miami-Dade Historic Preservation Board (FPL 2014-TN4058).

There also are 16 resource groups within the 1.2 mi search area. Ten of the groups are linear resources, primarily roads that extend through multiple towns. One of these is listed in the NRHP, three are ineligible for listing, and the remaining six have not been evaluated for significance. Four of the resource groups are historic districts. One is listed in the NRHP and one is listed by the Miami-Dade Historic Preservation Board. The remaining two resource groups consist of a mixed period district and a multiple property submission. Neither has been evaluated for significance (FPL 2014-TN4058).

In addition to the desktop studies, FPL provided a separate work plan that describes the additional work that would be required once a transmission line corridor is selected (FPL 2009-TN1515; FPL 2011-TN95). SHPO has concurred with the adequacy of this work plan, which stipulates coordination with appropriate local government representatives, additional Tribal coordination, development of an unanticipated finds plan (including personnel training), and archaeological and architectural resource surveys. If resources cannot be avoided, including those identified in the desktop study and any additional resources that might be identified during future survey efforts, then appropriate minimization or mitigation measures would need to be developed in coordination with the SHPO.

Consultation with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida indicates that construction in the transmission line corridors has the potential to affect cultural resources (USACE and NRC 2015-TN4735; USACE and NRC 2015-TN4736). These resources include both documented and undocumented archaeological resources within the Everglades that may contain human remains, particularly within the West Preferred and West Consensus corridor alignments. The eastern corridor, particularly at the northern end, is sensitive for archaeological resources as well, including sites that may contain human burials. Further, the eastern corridor passes near an area considered sacred to both tribes.

2.7.3 Consultation

In June of 2010, the NRC initiated consultation on the proposed action by writing to the Florida SHPO (NRC 2010-TN1453) and the Advisory Council on Historic Preservation (ACHP) (NRC 2010-TN1454). The NRC received a reply from the Florida SHPO on July 28, 2010 (FDHR 2010-TN1455), which indicated that the office received the cultural resource assessment from FPL and that, for the Units 6 and 7 project area, no historic or cultural resources had been identified to date. The NRC received correspondence from the ACHP on July 8, 2010 (ACHP 2010-TN1456), which summarized NRC's requirements under Section 106 of the NHPA and 36 CFR Part 800 (TN513). In addition, the NRC met with Florida SHPO staff on June 10, 2010, at which time the SHPO concurred with the adequacy of Tribal consulting parties identified by the NRC and the cultural resources survey work performed by FPL to that point, but stressed the need for an inadvertent discovery plan for the treatment of unanticipated resources that might be discovered during construction of the project (NRC 2010-TN1457). The SHPO indicated that, while the proposed Units 6 and 7 project site has a low potential for encountering cultural resources, the routes of the proposed transmission line corridors and other offsite facilities occur in areas containing historical districts and other sensitive resources. The SHPO also recommended coordination with the Miami-Dade County Office of Historic and Archaeological Resources for the identification and treatment of resources.

The NRC sent a letter to the Miami-Dade County Office of Historic and Archaeological Resources on July 1, 2010 (NRC 2010-TN1458), inviting them to participate as a consulting party (see Appendix C). The Office of Historic and Archaeological Resources responded by letter dated August 12, 2010 (Miami-Dade County 2010-TN1459), acknowledging their willingness to participate in the project, and requesting the opportunity to participate in and provide input on historical resources studies for the project. The NRC also sent scoping letters to the Archaeological and Historical Conservancy, Inc., the Historic Preservation Officer of the City of Miami, the Historic Preservation Administrator of the City of Coral Gables, the Assistant Director, Community Redevelopment Agency of the City of Homestead, and the Director of Planning and Zoning of the City of South Miami (see Appendix C for scoping letters). On July 15, 2010, the NRC conducted public scoping meetings in Homestead, Florida, at which no comments or concerns regarding historic and cultural resources were made.

By letters dated June 24, 2010, the NRC initiated consultations with five Federally recognized tribes—the Miccosukee Tribe of Indians of Florida, the Muscogee (Creek) Nation of Florida, the Seminole Tribe of Florida, the Poarch Band of Creek Indians, and the Seminole Nation of Oklahoma—regarding the proposed COL application (see Appendix C for complete listing). In the letter, the NRC provided information about the proposed action and indicated that review under the NHPA would be integrated with the NEPA process in accordance with 36 CFR 800.8(c) (TN513). The letter also provided the recipients with an opportunity to identify concerns and provide advice on the evaluation of historic properties, including those of traditional, religious, and cultural importance, and to participate in any necessary resolution of adverse effects to such properties. On July 29, 2010, the NRC also conducted follow-up calls to the tribes. The Muscogee (Creek) Nation of Florida, the Poarch Band of Creek Indians, and the Seminole Nation of Oklahoma did not express interest in the project. Additional consultation with the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida is outlined below.

The Seminole Tribe of Florida responded by letter on September 14, 2010 (Seminole Tribe of Florida 2010-TN1452), stating that the project occurs in its geographic area of interest. The Tribe requested that surveys be conducted in all unsurveyed portions of the project, including transmission line corridors, and that it be kept informed of any future studies or identified cultural resources.

On October 20, 2010, the NRC and the USACE met with the Seminole Tribe of Florida to discuss the Turkey Point project (NRC 2010-TN1460). During the meeting, the NRC presented a summary of the project and a review of NRC's role. The Tribal Historic Preservation Officer (THPO) for the Seminole Tribe of Florida stressed that the THPO's role is limited to review under the NHPA. The THPO also requested participation in the development of any work plans and future studies, and stressed the possibility of encountering both historic resources important to the Tribe as well as deeply buried resources that might be unearthed during construction, particularly in regard to the offsite facilities such as the transmission lines.

In letters dated October 23, 2014 (NRC 2014-TN4055; NRC 2014-TN4056; NRC 2014-TN4057; NRC 2014-TN4059; NRC 2014-TN4060; NRC 2014-TN4061; NRC 2014-TN4062; NRC 2014-TN4065; NRC 2014-TN4066), the NRC provided an update of the status of the COL review to the Florida SHPO, the ACHP, the Miami-Dade County Office of Historic and Archaeological Resources, the Archaeological and Historical Conservancy, Inc., the Historic Preservation Officer of the City of Miami, the Historic Preservation Administrator of the City of Coral Gables, the Assistant Director, Community Redevelopment Agency of the City of Homestead, and the Director of Planning and Zoning of the City of South Miami. The primary purpose of the letters was to inform the agencies that, following discussions between the NRC and the USACE, the NRC and USACE determined that the USACE would be the lead Federal agency for Section 106 of the NHPA for the project and for consultation with Federally recognized tribes. The NRC would continue in its role as lead agency in the production of the draft EIS.

Also in letters dated October 23, 2014 (NRC 2014-TN4063; NRC 2014-TN4064) the NRC informed the Muscogee (Creek) Nation of Florida and the Seminole Tribe of Florida of this change in lead agency for Section 106 of the NHPA. The NRC also informed the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida of a request for a consultation meeting with the NRC, the USACE, and the tribes prior to the publication of the draft EIS. The Muscogee (Creek) Nation of Florida did not express interest in the project. Additional consultation with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida is described below.

On June 23, 2015, the NRC and USACE met with the Seminole Tribe of Florida THPO and the Miami-Dade County archaeologist to discuss the Tribe's concerns about the project, and the status of the USACE's review under Section 106 of the NHPA (USACE and NRC 2015-TN4735). The NRC and USACE held a similar meeting with the Miccosukee Tribe of Indians of Florida THPO and the Miami-Dade County archaeologist on June 24, 2015 (USACE and NRC 2015-TN4736). Consultation among the USACE, SHPO, and the tribes will remain ongoing throughout the duration of the review process for Section 106 of the NHPA.

In a letter dated, October 5, 2015 (Seminole Tribe of Florida 2015-TN4587), the Seminole Tribe of Florida provided comments to the USACE regarding the transmission line corridors. The Seminole Tribe of Florida requested a Phase I cultural resource assessment survey conducted at the appropriate time and the results be provided to the THPO for review and comment. The Tribe requested that protocols be developed prior to any ground-disturbing activities to be followed in the event of unanticipated discovery of human remains. The tribe identified a sacred spring that near the East Preferred corridor and expressed concern that construction of the transmission corridor could affect water flow to the spring. The Tribe also requested that they be consulted when the details for the underground transmission line crossing the Miami River are developed further.

In response to the October 5, 2015 letter from the Seminole Tribe of Florida, and by letter to the USACE dated March 31, 2016 (FPL 2016-TN4581), FPL provided a detailed response reiterating their commitment to develop a work plan to address unanticipated discoveries and future studies that will need to be conducted for the transmission line corridors, as well as detailing the Florida State Conditions of Certification pertaining to further cultural resources studies including a commitment, if practicable to avoid or minimize impacts to resource such as the sacred site..

In a letter date March 7, 2016 (DA 2016-TN4601), the USACE requested comments from the Miccosukee Tribe of Indians of Florida about the proposed project. In this letter, the USACE reiterated its commitment regarding its obligations to Native Americans and their cultural heritage and requested requested comments on the project within 30 days. No response was received. The USACE considers consultation ongoing with the Miccosukee Tribe regarding the transmission lines.

In a letter dated August 2, 2016 (Seminole Tribe of Florida 2016-TN4727) Seminole Tribe of Floridaprovided comments regarding the the Cultural Resources Assessment Survey Work Plan for the Turkey Point facilities. The THPO concured with the recommendation that an Unanticipated Finds plan be developed prior to construction and that this plan address the possible discovery of human remains or archaeological material. Likewise, the THPO agreed that construction personnel, inspectors, managers, etc., should receive training.

The Seminole THPO recommended that the pre-existing dirt roads be subjected a field survey, at a minimum a pedestrian examination of exposed surfaces unless assurance can be made that unimproved dirt roads will not be subject to ground disturbance including exclusion of construction/heavy equipment use. Dirt roads can be vulnerable to severe impacts from vehicle traffic especially during rain events. Since most dirt roads were not subjected to a cultural resource assessment survey before they were established, a walkover survey seems appropriate.

The Seminole THPO believes that a standard archaeological survey should be conducted for new roads or areas of road widening if the road is located within either an area of high or moderate archaeological probability. The Florida Division of Historical Resources Module Three does not say anything about exempting moderate probability zones from survey.

The STOF THPO's comments were provided to FPL on August 8, 2016; FPL stated that it had no concerns with these comments and recommendations. FPL's response was forwarded to the STOF; no further comments were received from the STOF. If the DA permit is issued, it would likely contain the Turkey Point Cultural Resources Assessment Survey Work Plan as special condition of the permit. The USACE's NHPA Section 106 consultation for this project has been completed with the exception of the transmission line consultation with the SHPO and the THPOs for STOF and the Miccosukee Tribe which is ongoing.

2.8 Geology

A summary of the geology of the Turkey Point site is provided in Section 2.6 of the ER (FPL 2014-TN4058). The geology and associated seismological and geotechnical conditions at the Turkey Point site are described in greater detail in Section 2.5 of the FSAR (FPL 2014-TN4069). Both the ER and the FSAR incorporated information obtained from onsite subsurface investigations performed in support of the COL application. The NRC staff also used information from exploratory well EW-1 (FPL 2012-TN1577) drilled by FPL in support of the UIC injection permit, and other publicly available documents on the geology of the site. The NRC staff's description of the geological features and the technical analyses related to safety issues will be presented in the Safety Evaluation Report.

The Turkey Point site lies near the southern end of the Atlantic Coastal Plain physiographic province of North America (Miller 1990-TN550). The site is within the "Coastal Marshes and

Mangroves" subprovince and just east of a higher elevation area called the "Atlantic Coastal Ridge" subprovince (Renken et al. 2005-TN110). The geologic setting is near the eastern edge of the South Florida Basin, where up to 20,000 ft of rock was deposited during the Mesozoic and Cenozoic eras in a shallow sea environment with a slowly subsiding landmass (Pressler 1947-TN2472; Palacas 1978-TN2473).

The carbonate formations underlying southeastern Florida are predominantly limestone with dolomitic limestone and dolomite being common in the lower sections below about 1,000 ft deep (Reese 1994-TN1439). Figure 2-42 shows the generalized geologic formations and corresponding hydrostratigraphy at the Turkey Point site. Aquifers are defined based on their permeability with the productive zones classified as aquifers and the low-permeability intervals classified as confining or semi-confining units. Two major aquifer systems are found within the Cenozoic sediments that underlie the Turkey Point site. The surficial aquifer system (Biscayne aquifer) is separated from the deeper Floridan aquifer system by the low-permeability sediments of the Hawthorn group, which form a confining unit above the Floridan aquifer system. Permeable zones are found in some places in Florida within the Hawthorn confining unit and form local aquifers that are collectively called the intermediate aquifer system. However, these permeable zones and the intermediate aquifer system are not present in southeastern Florida (Miller 1990-TN550).

The uppermost part of the surficial aquifer beneath the Turkey Point site is called the Biscayne aquifer; it is composed of the Miami Limestone, Key Largo Limestone, and Fort Thompson Formation. The Biscayne aquifer is about 110 ft thick at the Turkey Point site (FPL 2014-TN4058). The Floridan aquifer system occurs at a depth of approximately 1,000 ft in the Miami-Dade County area and is separated from the surficial aquifer system by approximately 600 ft of Intermediate Confining Unit (Reese 1994-TN1439). The Floridan aquifer system consists of two main permeable sequences, the Upper Floridan and Lower Floridan aquifers, separated by a less permeable MCU. The Upper Floridan aquifer includes the Suwannee and Ocala limestones and the upper part of the Avon Park Formation. The Floridan aquifer system occurs under confined conditions at the Turkey Point site and throughout southeastern Florida.

The Lower Floridan aquifer includes the lower part of the Avon Park Formation, the Oldsmar Limestone, and the upper part of the Cedar Keys Formation. Much of the Lower Floridan aquifer contains saltwater. An extremely permeable zone called the Boulder Zone is present within a karstic fractured dolomite layer within the Lower Floridan aquifer in southeastern Florida. The Boulder Zone contains water the salinity and temperature of which is similar to modern seawater (Miller 1990-TN550). The top of the Boulder Zone was identified at 3,030 ft below the surface at the Turkey Point site and is separated from the Upper Floridan aquifer by more than 750 ft of low-permeability confining unit (FPL 2009-TN2474). Within the Boulder Zone, seawater is thought to move westward from a connection with the Atlantic Ocean and migrate very slowly upward through the MCU (Meyer 1988-TN2475).

FPL's investigation of the site revealed no features or lineaments associated with faulting on the site and determined that a continuous horizontal stratigraphy is present with no faults or folds related to tectonic deformation within a 25 mi radius (FPL 2014-TN4058).

SERIES	STRATIGRAPHIC UNIT	LITHOLOGY	TOP DEPTH (ft)	THICK-NESS (ft)	HYDRO-GEOLOGIC UNIT	TOP DEPTH (ft)
HOLOCENE	organic muck	organic soil and silt	0	3	Biscayne Aquifer	0 - 3
PLEISTOCENE	Miami Formation	sandy, oolitic limestone	3	25		
	Key Largo Limestone	well indurated, vuggy, coraline limestone	28	22		
	Ft Thompson Formation	poor/well indurated fossiliferous limestone	50	65		
PLIOCENE	Tamiami Formation	sand and silt with calcarenite limestone	115	105	Intermediate Confining Unit	140
MIOCENE	Hawthorne Group: Peace River Formation	silty calcareous sand and silt	220	235		
	Hawthorne Group: Arcadia Formaion	calcareous wackestone with indurated limestone, sandstone and sand	455	555		
OLIGO-CENE	Suwannee Limestone	fine-grained limestone and dolomitic limestone	1010	245	Upper Floridan Aquifer (USDW)	1010
EOCENE	Avon Park Formation	fine-grained limestone and dolomite	1255	(~445)	Middle Floridan Confining Unit	1450
		permeable limestone	(~1700)	(~75)	APPZ (?)	(1700)
		fine-grained limestone and dolomite	(1775)	745	Middle Floridan Confining Unit	1930
	Oldsmar Formation	limestone, dolomitic limestone and dolomite	2580	450		
					Lower Floridan Aquifer	2915
		Boulder Zone	3030	>200	Boulder Zone	3030
PALEO-CENE	Cedar Keys Formation	dolomite and dolomitic limestone	?	?		
		massive anhydrite beds	?	1200 ?	Sub-Floridan Confining Unit	?

(?) denotes uncertainty

Figure 2-42. **The Generalized Stratigraphy and Corresponding Hydrogeologic Units at the Turkey Point Site (FPL 2012-TN1577; Reese and Richardson 2008-TN3436; FPL 2014-TN4069)**

2.9 Meteorology and Air Quality

The following sections describe the climate and air quality at the Turkey Point site. Section 2.9.1 describes the climate of the region and area in the immediate vicinity of the Turkey Point site, Section 2.9.2 describes the air quality of the region, Section 2.9.3 describes atmospheric dispersion at the site, and Section 2.9.4 describes the meteorological monitoring program at the site.

2.9.1 Climate

The Turkey Point site is located in Miami-Dade County, on the lower east coast of Florida close to the Atlantic Ocean. The climate at this location is best classified as subtropical maritime, and it is characterized as having two principal seasons—a relatively short, dry, and mild winter, and a long warm summer season with abundant rainfall (NCDC 2008-TN540). The Azores-Bermuda high-pressure system dominates the circulation pattern for most of the year causing a tropical air mass to prevail most of the year. Occasional cold continental air masses displace the maritime air during winter.

The closest first-order National Weather Service station is at the Miami International Airport, about 25 mi north of the site. This station represents the general climate at the Turkey Point site. The climatological cooperative observing station at Miami 12° SSW about 16 mi north-northeast of the site is also representative of the site, and is more indicative of the diurnal variation of precipitation and temperature at the site because of its proximity to the coast. However, the Miami 12° SSW site only records daily maximum and minimum temperature and precipitation data. Other sites within 50 mi of the Turkey Point site were also included in the assessment to characterize potential extremes in precipitation, wind, and temperature.

The following climatological statistics are derived from local climatological data collected at Miami International Airport. Temperatures are more variable in the winter than in the summer because of the strong differences in source regions from which the seasonal air mass originates. Daytime maximum temperatures range from about 77°F in January to about 91°F in July and August; nighttime minimum temperatures range from about 60°F in January to about 77°F in July and August. At the Turkey Point site these maximum and minimum averages are moderated due to the ocean's moderating influence. At Miami International Airport the monthly average wind speeds range from about 10 mph in March to about 8 mph in July and August. At Turkey Point site, monthly average wind speeds are slightly lower, averaging about 9 mph in March to about 7.5 mph in July and August. The normal amount of annual precipitation received at Miami International Airport is 58.53 in. The majority (about 53 percent) of the annual rainfall is associated with thunderstorms that frequently occur from June through September. On average during this period, thunderstorms occur on between 12 and 16 days per month. Average precipitation ranges from about 2 in. per month in January and February and peaks at about 8.5 in. per month in August. The only observation of frozen precipitation near the Turkey Point site was a trace (0.05 in.) observed at Homestead, Florida, on January 19, 1977. The Turkey Point site is flat with no topographical features that should cause the climate to deviate significantly from this general regional climate.

Recent improvements in the emissions and the science of climate change have enabled the U.S. Global Change Research Program (GCRP) to estimate regional climate changes in the United States (GCRP 2014-TN3472). The projected change in temperature by 2100, which encompasses the period of the licensing action in the southeastern United States is a regional average increase of between 4°F to 8°F in the annual average temperature. While the GCRP has not incrementally forecasted the change in precipitation by decade to align with the licensing action, the projected change in precipitation in spring and summer rainfall is projected to decline in South Florida during this century (GCRP 2014-TN3472).

Based on the assessments of the GCRP and the National Academy of Sciences' National Research Council, the EPA determined that potential changes in climate caused by greenhouse gas (GHG) emissions endanger public health and welfare (74 FR 66496) (TN245). The EPA indicated that, while ambient concentrations of GHGs do not cause direct adverse health effects (such as respiratory or toxic effects), public health risks and impacts can result indirectly from changes in climate. As a result of the determination by the EPA and the recognition that mitigative actions are necessary to reduce impacts, the effects of GHG on the climate and the environment are already noticeable, but not yet destabilizing. In CLI-09-21, the Commission provided guidance to the NRC staff to consider carbon dioxide and other GHG emissions in its NEPA reviews and directed that it should encompass emissions from constructing and operating a facility as well as from the fuel cycle (NRC 2009-TN539). Further, the President's CEQ (2016-TN4732) has provided guidance on how the Federal government should analyze the environmental effects of GHG emissions and climate change when it describes the environmental effects of a project under NEPA. The review team characterized the affected environment and the potential GHG impacts of the proposed action and alternatives in this EIS. Consideration of GHG emissions was treated as an element of the existing air-quality assessment that is essential in a NEPA analysis. In addition, where it was important to do so, the review team considered the effects of the changing environment during the period of the proposed action on other resource assessments.

2.9.1.1 Wind

Wind at the Turkey Point site is consistent with the dominant influence of the Azores-Bermuda high and the coastal location of the site. The seasonal variation of the prevailing directions shows a predominance of east-southeast winds except in December, January, and February when north-northwesterly winds prevail, and in September, October, and November when easterly winds prevail (FPL 2014-TN4058). The coastal location of the site experiences typical onshore (east-southeast) winds during the day and offshore land-breeze winds during mid-morning hours. However, the review team's analysis of the Turkey Point site data showed that wind reversal was a moderately frequent event and that the dominate wind direction is from the east-southeast regardless of the time of day. Wind direction persistence is generally limited to 4 hours or less; persistence of 8 hours or longer occurs less than 9 percent of the time, and persistence of 12 hours or longer occurs about 3 percent of the time based on the Turkey Point onsite 10 m wind data.

2.9.1.2 Temperature

The period of record for the onsite temperature data does not cover multiple decades. Consequently, it was determined that the average temperature at the Turkey Point site is most likely consistent with the temperature data from the Miami 12 SSW station (period of record 1958–1988) based on its relative proximity to the Turkey Point site and its near-coastal location. Based on data in Table 2.7-4 of the FPL ER (FPL 2014-TN4058) for observations at 13 National Weather Service (NWS) and cooperative observing stations and the climatological record for the Miami International Airport NWS station, the temperature extremes at the site are between 25°F and 97°F. The mean monthly maximum temperature is 83°F and the mean monthly minimum is 66°F.

2.9.1.3 Atmospheric Moisture

The Turkey Point meteorological system does not measure any parameters related to atmospheric moisture. Consequently, the review team determined the relative humidity data for Miami International Airport is representative of the Turkey Point site. Relative humidities for 0700 local standard time (LST) approximate the daily maximum values. Monthly average 0700 LST relative humidities range from about 85 percent in January to about 79 percent in April. Relative humidities for 1,300 LST approximate the daily minimum relative humidity. Monthly average 1,300 LST relative humidities range from a high of about 66 percent in September to a low of about 54 percent in April. Climatological statistics for Miami International Airport indicate that the Turkey Point site could expect heavy fog about 5 days per year. The likelihood of fog is greatest from December through February and least from May through September.

2.9.1.4 Severe Weather

The Turkey Point site can experience severe weather in the form of thunderstorms, tornadoes, and tropical storms. Thunderstorms are the most frequent severe weather events. They occur on average about 73 days per year at Miami International Airport. About three-fourths of the thunderstorms occur in the period of June through September. Fifty hurricanes have made landfall within 100 mi of Turkey Point since 1851 or about three every 10 years. Three of these tropical cyclones have had sustained wind speeds in excess of 155 mph that have tracked within 100 nautical mi of the Turkey Point site; the most recent being hurricane Andrew in 1992 (NOAA 2011-TN541; Jarvinen et al. 1984-TN276). Hurricane Andrew was historic because it was the first time that a hurricane significantly affected a commercial nuclear power plant. The eye of the storm, featuring sustained winds of up to 145 mph and gusts of 175 mph, passed over the Turkey Point site and caused extensive onsite and offsite damage. However, there was no damage to the safety-related systems of Units 3 and 4 except for minor water intrusion and some damage to insulation and paint (NRC 1993-TN542). Tornadoes are the least frequent of these extreme weather events. Using tornado statistics from 1950 through 2003 and the methodology outlined in NUREG/CR–4461, *Tornado Climatography of the Contiguous United States* (Ramsdell and Rishel 2007-TN277), the probability of a tornado striking the nuclear island at the Turkey Point site is about 2×10^{-4}/yr.

2.9.1.5 Atmospheric Stability

Atmospheric stability is a derived meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined for the lowest layer of the atmosphere by the difference in temperature between two heights separated by at least 30 m. A seven-category atmospheric stability classification scheme based on temperature differences is set forth in Regulatory Guide 1.23, Revision 1 (NRC 2007-TN278). When the temperature decreases rapidly (<-1.5°C per 100 m) with height, the atmosphere is unstable and atmospheric dispersion is greater. Conversely, when temperature increases with height, the atmosphere is stable and dispersion is more limited. Typically, the atmospheric stability is neutral to unstable during the day and neutral to stable at night. Cloudiness and high winds tend to decrease both stability and instability, thereby resulting in more nearly neutral conditions.

Measurements at the 10 and 60 m levels of the Turkey Point meteorological tower are used to determine atmospheric stability for the Turkey Point site. On an annual basis, the atmosphere at the Turkey Point site is stable about 53 percent of the time, neutral about 28 percent of the time, and unstable about 19 percent of the time. These percentages vary seasonally with more frequent unstable conditions in the spring and winter, and more frequent neutral conditions in the summer and fall (FPL 2014-TN4058).

2.9.2 Air Quality

The discussion of air quality includes the six common "criteria pollutants" for which the EPA has set National Ambient Air Quality Standards (NAAQSs) (ozone [O_3], particulate matter [PM_{10} and $PM_{2.5}$; particulate matter with a mean aerodynamic diameter of less than or equal to 10 microns and 2.5 microns; respectively], carbon monoxide [CO], nitrogen dioxide [NO_2], sulfur dioxide [SO_2], and lead [Pb]). The air-quality discussion also includes heat-trapping GHGs (primarily carbon dioxide [CO_2]), which have been the principal factor causing climate change over the last 50 years (GCRP 2014-TN3472).

Climate change is a subject of national and international interest. The recent compilation of the state of knowledge in this area by the GCRP has been considered in preparation of this EIS. The GCRP report (GCRP 2014-TN3472) synthesizes the work of the Federal government on climate change. Climate-related changes include rising temperatures and sea levels; increased frequency and intensity of extreme weather (e.g., heavy downpours, floods, and droughts); earlier snowmelts and associated frequent wildfires; and reduced snow cover, glaciers, permafrost, and sea ice. GHGs are transparent to incoming short-wave radiation from the sun but opaque to outgoing long-wave (infrared) radiation from the Earth's surface. The net effect over time is a trapping of absorbed radiation and a tendency to warm the Earth's atmosphere, which together constitute the "greenhouse effect."

The Turkey Point site is in southeast Miami-Dade County, Florida, which is part of the Southeast Florida Intrastate Air Quality Control Region. All of the counties (Broward, Miami-Dade, Indian River, Martin, Monroe, Okeechobee, Palm Beach, and St. Lucie) within this control region are in attainment of the NAAQSs (40 CFR 81.310) (TN255). There is one Class I Federal Area where visibility is an important value within 100 mi of the Turkey Point site. This is the Everglades

National Park located approximately 13 mi west of the site of proposed Units 6 and 7 (40 CFR 81.407) (TN255).

2.9.3 Atmospheric Dispersion

As described in Section 2.9.4, the NRC staff visited the meteorological measurement system at the Turkey Point site, reviewed the available information about the design of the meteorological measurement program, and evaluated data collected by the program. Based on this information, the NRC staff concludes that the program provides data that represent the affected environment onsite meteorological conditions as required by 10 CFR 100.20 (TN282). The data also provide an acceptable basis for estimating atmospheric dispersion for the evaluation of the consequences of routine and accidental releases as required by 10 CFR 50.34 (TN249), 10 CFR Part 50 (TN249), Appendix I, and 10 CFR 52.79 (TN251).

2.9.3.1 Short-Term Dispersion Estimates

FPL calculated short-term dispersion estimates for the Turkey Point site using 3 years of onsite meteorological data for the years 2002, 2005, and 2006. These estimates, which were provided in ER Section 2.7.5, were based on distances to the exclusion area boundary (EAB) and outer boundary of the low-population zone (LPZ) in ER Table 2.7-12. The exclusion area and LPZ are defined in 10 CFR 50.2 (TN249). The NRC staff reviewed these data and calculations to determine whether the short-term dispersion estimates were appropriate for use in the EIS design basis accident (DBA). The short-term dispersion estimates for use in the DBA calculations are listed in Table 2-55. They are based on the PAVAN computer code (Bander 1982-TN538) calculations of 1-hour and annual average atmospheric dispersion factor (χ/Q) values from a joint frequency distribution of wind speed, wind direction, and atmospheric stability. These values were calculated for the shortest distances from a release boundary envelope that encloses the proposed Turkey Point Unit 6 or Unit 7 release points to the EAB and to the LPZ. The 50 percent EAB χ/Q value listed in Table 2-55 is the median 1-hour χ/Q, which is assumed to persist for 2 hours. The 50 percent LPZ χ/Q values listed in Table 2-55 were determined by logarithmic interpolation between the median 1-hour χ/Q, which was assumed to persist for 2 hours, and the annual average χ/Q. This approach is consistent with the procedure described in Regulatory Guide 1.145 (NRC 1983-TN279), and the NRC staff concluded that the site-specific short-term dispersion estimates are appropriate for use in the EIS DBA review.

Table 2-55. Atmospheric Dispersion Factors for Proposed Units 6 and 7 Design Basis Accident Calculations

Time Period	Boundary	χ/Q (s/m^3)
0 to 2 hours	Exclusion area boundary	1.89×10^{-4}
0 to 8 hours[(a)]	Low-population zone	5.29×10^{-6}
8 to 24 hours[(a)]	Low-population zone	4.02×10^{-6}
1 to 4 days[(a)]	Low-population zone	2.21×10^{-6}
4 to 30 days[(a)]	Low-population zone	9.39×10^{-7}

(a) Times are relative to the beginning of the release to the environment.

2.9.3.2 Long-Term Dispersion Estimates

Long-term dispersion estimates for use in evaluation of the radiological impacts of normal operations were calculated by FPL using the XOQDOQ computer code (Sagendorf et al. 1982-TN280). This code implements the guidance set forth in Regulatory Guide 1.111 (NRC 1977-TN91) for estimation of χ/Q and atmospheric deposition factors (D/Q) for use in evaluation of the consequences of normal reactor operations. The XOQDOQ model uses the diffusion parameters as specified in Regulatory Guide 1.145 (NRC 1983-TN279). The NRC reviewed the model inputs and distances from the release point to the nearest residence, EAB, school, vegetable garden, and meat animal. No residential milk cows were identified with 5 mi of the Turkey Point site and no dairies within 50 mi. Site-specific meteorological data covering the 3-year period (2002, 2005, and 2006) were used to determine the diffusion estimates.

Table 2-56 summarizes the results of the maximum annual average χ/Q and D/Q predicted by XOQDOQ for the sensitive receptors of interest in the area as a result of routine releases of effluents. The listed maximum values are results for several plume depletion scenarios that account for radioactive decay: no decay, half-life decay of 2.26 and 8 days. Table 2-56 also includes χ/Q and D/Q estimates at the proposed Unit 7 location for releases from proposed Unit 6 for use in estimating Unit 7 construction worker doses after Unit 6 begins operation.

2.9.4 Meteorological Monitoring

There has been a meteorological monitoring program at the Turkey Point site since the early 1970s. The initial measurements were to provide the onsite meteorological information required for licensing of existing Turkey Point Units 3 and 4. Measurements have continued in support of existing Turkey Point Units 3 and 4 operations. The meteorological system was last upgraded to enhance its reliability in 2007 in support of the proposed new Units 6 and 7 Distributed Control System installation (FPL 2014-TN4058). These improvements were directed at improving reliability, maintainability, and communication.

Table 2-56. Maximum Annual Average Atmospheric Dispersion and Deposition Factors for Evaluation of Normal Effluents for Receptors of Interest

Receptor	Downwind Sector	Distance (mi)	No Decay χ/Q (s/m^3)	2.26-Day Decay χ/Q (s/m^3)	8-Day Decay χ/Q (s/m^3)	D/Q (1/m^2)
EAB	W	0.49	1.7×10^{-5}	1.7×10^{-5}	1.6×10^{-5}	1.4×10^{-7}
EAB	SE	0.36	1.7×10^{-5}	1.7×10^{-5}	1.6×10^{-5}	5.2×10^{-8}
Property Boundary	SSE	0.35	3.4×10^{-5}	3.4×10^{-5}	3.2×10^{-5}	1.2×10^{-7}
Residence	N	2.7	1.4×10^{-7}	1.3×10^{-7}	1.1×10^{-7}	7.5×10^{-10}
Satellite School	NW	2.0	5.2×10^{-7}	5.2×10^{-7}	4.3×10^{-7}	2.9×10^{-9}
Meat Animal	NW	4.0	1.3×10^{-7}	1.3×10^{-7}	1.0×10^{-7}	5.8×10^{-10}
Veg. Garden	NW	4.8	9.6×10^{-8}	9.4×10^{-8}	7.2×10^{-8}	3.8×10^{-10}
Unit 7 Reactor	W	0.13	1.6×10^{-4}	1.6×10^{-4}	1.5×10^{-4}	1.0×10^{-6}

The instrument systems are described in Section 6.4 of the FPL ER (FPL 2014-TN4058). The primary meteorological tower (South Dade) is situated about 5.8 mi southwest of the location of proposed Units 6 and 7. The primary meteorological tower instruments include sensors to measure wind speed and direction, temperature, and sigma theta (standard deviation in wind direction) at 10 m and 60 m above ground, precipitation, barometric pressure, and solar radiation. A 10 m backup meteorological tower is located about 0.3 mi northwest of the location of proposed Units 6 and 7. Instrumentation on the backup tower consists of sensors to measure wind speed and direction and sigma theta at 10 m and precipitation near ground level. Table 6.4-4 of FPL's ER (FPL 2014-TN4058) lists the instrumentation in the current measurement system and compares instrument specifications with criteria set forth in NRC guidance and industry standards.

The NRC staff viewed the meteorological site and instrumentation and reviewed the available information about the meteorological measurement program, which included maintenance, calibration, and audit records. The NRC staff then evaluated the data-collection program and then, based on this information, concluded that the program provides data that represent the affected environment onsite wind and stability conditions as required by 10 CFR 100.20 (TN282). The NRC staff did note however, that for certain wind directions the South Dade tower monitoring building interferes with wind data collection, but only for a small percentage of time due to the prevailing wind direction pattern. The data also provide an acceptable basis for making estimates of atmospheric dispersion for the environmental review evaluation of the consequences of routine and accidental releases required by 10 CFR 50.34 (TN249), 10 CFR Part 50 (TN249), Appendix I, and 10 CFR 52.79 (TN251).

2.10 Nonradiological Health

This section describes aspects of the environment at the Turkey Point site and within the vicinity of the site that are associated with nonradiological human health impacts. It provides the basis for evaluation of impacts on human health from site preparation, construction, operation, and decommissioning of proposed Turkey Point Units 6 and 7. Building activities, noise, and the transportation of construction materials and personnel to the Turkey Point site all have the potential to affect the health of the public and/or workers. Operation of proposed Units 6 and 7 has the potential to affect the public and workers at the Turkey Point site through operation of the cooling system, noise generated by operations, electromagnetic fields generated by transmission systems, and transportation of operations and outage workers to and from the Turkey Point site.

2.10.1 Public and Occupational Health

This section describes public and occupational health at the Turkey Point site and vicinity associated with air quality, etiological agents (i.e., disease-causing microorganisms), and occupational injuries.

2.10.1.1 Air Quality

Public and occupational health can be affected by changes in air quality from activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 1996-TN288). The potential impact of these changes on compliance with air-quality standards for the Turkey Point site and Miami-Dade County are discussed in Section 2.9.2. Air-quality measures include particulate matter, such as fugitive dust and selected gaseous pollutants. Particulates can be released into the atmosphere during excavation of muck, backfilling, grading and compacting, concrete batching, and vehicular travel over paved and unpaved roads. Particulates and other emissions can be released by construction equipment and vehicles used for hauling debris, soil, construction equipment, and supplies. Smoke would be released if open burning is conducted during site-clearing and site-preparation activities.

Exhaust emissions during normal plant operations associated with onsite vehicles and equipment as well as from commuter traffic also can affect air quality and human health. Nonradiological supporting equipment (e.g., diesel generators, fire pump engines) and other nonradiological emission-generating sources (e.g., storage tanks) and activities are expected to be a source of pollutant emissions. Diesel generators and supporting equipment would be in place for emergency use only but would be started regularly to verify that the systems are operational.

Recirculating mechanical draft wet cooling is a typical cooling method for power plants that also is associated with air emissions. Unit 5 uses this method, supplied with cooling-tower makeup water from the Upper Floridan aquifer. The blowdown (or draw-off), used principally to control the buildup of minerals in the water, is routed to the IWF. Most of the water typically leaves the plant via the cooling towers by evaporation and aerosolization, often referred to collectively as "drift" (although technically drift generally refers only to the aerosolized portion). The evaporated portion includes gaseous forms of chemicals, including volatile "contaminants of emerging concern," or CECs (EPA 2012-TN1018), which can be inhaled by plant workers and the public. Aerosol drift results in particulate matter that is formed as the salts and chemicals, including CECs, precipitate. Furthermore, aerosol drift can contain etiological agents, depending on the degree of disinfection used (and as described in the next section). If exposure to any of these hazards is greater than health-based thresholds, such as minimum infective doses for pathogens, particulate matter standards, or minimal risk levels for chemicals, then risks could be considered significant and thus require mitigation such as additional treatment or setback distances from the towers.

As noted in the ER (FPL 2014-TN4058) and SCA (FPL 2009-TN1246), and as illustrated in Figure 2-43, the nearest receptors to proposed Units 6 and 7, as measured from the center of the proposed site area, are as follows:

- The nearest school (day-care center) is 2 mi northwest.
- The nearest transient residence is 2.7 mi north (in Homestead Bayfront Park).
- The nearest known food (meat) animal is 2.7 mi north.
- The nearest permanent residence is 3.9 mi northwest.
- The nearest known vegetable garden is 4.8 mi northwest (not shown).

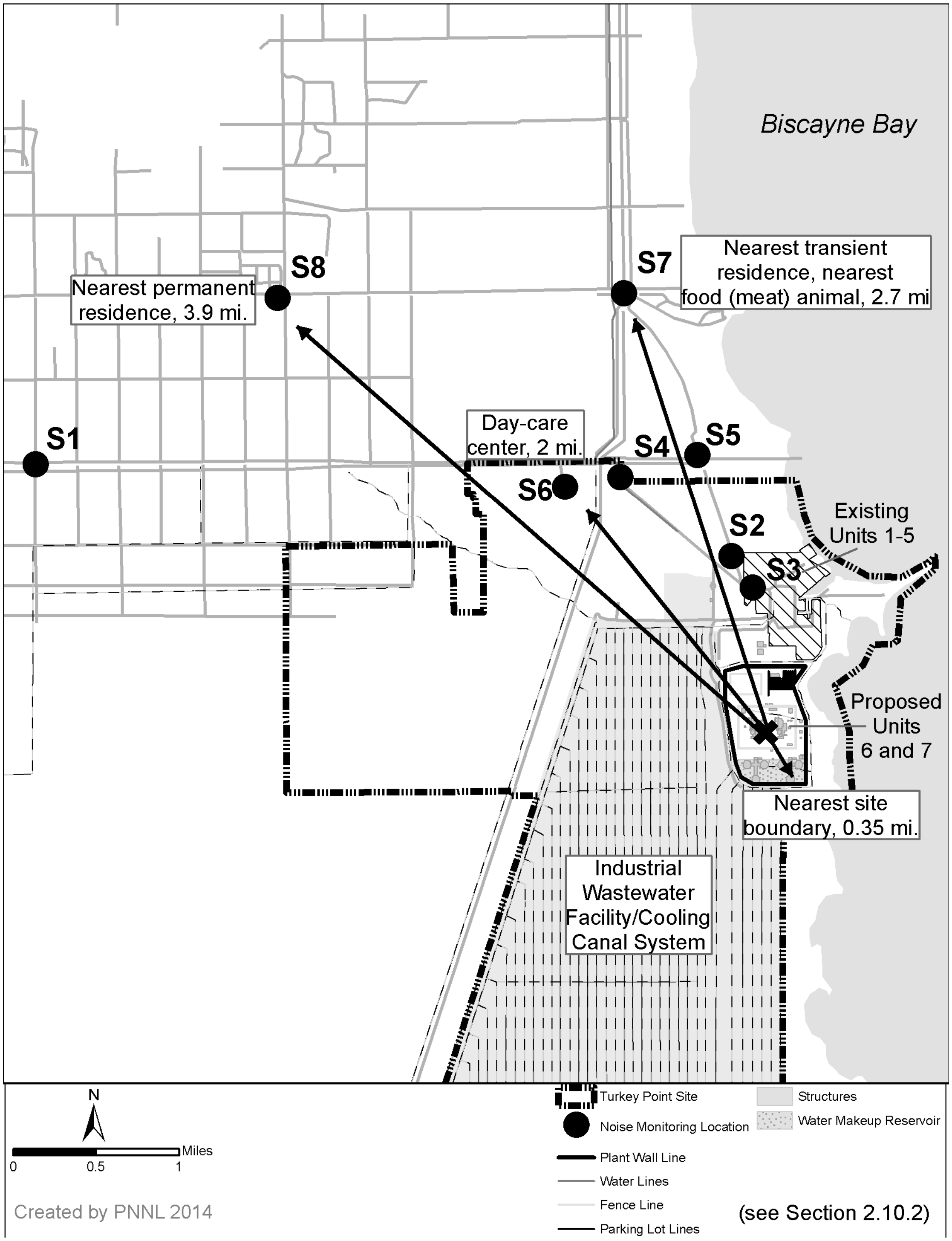

Figure 2-43. Nearest Actual and Potential Receptors

Emissions from nonradiological air pollution sources, including the “criteria pollutants,” i.e., sulfur dioxide, particulate matter with aerodynamic diameters of 10 microns or less (PM_{10}), particulate matter with aerodynamic diameters of 2.5 microns or less ($PM_{2.5}$), carbon monoxide, nitrogen dioxide, lead, and ozone, are controlled through compliance with Federal, State, and local regulations. Attainment areas are areas where the ambient levels of criteria air pollutants are designated as being “better than,” “unclassifiable/attainment,” or “cannot be classified or better than national standards” (depending on the pollutant and other factors). FPL notes that the Southeast Florida Intrastate Air Quality Control Region (AQCR), which includes Miami-Dade County, was in attainment for these pollutants in 2008 (FPL 2014-TN4058). The AQCR was still in attainment in 2011 (40 CFR 81.310) (TN255).

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities such as building, maintenance, testing, excavation, and modifications are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. The U.S. Bureau of Labor Statistics provides reports that account for occupational injuries and illnesses as total recordable cases (TRCs), which includes those cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid (BLS 2011-TN668). The State of Florida also tracks the annual incidence rates of injuries and illnesses for electric power-generation, transmission, and distribution workers (BLS 2012-TN669). These records of statistics are used to estimate the likely number of occupational injuries and illnesses for operation of the current units and predict the likely number of cases for the proposed new units.

The average TRC incidence rate for the Turkey Point Units 3 and 4 workforce for 2004 through 2008 was reported to be 0.4 cases per 100 workers (FPL 2014-TN4058). These rates are substantially lower than expected based on data for the industry overall. As seen in Table 2-57, rates of injuries and illnesses per 100 full-time workers for years 2003-2010 in the heavy and civil engineering construction sector—an important sector baseline for assessing building impacts

Table 2-57. Injuries and Illnesses by Industry and Area (per 100 full-time workers per year)

	Heavy and Civil Engineering Construction		Electric Power Generation, Transmission, and Distribution	
Year	U.S.	Florida	U.S.	Florida
2003	4.0	7.0	5.0	3.3
2004	5.9	7.0	4.5	3.3
2005	5.6	5.6	4.0	2.0
2006	5.3	6.3	3.8	3.9[a]
2007	4.9	4.9	3.6	2.8
2008	4.2	3.8	3.2	2.1
2009	4.2	3.6	3.5	2.7
2010	3.8	3.4	2.8	2.4

(a) For 2006, data were only available for utilities overall.

(Chapter 4)—ranged from 3.8 to 5.9 for the United States and 3.4 to 7.0 for Florida. While some reduction in TRC incidence rate over time is seen for the United States as a whole, other than the period from 2003 to 2004, there is a clearer and more substantial reduction over time for Florida. For the same years, rates of injuries and illnesses in the electric power-generation, transmission, and distribution sector—an important sector baseline for assessing operational impacts (Chapter 5)—ranged from 2.8 to 5.0 for the United States and 2.1 to 3.9 for Florida. Reductions over time are apparent in this sector for both the United States and Florida.

Fatal injury rate data are available from the above sources for 2003–2007. As seen in Table 2-58, rates of fatal injuries per 100,000 workers for the years 2003–2007 in the United States construction sector ranged from 10.4 to 12.0. As with non-fatal injuries and illnesses, these data show some reduction over time, although the trend is weaker and the change smaller for fatal injuries compared to non-fatal injuries and illnesses. One caveat related to these data is that fatal injury rates in the utility construction sector likely are lower than the rates shown here for the general construction sector. This is based on lower non-fatal injury and illness rates in the utility construction sector compared to the overall construction sector. For example, the non-fatal injury and illness rate for the utility construction sector for 2007 is 4.7 per 100 full-time workers, while the non-fatal injury and illness rate for the general construction sector is 15 percent higher, at 5.4 per 100 full-time workers.

Table 2-58. Fatal Injuries by Industry in the United States (per 100,000 workers per year)

Year	Construction	Utilities
2003	11.7	3.7
2004	12.0	6.1
2005	11.1	3.6
2006	10.9	6.3
2007	10.4	4.0

As seen in Table 2-58, fatal injury rates for utility operations ranged from 3.6 to 6.3 per 100,000 workers. While this range is relatively large, no discernible trend over time is apparent.

Occupational injury and fatality risks are reduced by adherence to NRC and Occupational Safety and Health Administration safety standards, practices, and procedures to minimize worker exposures. Appropriate State and local statutes also must be considered when assessing the occupational hazards and health risks associated with the Turkey Point site. Currently, the Turkey Point site has programs and personnel to promote safe work practices and respond to occupational injuries and illnesses for existing units (FPL 2014-TN4058). Procedures are in place with the objective to provide personnel who work at the Turkey Point site with an effective means of preventing accidents due to unsafe conditions and unsafe acts. They include safe work practices to address hearing protection, confined space entry, personal protective equipment, heat stress, electrical safety, ladders, and chemical handling, storage, and use, as well as other industrial hazards. Personnel are provided training on FPL safety procedures. In addition, FPL requires contractors to develop and implement safety procedures with the intent of preventing injuries, occupational illnesses, and deaths.

2.10.1.3 Etiological Agents

Public and occupational health can be compromised by activities at nuclear power sites that encourage the growth of disease-causing microorganisms (etiological agents). The types of organisms of concern for public and occupational health include enteric pathogens (such as *Salmonella* spp. and *Pseudomonas aeruginosa*), thermophilic fungi, bacteria (such as *Legionella* spp. and *Vibrio* spp.), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels (NRC 2013-TN2654). For proposed Units 6 and 7 at the Turkey Point site, exposure could occur from cooling-tower evaporation and aerosol drift and thermal discharges onsite. In contrast to other units at the site, however, as well as to most other nuclear power plants, the thermal discharges would be collected in a common blowdown sump and injected underground via UIC wells. These waste streams thus are not expected to be discharged to waters that have the potential for direct contact by members of the public (FPL 2014-TN4058), and therefore the following information about etiological agents is largely for providing a baseline for the potential aerosol drift and onsite waste-treatment exposure pathways.

Vibrio spp. are a concern for human health because these theromophilic bacteria are commonly found in coastal marine waters such as those at the Turkey Point site and can be associated with filter-feeding shellfish (e.g., oysters). People can be exposed to the bacteria through activities such as swimming, diving, or wading in the water, as well as through consumption of contaminated shellfish. *Vibrio cholera*e causes the disease cholera, which is an acute, diarrheal illness. Other *Vibrio* species do not cause cholera (e.g., *V. vulnificus* and *V. parahaemolyticus*), but exposure to the bacteria can cause watery diarrhea and abdominal cramps as well as skin infections. Cholera and non-cholera illnesses caused by *Vibrio* spp. can be fatal. During 2007-2008, a total of 236 individual vibriosis cases associated with water exposure (recreational or flood water) were reported by 25 states (CDC 2011-TN558). Of these, 74 (31 percent) were hospitalizations, and nine (4 percent) were fatal. During 2005-2006, a total of 189 vibriosis cases associated with water exposure were reported, and during 2003-2004 a total of 142 cases were reported (CDC 2008-TN557). Vibriosis cases were not routinely reported prior to 2003, so data are not readily available for prior years. Nearly all vibriosis patients reported that they were exposed to recreational water in coastal states. The most frequently reported exposure state for all reporting periods was Florida.

Naegleria fowleri is a free-living amoeba that proliferates in warm freshwater and hot springs. Primary amebic meningoencephalitis (PAM) occurs when the amoeba coincidentally enters the nasal passages, travels to the olfactory lobe of the brain, and infects brain tissue. This rare disease is of public health importance because of the high (>99 percent) fatality rate associated with infection. In 2009, three cases of PAM, all fatal, were reported from Madison, Orange, and Polk Counties in Florida (Terzagian 2011-TN998). No data were found on cases from other states for 2009. In 2008, no PAM cases were reported in the United States. In 2007-2008, eight individual cases of PAM were reported in the United States (CDC 2011-TN558). All were fatal, and the largest number of cases, three (38 percent), occurred in Florida. In 2005-2006, five cases of PAM were reported in the United States; all were fatal, but none occurred in Florida (CDC 2008-TN557).

Cryptosporidium is a parasite that can survive outside the body for long periods of time and is very tolerant to chlorine disinfection. It has emerged as the single most important etiologic agent of recreational water-associated outbreaks. In 2007-2008, of 81 outbreaks of acute gastrointestinal illness, 60 (74 percent) were caused by *Cryptosporidium* and resulted in 12,154 cases (CDC 2011-TN558). In 2005–2006, of 48 outbreaks of acute gastrointestinal illness, 31 (65 percent) were caused by *Cryptosporidium* and resulted in 3,751 cases (CDC 2008-TN557).

Legionella is a bacterium that can cause a type of pneumonia called legionellosis, more commonly known as Legionnaires' disease, which is sometimes fatal. Approximately 8,000-18,000 cases of legionellosis occur each year in the United States (CDC 2011-TN558). In 2007-2008, three outbreaks were reported that resulted in 16 cases known to be associated with cooling towers (CDC 2011-TN558). In 2005-2006, three outbreaks also were reported associated with cooling towers, which resulted in 52 cases and 6 deaths (CDC 2008-TN557).

The Florida Department of Health's Food and Waterborne Disease Program is responsible for the surveillance, investigation, reporting, and prevention of food and waterborne diseases within the state. Each year, the program publishes an annual report that summarizes food and waterborne disease outbreaks in the state. Annual reports dating back to 1997 are available from the Florida Department of Health (FDOH 2012-TN667). Table 2-59 summarizes these data and shows total number of waterborne disease outbreaks by organism and location (county) over the 2002–2011 period (2011 data being the most recent data available). From 2002 to 2011 there was a total of 558 reported cases of waterborne disease and 2 organisms were implicated in 58.6 percent of the cases reported—the Norovirus (a virus that causes acute gastroenteritis) and *Cryptosporidium* were blamed for 180 and 147 cases, respectively. *Legionella* was the cause of 36 cases (6.5 percent). An outbreak of "sea bather's eruption," dermatitis caused by exposure to *Linuche unguiculata* (larval thimble jellyfish), occurred in 2005; 24 cases (4.3 percent) were reported. Seven cases (1.3 percent) were associated with *Naegleria fowleri* and 26 cases (4.7 percent) were associated with *Shigella*. In 83 cases (14.9 percent), the cause of the outbreak was listed as "unknown." The vast majority of cases were associated with inadequate treatment, improper treatment, or temporary interruption of treatment of drinking water or recreational water (pools, recreational water slides, whirlpools). In some instances, swimmers were infected by pathogenic microorganisms in freshwater lakes, presumably from human or animal waste contamination. None of the cases was attributed to a heated (thermal effluent) or unheated (sanitary waste) discharge from a steam electric plant. Only one outbreak (10 Legionella cases in Dade County in 2009) occurred in one of the counties (i.e., Dade, Glades, Kissimmee, Martin, Okeechobee, and St. Lucie) in which the proposed and alternative sites would lie.

None of the cases described above or in Table 2-59 have been attributed to a heated (thermal effluent) or unheated (sanitary waste) discharge from a steam electric plant.

Table 2-59. Waterborne Disease Outbreaks in Florida, 2002−2011[(a)]

Year	Total No. of Outbreaks (and Associated Cases)	Organism/Vector	County	No. of Cases	Exposure Source
2002	11 (43)	Unknown	Hillsborough	43	Not described
2003	3 (88)	Norovirus	Orange	56	Public drinking water
		Norovirus	Polk	10	Freshwater lake
		Norovirus	Polk	22	Freshwater lake
2004	1 (42)	Norovirus	Duval	42	Recreational water slide
2005	3 (73)	Cryptosporidium	Duval	47	Recreational water
		Legionella	Broward	2	Unknown
		Linuche unguiculata (thimble jellyfish)	Nassau	24	Atlantic Ocean
2006	4 (119)	Cryptosporidium	Orange	3	Hotel swimming pool
		Giardia	Orange	55	Swimming pool/waterfall
		Legionella	Volusia	11	Whirlpool/ spa
		Norovirus	Santa Rosa	50	Recreational swimming lake
2007	9 (98)	Cryptosporidium	Collier	8	Condo swimming pool
		Cryptosporidium	Indian River	38	"Interactive water fountain"
		Cryptosporidium	Marion	3	Swimming pool
		Cryptosporidium	Palm Beach	6	"water"
		Naegleria fowleri	Orange	1	Lake water
		Naegleria fowleri	Orange	1	Freshwater
		Naegleria fowleri	Osceola	1	Lake water exposure
		Unknown	Palm Beach	38	Public drinking water
		Unknown	Pasco	2	Recreational water exposure
2008	4 (23)	Cryptosporidium	Sarasota	13	Pool
		Legionella	Orange	5	Hot tub
		Legionella	Orange	3	Hot tub
		Shigella	Hillsborough	2	Freshwater
2009	10 (44)	Cryptosporidium	Orange	8	Swimming pool
		Cryptosporidium	Orange	6	Swimming pool
		Cryptosporidium	Orange	5	"Multiple pools"
		Cryptosporidium	Palm Beach	6	Recreational water, untreated
		Cryptosporidium	Santa Rosa	4	Swimming pool
		Legionella	Dade	10	Private water system
		Legionella	Seminole	2	Shower heads
		Naegleria fowleri	Nassau	1	Freshwater lake
		Naegleria fowleri	Polk	1	Lake
		Naegleria fowleri	Orange	1	Lake
2010	1 (2)	*Shigella*	Orange	2	Recreational water
		Shigella	Dade	22	Public drinking water
2011	3 (26)	*Legionella*	Hillsborough	3	Decorative fountain
		Naegleria fowleri	St. Johns	1	Recreational water, untreated

(a) Cases associated with waterborne chemicals/chemical contamination were not included.

2.10.2 Noise

Any pressure variation that the human ear can detect is considered sound, and noise is defined as unwanted sound. Sound involves three principal components: a noise source, a person or a group of people, and the transmission path. While two of these components—the noise source and the transmission path—are easily quantified by direct measurements or through predictive calculations, the effect of noise on humans is difficult to determine because of the varying responses of humans to the same or similar noise patterns. The perception of sound (noise) by humans is very subjective and, just as for odors and taste, it is very difficult to predict a response from any particular individual to these levels. To help predict responses, several metrics and tools have been developed. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured by using the logarithmic decibel (dB) scale. A-weighting (denoted by dBA) is widely used to account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies and most sensitive to sounds between 1 and 5 kHz), which correlates well with a human's subjective reaction to sound. Several sound descriptors have been developed to account for variations of sound with time. L_{90} is the sound level exceeded 90 percent of the time, called the residual sound level (or background level) or fairly steady lower sound level on which discrete single sound events are superimposed. The equivalent continuous sound level (L_{eq}) is a sound level that, if it were continuous during a specific time period, would contain the same total energy as a time-varying sound. (Unless designated otherwise, all sound levels are instantaneous or L_{eq} values measured over short [e.g., 1- to 5-minute] time periods.) In addition, human responses to noise differ depending on the time of the day (e.g., higher sensitivity to noise during nighttime hours because of lower background noise levels). The day-night average sound level (L_{dn} or DNL) is a single dBA value calculated from hourly L_{eq} over a 24-hour period, with the addition of 10 dBA to sound levels from 10 p.m. to 7 a.m. to account for the greater sensitivity of most people to nighttime noise. Generally, a 3-dBA change over existing noise levels is considered to be a "just noticeable" difference, and a 10-dBA increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response.

Sources of noise related to proposed Units 6 and 7 at the Turkey Point site would be those associated with heavy equipment during the construction phase and with mechanical draft cooling towers, cooling pumps, transformers, transmission lines, and other electrical equipment, and the public address system during operation. The Turkey Point site is located on 9,460 ac in unincorporated southeast Miami-Dade County, Florida, approximately 25 mi south of Miami, 8 mi east of Florida City, 9 mi southeast of the City of Homestead, and bordered by Biscayne Bay to the east (FPL 2014-TN4058). There are no residential areas or public roads on the Turkey Point site. The rural surroundings and enclosure of noise-generating equipment in facilities help to mitigate onsite noise perceived by offsite receptors.

An ambient noise-monitoring survey was performed in June 2008 to assess the existing ambient noise in areas adjacent to the current Turkey Point units (FPL 2014-TN4058). Monitoring sites were chosen to characterize the noise levels at or near a variety of locations. These locations are depicted in Figure 2.7-16 of FPL's ER (FPL 2014-TN4058) and in a baseline noise study report (FPL 2009-TN1246). The locations are identified below by a location description, the distance and direction from Unit 1 (not the proposed units), and the site code used in the noise study:

- Onsite, next to Unit 5, northwest, sites S2 and S3
- Site boundaries, 1.3 and 1 mi north, sites S4 and S5
- Day-care facility, 1.6 mi northwest, site S6
- Homestead Bayfront Park entrance, 2.1 mi north, site S7
- Nearest permanent private residence, 3.6 mi northwest, site S8
- Homestead-Miami Speedway, 5 mi west-northwest, site S1.

Distances from the proposed Units 6 and 7 will differ from distances from the existing units, as described in Section 4.8. Also, note that the site boundaries used for the noise survey (1.3 and 1 mi north; sites S4 and S5) differ from the boundaries used for air quality in Section 2.10.1.1 and illustrated in Figure 2-43 (0.35 mi south-southeast and 1.6 mi north) for two reasons. First, the shorter distance noted for air quality (0.35 mi) is for the physically closest boundary to the proposed units, which borders Biscayne Bay to the south-southeast where there are no residences currently and likely none in the future, while for the noise survey the receptors are the potential nearest future residences north of the site on the other side of the existing units. Second, the longer distance noted for air quality (1.6 mi north) is measured from the center of the area that would be used for proposed Units 6 and 7, while the two baseline noise survey site boundaries (S4 and S5) are measured from Unit 1 (an existing unit). In other words, this latter location for noise (S5), at 1 mi north of the existing site, is the same location as the longer air-quality distance, at 1.6 mi north of the proposed site. This location also is considered the nearest site boundary at which a future residence could reasonably be expected to be located.

Section 5.3.4 of NUREG–1555 (NRC 2000-TN614) notes that, based on U.S. Department of Housing and Urban Development (HUD) regulations for exterior noise standards (24 CFR 51.101(a)(8)) (TN1016), no further analysis is needed if the L_{dn} is below 60 to 65 dBA. While the noise survey did not calculate an L_{dn} for each of the sites noted above, it did measure both daytime and nighttime averages (L_{eq}s), which can be used to approximate the L_{dn}, as described below.

The baseline daytime L_{eq} measurements for the monitoring locations within and adjacent to the Turkey Point site boundary ranged from a low of 44 dBA to a high of 67.6 dBA, depending on the site, while the nighttime L_{eq} measurements for these sites ranged from a low of 47 dBA to a high of 67 dBA. These monitoring sites are closest to Unit 5, which had an audible contribution. Also contributing to the observed sound levels were transient noise sources such as traffic, birds, insects, and wind.

The baseline daytime L_{eq} measurements for the monitoring locations beyond the site boundary ranged from a low of 46 dBA to a high of 67 dBA. The contributing audible noise sources to the highest observed noise levels the nearest residence were transient noises that included traffic, birds, insects, and wind. The nighttime L_{eq} measurements beyond the site boundary ranged from a low of 41 dBA to a high of 56 dBA. The contributing audible noise sources to the highest observed noise levels were transient noises that included insects, wind noise, and traffic.

The baseline noise report indicates that audible sound from the Turkey Point site does not reach the current nearest residences (the transient residences in Homestead Bayfront Park, 2.1 mi north of Unit 1, near site S7) and the nearest permanent private residence (3.6 mi northwest of Unit 1, site S8). A residence could be assumed to be located in the future at the Turkey Point boundary (1.3 mi north of the existing units, or 1.6 mi north of the proposed units, site S5). The two daytime average L_{eq}s for this location are 43.9 and 44.3 dBA. The two nighttime average L_{eq}s are 47.3 and 48.5 dBA. Adding 10 dBA to the nighttime L_{eq}s as described above and averaging all values (after converting the values to linear sound pressure level values) results in an L_{dn} of approximately 55.1 dBA, which is less than the 60 to 65 dBA acceptance range noted above.

Occasional activities associated with current operations at the Turkey Point site would have peak noise levels in the range of 100 to 110 dBA. As illustrated in Table 2-60, noise strongly lessens with distance. A decrease of 10 dBA in noise level is generally perceived as cutting the loudness in half. At a distance of 50 ft from the source, these peak noise levels would generally decrease to the 80 to 95 dBA range and at distance of 400 ft, the peak noise levels would generally be in the 60 to 80 dBA range. For context, the sound intensity of a quiet office is 50 dBA, normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA (Tipler and Mosca 2008-TN1467).

Table 2-60. Construction Noise Sources and Attenuation with Distance

Source	Noise Level (dBa) (peak)	Noise Level (dBa) Distance from Source			
		50 ft	100 ft	200 ft	400 ft
Heavy trucks	95	84-89	78-83	72-77	66-71
Dump trucks	108	88	82	76	70
Concrete mixer	105	85	79	73	67
Jackhammer	108	88	82	76	70
Scraper	93	80-89	74-82	68-77	60-71
Dozer	107	87-102	81-96	75-90	69-84
Generator	96	76	70	64	58
Crane	104	75-88	69-82	63-76	55-70
Loader	104	73-86	67-80	61-74	55-68
Grader	108	88-91	82-85	76-79	70-73
Dragline	105	85	79	73	67
Pile driver	105	95	89	83	77
Forklift	100	95	89	83	77

Source: Golden et al. 1979-TN3873

In addition to the HUD noise level described above, regulations governing noise associated with the activities at the Turkey Point site are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 (TN654), *Occupational Health and Safety Standards*, and 40 CFR Part 204 (TN653), *Noise Emission Standards for Construction Equipment*. The regulations in 29 CFR Part 1910 (TN654) address noise exposure in the construction environment, and the regulations in 40 CFR Part 204 (TN653) generally govern the noise levels of compressors. Turkey Point would be covered by Section 21-28 of the Miami-Dade County Code of Ordinances ("Noises; unnecessary and excessive prohibited"), although based on the L_{dn} assessment above, noise levels at the nearest receptors would not trigger this ordinance (Miami-Dade Code of Ordinances 21-28-TN1017). The State of Florida does not have noise regulations covering rural areas that would be applicable to the Turkey Point site.

2.10.3 Transportation

The transportation network surrounding the Turkey Point site is shown in Figure 2-6 and Figure 2-36. This network includes U.S. and Interstate highways, multilane divided State highways, local streets, rail service, airports, and waterways. This network is summarized below and is described in more detail in Section 2.5.2.3.

The major Federal highways in Miami-Dade County are US-1, which bisects the county from north to south and continues south to the Florida Keys, and I-75 and I-95, which also have a north-south direction but terminate in Miami. Two of the major State highways in Miami-Dade County are Florida's Turnpike and SR-997. Florida's Turnpike is a multilane, divided toll road that traverses much of Florida, linking I-75 in the interior south of Ocala to Miami. The Homestead extension of Florida's Turnpike terminates at US-1 north of Florida City. SR-997 connects US-1 in Homestead with US-27, which fringes the western edge of metropolitan Miami and terminates in Homestead, becoming Krome Avenue. Krome Avenue continues south and terminates at US-1 south of Florida City.

The existing access road for the Turkey Point site is SW 344th Street/Palm Drive. SW 344th Street/Palm Drive intersects US-1 and SR-997. It is a four-lane road that narrows at its intersection with SW 137th Avenue/Tallahassee Road to two lanes as it leads to the Turkey Point site. Access to the site and proposed Units 6 and 7 plant area from US-1 could also be made using SW 328th Street/North Canal Drive, which parallels SW 344th Street/Palm Drive to the north. This road is linked to SW 344th Street/Palm Drive by cross streets such as the four-lane SW 137th Avenue/Tallahassee Road and the two-lane SW 117th Avenue. Access to the site from Florida's Turnpike could be made via the exit at SW 312th Street/Campbell Drive or via the Turnpike terminus at US-1. SW 312th Street/Campbell Drive is a four-lane road that parallels SW 344th Street/Palm Drive to the north. A connecting road is SW 137th Avenue/ Tallahassee Road. This intersection should be minimally affected by construction and operations personnel. Most personnel are expected to come from the west and south (as opposed to the north) of the Turkey Point site and only a small number would be expected to commute to/from the site via this intersection. This intersection should be minimally affected by construction and operations personnel, who are expected to come from the west and south (as opposed to from the north) of the Turkey Point site.

Rail passenger service is provided to Miami by Amtrak and TRI-Rail; both have service to connecting rail lines across the United States. Neither rail service travels to locations south of Miami. Rail freight service in Miami-Dade County is provided by CSX operating Class 1 rail lines. The CSX line services the Port of Miami and has an intermodal terminal in Miami. The rail line terminates in Homestead. The nearest rail crossing to Turkey Point is at SW 320th Street and is approximately 11 roadway mi to the plant entrance. There are no rail systems within 5 mi of the Turkey Point site.

An equipment barge-unloading area exists at the Turkey Point site and is accessed via the waterway to receive shipments of oil and equipment.

2.10.4 Electromagnetic Fields

As described in Section 2.2.2, eight 230 kV transmission lines currently connect the existing Turkey Point units to the transmission system by way of two corridors, one proceeding to the north and one to the west. Transmission lines generate both electric and magnetic fields, referred to collectively as electromagnetic field (EMF) (NRC 2013-TN2654). Public and worker health can be compromised by acute and chronic exposure to EMF from power transmission systems, including switching stations (or substations) onsite and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of

60 Hz (60 cycles per second), which is referred to as extremely low frequency. In comparison, television transmitters have frequencies of 55 to 890 MHz and microwaves have frequencies of 1,000 MHz and greater (NRC 2013-TN2654).

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines. Objects near transmission lines can become electrically charged by close proximity to the electric field of the line. An induced current can be generated in such cases, where the current can flow from the line through the object into the ground. Capacitive charges can occur in objects that are in the electric field of a line, storing the electric charge, but isolated from the ground. A person standing on the ground can receive an electric shock by coming into contact with such an object because of the sudden discharge of the capacitive charge through the person's body to the ground. Such acute effects are controlled and minimized by conformance with National Electrical Safety Code criteria and adherence to the standards for transmission systems regulated by the FDEP (Fla. Admin. Code 62-814 2008-TN644).

Long-term or chronic exposure to power transmission lines has been studied for a number of years. These health effects were evaluated in NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 2013-TN2654) for nuclear power in the United States, and are discussed in the ER (FPL 2014-TN4058). The GEIS reviewed human health and EMF and concluded:

The chronic effects of EMFs associated with nuclear plants and associated transmission lines are uncertain. Studies of 60 Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and longer-term effects, if real, are subtle. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible.

2.11 Radiological Environment

Turkey Point Unit 3 began operation in 1972 and Unit 4 in 1973. FPL has conducted a Radiological Environmental Monitoring Program (REMP) around the Turkey Point site since 1969 (AEC 1972-TN999). The NRC published in the *Federal Register* on April 3, 2012, a final Environmental Assessment and Finding of No Significant Impact (77 FR 20059) (TN1001) and on June 15, 2012 the final approval of the licensing amendments for the approximately 15 percent extended power uprates of Turkey Point Units 3 and 4 (NRC 2012-TN1438). In addition to the REMP and the Offsite Dose Calculation Manual (ODCM) description in the Annual Radiological Effluent Release Report, ODCM Appendix A discusses a supplemental REMP sampling program agreed-upon by the State of Florida Department of Health and FPL to address the extended power uprates. This supplemental sampling program is being performed to provide additional data for the REMP (FPL 2011-TN119). The sampling under this supplemental program provides additional data, including data from sampling in the discharge canal.

The American crocodile inhabits the CCS used by Turkey Point Units 3 and 4. Units 3 and 4 discharge radioactive liquid effluent to the CCS, thus exposing the crocodiles to this effluent. In addition, the crocodiles are exposed to gaseous radioactive effluents from Turkey Point Units 3 and 4. The exposure pathways for the radiological effluents from Turkey Point Units 6 and 7 are discussed in Section 5.9. The cumulative radiological impacts are discussed in Section 7.8.

Currently, radiological releases are summarized in the annual reports entitled *Turkey Point, Units 3 and 4, Annual Radioactive Effluent Release Report* and *Turkey Point, Units 3 and 4, Annual Radiological Environmental Operating Report*. The limits for all radiological releases are specified in the Turkey Point ODCM, and these limits are designed to meet Federal standards and requirements. The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment), atmospheric environment (airborne radioiodine, gross beta, and gamma), terrestrial environment (vegetation), and direct radiation. The NRC staff reviewed these annual reports for calendar years 2002 through 2015.(10) These reports show that doses to individuals around the Turkey Point site were a small fraction of the limits specified in Federal environmental radiation standards (10 CFR Part 20 [TN283], 10 CFR Part 50, Appendix I [TN249], and 40 CFR Part 190 [TN739]).

FPL is also undertaking a groundwater monitoring program as delineated in the *FPL Turkey Point Power Plant Groundwater, Surface Water, and Ecological Monitoring Plan* (SFWMD 2009-TN149). In this plan, FPL commits to monitoring tritium as a “tracer suite” for tracking the movement of CCS plume. In Section 2.2.1 of the plan, the SFWMD states:

> “The FDEP’s drinking water standard for concentrations of tritium in groundwater is 20,000 pCi/L. The Agencies and FPL recognize that the concentrations of tritium from the CCS water are expected to fall below the regulatory standard used to identify the potential for human health concerns. Accordingly it is mutually understood tritium is being monitored only as a potential tracer for identifying contributions of CCS water as a source. According to the FDEP, pursuant to Chapter 62-520 and 62-550, F.A.C., the presence of tritium below 20,000 pCi/L in water does not represent a public health and safety issue.”

The NRC’s Lessons Learned Task Force Report (NRC 2006-TN1000) made recommendations regarding potential unmonitored groundwater contamination at U.S. nuclear plants. In response to that report, FPL began additional groundwater sampling in various onsite locations that may be sources of groundwater contamination around the Turkey Point site. The ODCM discusses the groundwater sampling program for tritium (FPL 2011-TN119). However, a drinking water pathway does not exist from groundwater at the Turkey Point site (FPL 2009-TN100).

As discussed in Section 2.3, a sampling site from a deep excavation location, once part of a canal but now isolated from the CCS, in the Biscayne Bay bottom has measured tritium concentrations greater than 4,000 pCi/L (Miami-Dade County 2016-TN4510). As stated above,

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(10) (FPL 2003-TN1380; FPL 2003-TN1380; FPL 2004-TN1381; FPL 2005-TN1382; FPL 2006-TN1383; FPL 2007-TN1384; FPL 2008-TN1385; FPL 2009-TN100; FPL 2010-TN1388; FPL 2011-TN119; FPL 2012-TN1389; FPL 2013-TN2578; FPL 2014-TN3662; FPL 2015-TN4407; FPL 2016-TN4617 and FPL 2003-TN1369; FPL 2003-TN1370, Rev 1.; FPL 2004-TN1371; FPL 2005-TN1372; FPL 2006-TN1373; FPL 2007-TN1375; FPL 2008-TN1376; FPL 2008-TN1377, Rev 1; FPL 2009-TN101; FPL 2010-TN1378; FPL 2011-TN267; FPL 2012-TN1379; FPL 2013-TN2579; FPL 2014-TN3661; FPL 2015-TN4408; FPL 2016-TN4618).

tritium in the CCS water acts as a tracer to indicate the movement of the CCS water. In addition, as previously stated, the EPA drinking water standard sets a maximum tritium limit of 20,000 pCi/L. Thus, this concentration measurement of tritium does not present a safety or health issue.

2.12 Related Federal Projects and Consultation

The staff reviewed the possibility that activities of other Federal agencies might affect the issuance of COLs to FPL. Any such activities could result in cumulative environmental impacts and the possible need for another Federal agency to become a cooperating agency for preparation of the EIS (10 CFR 51.10(b)(2) [TN250]). As discussed in Chapter 1, the USACE and the NPS are cooperating agencies in the preparation of this EIS.

The CERP is a congressionally approved long-term Federal effort to restore the Everglades and South Florida ecosystem. The plan is supported by Federal, State, Tribal, and local government agencies, including the USACE and the SFWMD. The goal of CERP is to capture, store, and redirect freshwater for environmental restoration of the entire Everglades ecosystem (USACE 2010-TN113).

Federal lands within a 50 mi radius of the Turkey Point site include Biscayne National Park, Everglades National Park, FKNMS (Florida Keys National Marine Sanctuary), Crocodile Lake National Wildlife Refuge, and Big Cypress National Preserve.

Several state parks exist within the 50 mi radius, including Dagny Johnson Key Largo Hammock Botanical State Park, The Barnacle Historic State Park, Bill Baggs Cape Florida State Park, John Pennekamp Coral Reef State Park, Lignumvitae Key Botanical State Park, San Pedro Underwater Archaeological Preserve State Park, Indian Key Historic State Park, Windley Key Fossil Reef Geological State Park, Oleta River State Park, and John U. Lloyd Beach State Park.

The Tribal reservation for the Federally recognized Seminole Tribe of Florida Reservation in Hollywood, Broward County, is within 50 mi of the Turkey Point site. Four Miccosukee Indian reservations—Tamiami Trail (Miami-Dade County), Alligator Alley (Broward County), and two at Krome Avenue (Miami-Dade County)—also lie within 50 mi of the site. Under Section 102(2)(C) of NEPA, the NRC is required to “consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved.” During the course of preparing this EIS, the NRC consulted with various Federal, State, and local agencies and Tribal contacts. Appendix F provides a list of consultation correspondence.

3.0 SITE LAYOUT AND PLANT DESCRIPTION

The site of proposed Turkey Point Nuclear Power Plant (Turkey Point) Units 6 and 7 is located in Miami-Dade County, Florida, approximately 25 mi south of Miami. Florida Power & Light Company (FPL) applied to the U.S. Nuclear Regulatory Commission (NRC) for combined construction permits and operating licenses (COLs) for proposed Turkey Point Units 6 and 7. FPL has also applied for a Department of the Army authorization to conduct activities that result in alteration of waters of the United States, including jurisdictional wetlands.

This chapter describes the key characteristics of the proposed plant that are used to assess the environmental impacts of the proposed action; the information is drawn primarily from FPL's Environmental Report (ER) (FPL 2014-TN4058), its Final Safety Analysis Report (FSAR) (FPL 2015-TN4502), and supplemental documentation from FPL (FPL 2010-TN272; FPL 2011-TN42; FPL 2011-TN303; FPL 2011-TN495; FPL 2012-TN2582). The supplemental documentation consists primarily of responses to NRC requests for additional information, FPL's Site Certification Application (SCA) to the State of Florida, and SCA amendments and responses to comments. As noted in Chapter 1 of this environmental impact statement (EIS), the State of Florida approved FPL's SCA, subject to final Conditions of Certification, on May 19, 2014 (State of Florida 2014-TN3637).

Whereas Chapter 2 of this EIS describes the existing environment at the proposed site and its vicinity, this chapter describes the physical aspects of the proposed nuclear plants. This chapter also describes the physical activities involved in building and operating the plants. The environmental impacts of building and operating the plants are discussed in Chapters 4 and 5, respectively. This chapter is divided into four sections. The external appearance and layout of the proposed plants are described in Section 3.1. The major plant structures are described in Section 3.2, and those structures that routinely interface with the environment are distinguished from those that minimally interface with the environment, or that interface temporarily with the environment. Activities involved in building or installing each of the plant structures are described in Section 3.3. Operational activities of the plant that interface with the environment are described in Section 3.4.

3.1 External Appearance and Plant Layout

The 9,460 ac Turkey Point site currently contains five power-generating stations. Units 1 and 2 are 400 MW(e) natural-gas/oil steam electrical generating units. Unit 1 has been in service since 1967; FPL plans to convert it to operate as a synchronous condenser in late 2016. Synchronous condenser mode provides voltage stability for the regional transmission system, but it does not provide electrical generation capacity. Unit 2 was placed in service in 1968; it has already been converted to operate in synchronous condenser mode (FPL 2016-TN4579). Two pressurized water reactors and associated facilities (Units 3 and 4) are located on the site. Unit 3 has been in service since 1972 and Unit 4 has been in service since 1973. The NRC approved a power uprate for Units 3 and 4 that was completed by FPL in 2013 (NRC 2012-TN1438; FPL 2014-TN3360). The net power output of Units 3 and 4 together increased from a nominal 1,400 MW(e) to 1,632 MW(e) as a result of the uprate (FPL 2000-TN3947; FPL 2014-TN3360). Unit 5 is a natural-gas combined-cycle unit rated to produce 1,150 MW(e); it began operating in 2007. These existing units occupy approximately 195 ac. Units 3 and 4 on the Turkey Point site rely on a system of canals, which occupy approximately 5,900 ac on the Turkey Point site, to provide cooling during operation (Figure 3-1). The canals are used as a closed-loop cooling system, and they are permitted as an industrial wastewater facility (FPL 2014-TN4058). Mechanical draft cooling towers are used to dissipate heat from Unit 5. Water from the Upper Floridan aquifer is withdrawn to provide makeup water to Unit 5. Blowdown water from the cooling towers is sent to the cooling canals of the industrial wastewater facility (FPL 2014-TN4058).

Proposed Turkey Point Units 6 and 7 would be located on the Turkey Point site directly south of the existing units (Figure 3-1). The site would be extensively modified to raise the land surface from its current elevation of approximately 1 ft North American Vertical Datum 1988 (NAVD88) (Zilkoski et al. 1992-TN1232) to the building floor elevation for the proposed reactors of 26 ft NAVD88 (FPL 2015-TN4502). The finished grade elevation would be slightly lower at 25.5 ft NAVD88 (FPL 2015-TN4502). The center lines for the power blocks of the two units would be separated by 850 ft (FPL 2015-TN4502).

All systems and structures directly supporting power generation by proposed Turkey Point Units 6 and 7 would be built as new independent facilities, including a separate cooling system and a separate substation (Clear Sky) to connect Units 6 and 7 to the existing Turkey Point substation. The proposed Units 6 and 7 would not use the existing industrial wastewater facility cooling canals for plant cooling. The proposed new facilities would also include nuclear administration and training buildings, parking areas, an expanded equipment barge-unloading area, and security buildings (FPL 2014-TN4058).

The proposed reactor design for Turkey Point Units 6 and 7 is the AP1000 pressurized water reactor. FPL proposed a closed-cycle wet-cooling system for both the circulating-water system (CWS) and the service-water system (SWS). Reclaimed water from the Miami-Dade Water and Sewer Department (MDWASD) would supply makeup water for the CWS. When reclaimed water is not available in sufficient quantity or quality, CWS makeup water would be saltwater pumped from radial collector wells in the subsurface sediment of Biscayne Bay. MDWASD would also supply potable water for the SWS as well as other plant systems (demineralized water, fire protection, sanitary, and other miscellaneous water uses) (FPL 2014-TN4058). FPL proposed that liquid effluents would be discharged to a deep aquifer via onsite injection wells.

The AP1000 reactor design does not rely on either the reclaimed water supply or the radial collector wells to shut down safely. The NRC does not require a backup water supply, such as the radial collector wells, for normal power operation. However, FPL has proposed a backup water system in its ER and it is considered part of the proposed project.

The containment vessel, shield building, and auxiliary building make up the “nuclear island,” which is one of five principal structures of the standard Westinghouse Electric Company, LLC (Westinghouse 2011-TN261) AP1000 pressurized water nuclear power reactor proposed for Turkey Point Units 6 and 7. The other four principal structures of an AP1000 unit are the turbine, diesel-generator, radwaste, and annex buildings. The footprint area of each new unit is adjacent to, but separate from, the other. The area to be used for the proposed two power-generating units, including cooling towers, makeup water reservoir, switchyard, and associated facilities, is approximately 218 ac. Each new reactor unit would be supported by three mechanical draft cooling towers, each approximately 67 ft high and 246 ft in diameter. A conceptualization of proposed Turkey Point Units 6 and 7 superimposed on the site is shown in Figure 3-2.

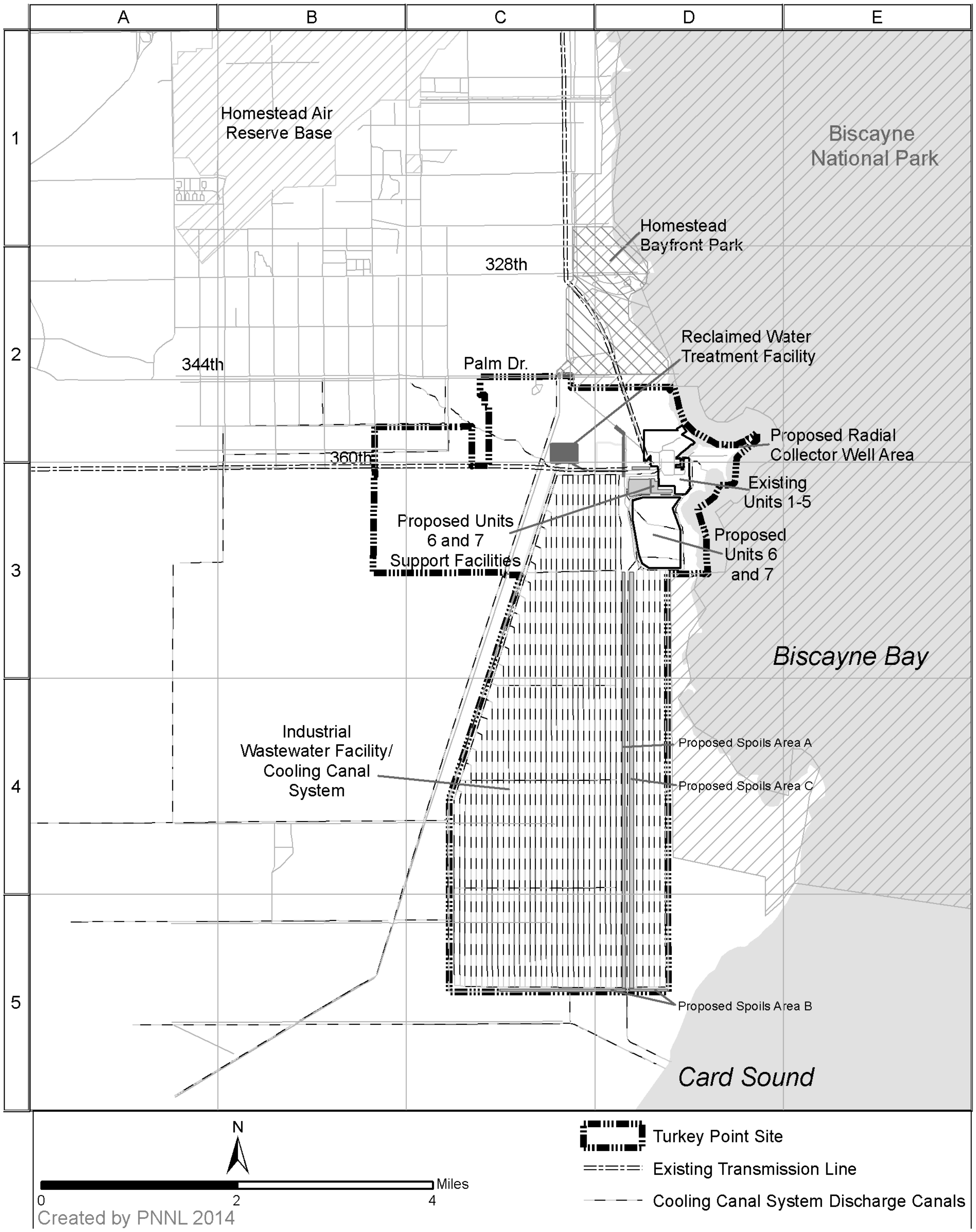

Figure 3-1. Location of Proposed Units 6 and 7 on the Turkey Point Site

Figure 3-2. Conceptualization of Proposed Units 6 and 7 Superimposed on the Turkey Point Site (FPL 2014-TN4058)

3.2 Proposed Plant Structures

This section describes each of the major plant structures: the reactor power system, structures that would interface with the environment during operation, and the balance of plant structures. In Chapter 4, all plant structures needed for operation are considered in the assessment of impacts of activities related to building and installing those structures. Only the structures that interface with the environment are relevant to the operational impacts discussed in Chapter 5.

3.2.1 Reactor Power-Conversion System

FPL has proposed building and operating two Westinghouse AP1000 reactor steam electric generating units at the Turkey Point site. An applicant or licensee intending to construct and operate a plant based on the AP1000 standard design may do so by referencing the rule certifying that design, which is set forth in Appendix D of Title 10 of the *Code of Federal Regulations* (CFR) Part 52 (TN251). As mentioned in Section 1.1.5 of this EIS, the standard Design Control Document (DCD) for the AP1000 standard reactor design referenced in the application is DCD Revision 19 (Westinghouse 2011-TN261), which amends the standard AP1000 DCD previously incorporated into 10 CFR Part 52, Appendix D (DCD Revision 15) (71 FR 4464) (TN258). NRC issued the design certification amendment final rule, based on Revision 19 of the DCD, in the *Federal Register* on December 30, 2011 (76 FR 82079) (TN248). DCD amendment review documents are available at http://www.nrc.gov/reactors/new-reactors/design-cert/amended-ap1000.html.

Figure 3-3 is an illustration of the reactor power-conversion system. Each AP1000 reactor is connected to two steam generators that transfer heat from the reactor core, converting feed water to steam that drives high-pressure and low-pressure turbines, thereby creating electricity. Steam that has passed through the turbines is condensed back to water that is heated and pumped back to the steam generators, repeating the cycle. The AP1000 design has a thermal power rating of 3,400 MW(t), and a design gross-electrical output of approximately 1,200 MW(e). The estimated station and auxiliary service load is 108 MW(e) for each proposed new unit at the Turkey Point site, for a net electrical output of 1,092 MW(e) per unit (FPL 2014-TN4058).

3.2.2 Structures with a Major Environmental Interface

The review team (the NRC staff, its contractor staff, and USACE staff who reviewed the ER and determined impact levels) divided the plant structures into two primary groups: (1) those that interface with the environment and (2) those that are internal to the reactor and associated facilities but do not take material from or release material to the environment outside the facilities. Examples of environmental interfaces are withdrawal of water from the environment at radial collector wells, release of water to the environment through deep-injection wells, and release of excess heat to the atmosphere. The interaction of structures with the environment are considered in the review team's assessment of the environmental impacts of facility construction and preconstruction, and facility operation in Chapters 4 and 5, respectively. The power-production processes that would occur within the plant itself and that do not affect the environment are not discussed further in this EIS because they are not relevant to a review under the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4321 et seq.) (TN661). However, such internal processes are considered in the Westinghouse AP1000 design certification documentation and in NRC safety reviews of the FPL COL application. This section describes only those structures that have a significant plant-environment interface.

The remaining structures are discussed in Section 3.2.3, to the extent that they may be relevant to the review team's consideration of construction and preconstruction impacts in Chapter 4. Figure 3-4 illustrates the Turkey Point site layout with a grid overlay to reference the locations of various plant structures and activity areas as they are described in the following sections.

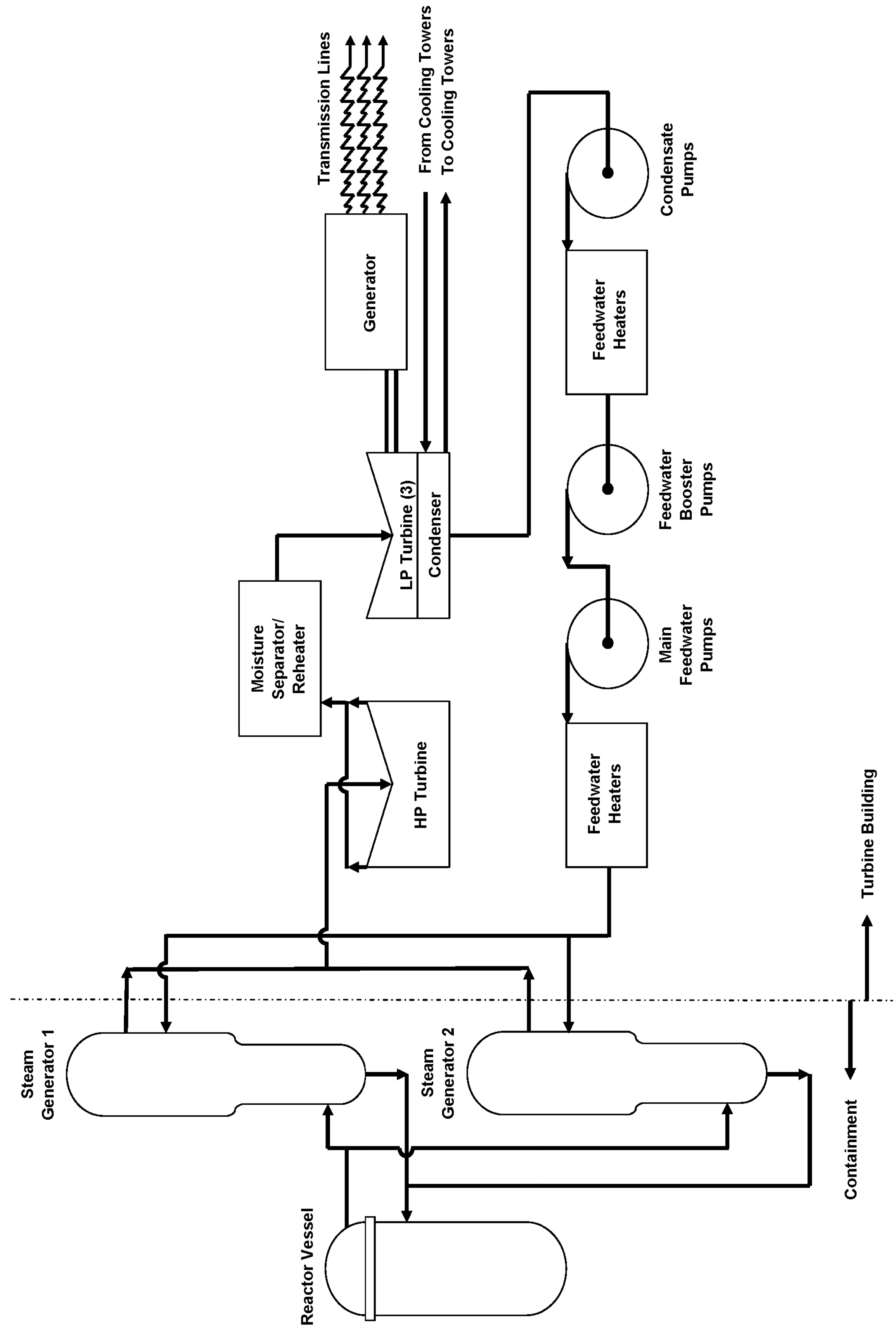

Figure 3-3. AP1000 Power-Conversion Diagram (FPL 2014-TN4058)

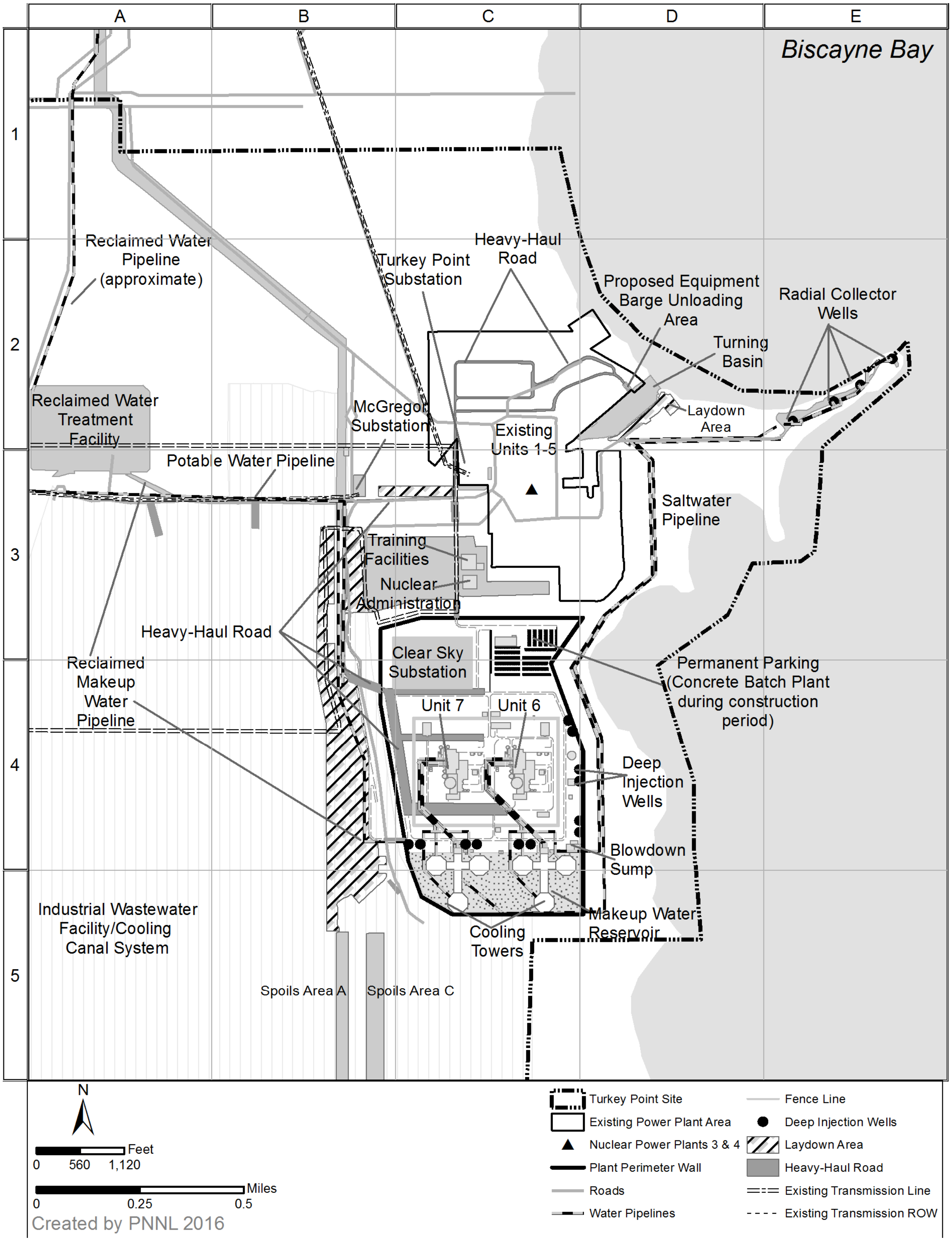

Figure 3-4. Site Layout for Proposed Turkey Point Units 6 and 7 and Associated Facilities

3.2.2.1 Landscape and Stormwater Drainage

Landscaping and the stormwater-drainage system would affect the recharge to the subsurface and the rate and location at which precipitation drains into adjacent waterbodies. Impervious surfaces hamper recharge to aquifers beneath the site.

As illustrated in Figure 3-4, the new reactor units, including cooling towers, makeup water reservoir, new substation, and associated facilities, would be built on a filled "island" enclosed by a stabilized earth perimeter wall on the north, east, and west sides and a reinforced concrete wall on the south side. The elevation of the top of the retaining wall would be 20 ft NAVD88 on the north, 21.5 ft on the east and west, and 24 ft on the south side where the wall encloses the makeup water reservoir. Within the filled portion of the perimeter wall, the ground surface would be raised to approximately 26 ft NAVD88 to meet the design requirements for the elevation of the AP1000 units, and would slope away from the reactor buildings to an elevation of 19 ft NAVD88 at the perimeter retaining wall. The modified ground surface and surrounding areas (about 162 ac) would be graded to direct stormwater runoff to catch basins, storm drains, or swales. The makeup water reservoir is not included in the runoff area because it is designed to retain up to 18 in. of precipitation. Stormwater from the main plant area would then be released to the canals of the adjacent existing industrial wastewater facility. Stormwater runoff from the laydown area west of the main plant area (about 46 ac) and from the administration and training buildings and parking lot north of the main plant area (about 32 ac) would also drain into the industrial wastewater facility (FPL 2014-TN4058; FPL 2015-TN4502; FPL 2011-TN303; FPL 2011-TN495).

The approximately 44 ac area of the reclaimed water-treatment facility would have a separate stormwater-management system. Because the treatment facility would be built on an area raised by fill to an elevation of about 14 ft NAVD88, the raised area would be graded and paved to direct stormwater to one of two retention ponds built on the raised area. The retention ponds would have the capacity to retain the first inch of precipitation and associated sediment. The retention pond outlets would drain over riprap aprons to the surrounding wetlands; each pond would also have an emergency spillway that would also drain over a riprap apron to the surrounding wetlands (FPL 2014-TN4058; FPL 2012-TN2582; FPL 2011-TN303; FPL 2011-TN495).

3.2.2.2 Cooling System

The cooling system generally represents the largest interface between a nuclear plant and the environment. Cooling water is typically obtained from a surface-water source, heat in the cooling water is typically rejected to the atmosphere, and blowdown and liquid effluents are typically discharged to the environment. For the proposed Turkey Point Units 6 and 7, FPL's primary source of cooling water would be reclaimed water from the MDWASD. However, because reclaimed water supply can vary in quantity and quality, the secondary source of cooling water would be saltwater extracted from Biscayne Bay subsurface sediment through radial collector wells built on the Turkey Point peninsula, east of the existing units (Figure 3-4, grid reference E2). FPL describes its approach to managing cooling-water supplies in the following way:

> Reclaimed water from the Miami-Dade Water and Sewer Department (MDWASD) would supply makeup water for the circulating-water system of Units 6 & 7. When reclaimed water cannot supply the quantity and/or quality of water needed for the circulating-water system, additional makeup water would be saltwater supplied from radial collector wells. The circulating-water system would be designed to accommodate 100 percent supply from reclaimed water, saltwater, or a combination of the two sources. The ratio of water supplied by the two makeup water sources would vary based on the availability of reclaimed water from the MDWASD (FPL 2014-TN4058).

A portion of the makeup water would be returned to the environment through deep-injection wells completed in the Boulder Zone (FPL 2014-TN4058). The Boulder Zone is an extremely permeable zone within a karstic fractured dolomite layer within the Lower Floridan aquifer in southeastern Florida. The Boulder Zone contains water the salinity and temperature of which is similar to modern seawater (Miller 1990-TN550). The remaining portion of the water would be released to the atmosphere via evaporative cooling through mechanical draft cooling towers. This section describes the components of the proposed cooling system based on the information provided by FPL in its ER (FPL 2014-TN4058) and FSAR (FPL 2015-TN4502).

Cooling-Water Source Structures

Reclaimed Water Source Structures

Reclaimed water from MDWASD would be piped from the MDWASD South District Wastewater Treatment Plant to the reclaimed water-treatment facility at the Turkey Point site (FPL 2014-TN4058). The reclaimed water-treatment facility would be located west of the proposed units and occupy approximately 44 ac (Figure 3-4, grid reference A2). The reclaimed water-treatment facility would house pumps, several types of filters, and clarifiers to reduce concentrations of iron, magnesium, oil and grease, total suspended solids, nutrients, and silica in the water to prepare it for use in the CWS (FPL 2014-TN4058).

The treated reclaimed water would be stored in a makeup water reservoir occupying 37 ac immediately south of proposed Units 6 and 7 (Figure 3-4, grid reference C5). The makeup water reservoir would have reinforced concrete walls and a concrete slab floor. The walls would extend to a height of 24.0 ft NAVD88 from the slab floor elevation of -2 ft NAVD88. Water would be withdrawn as needed to provide makeup water to the cooling-tower basins for each unit.

Saltwater Source Structures (Radial Collector Wells)

The source structures for the saltwater system would be four radial collector wells located on the Turkey Point peninsula (Figure 3-4, grid reference E2). Each radial collector well would consist of a central reinforced concrete caisson with several laterals (horizontal collector lines) extending out from the caisson. The laterals would extend horizontally up to 900 ft beneath Biscayne Bay. They would be installed approximately 25 to 40 ft below the sediment surface (FPL 2014-TN4058). Plan view and cross-section schematics of a typical radial collector well are shown in Figure 3-5 and Figure 3-6, respectively. Saltwater from the radial wells would be pumped directly to the cooling-tower basins as needed to provide makeup water.

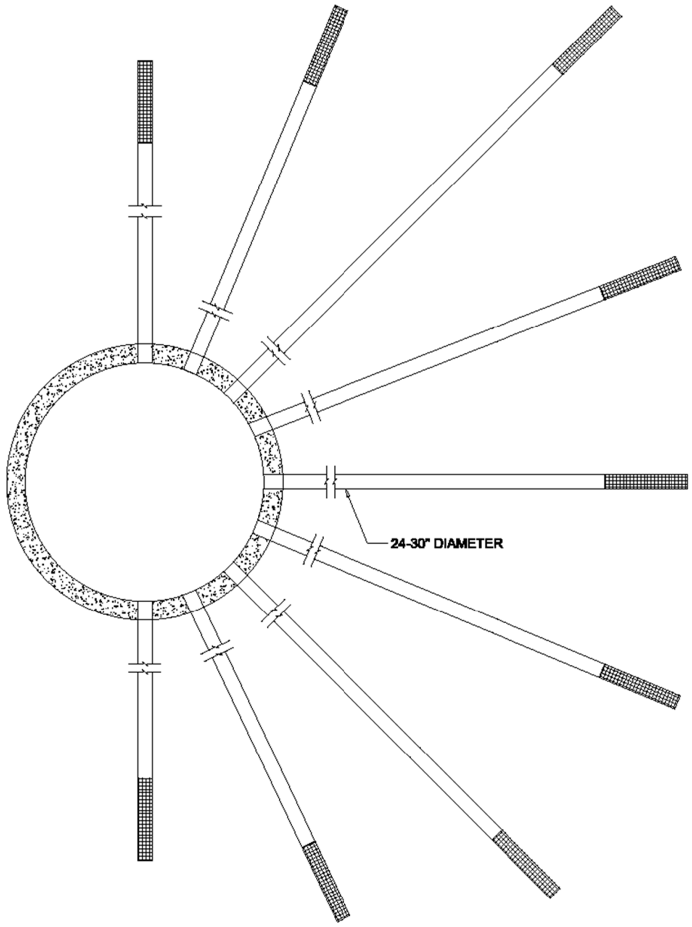

Figure 3-5. Plan View of a Typical Radial Collector Well System (FPL 2014-TN4058)

Deep-Injection Wells

Liquid effluents from proposed Turkey Point Units 6 and 7 would be transported via pipeline to deep-injection wells (FPL 2014-TN4058) and discharged to the Boulder Zone, a highly permeable geologic unit containing saltwater approximately 2,900 to 3,500 ft below grade. The deep-injection wells would be permitted by the Florida Department of Environmental Protection underground injection control program (FPL 2014-TN4058). A total of 12 deep-injection wells and 6 dual-zone monitoring wells are proposed. Six injection wells and three monitoring wells would be located along the east perimeter wall, and the other six injection wells and three monitoring wells would be located along the south wall dividing the filled area from the makeup water reservoir (Figure 3-7). Each injection well would be a 24 in. diameter steel well casing extending up to 3,500 ft below grade. A typical injection well steel casing would be lined with 18 in. diameter glass-fiber-reinforced plastic, with a nonhazardous corrosion inhibitor in the annulus between the two. The annulus would be pressurized using a positive-seal packer located at the base of the casing and the pressure would be continuously monitored for leaks during operation. Its upper section would be reinforced with additional steel casings of increasing diameter as shown in the typical injection well cross section in Figure 3-8. The monitoring wells would be installed to a depth of approximately 1,900 ft below grade in the aquifers overlying the Boulder Zone (FPL 2014-TN4058).

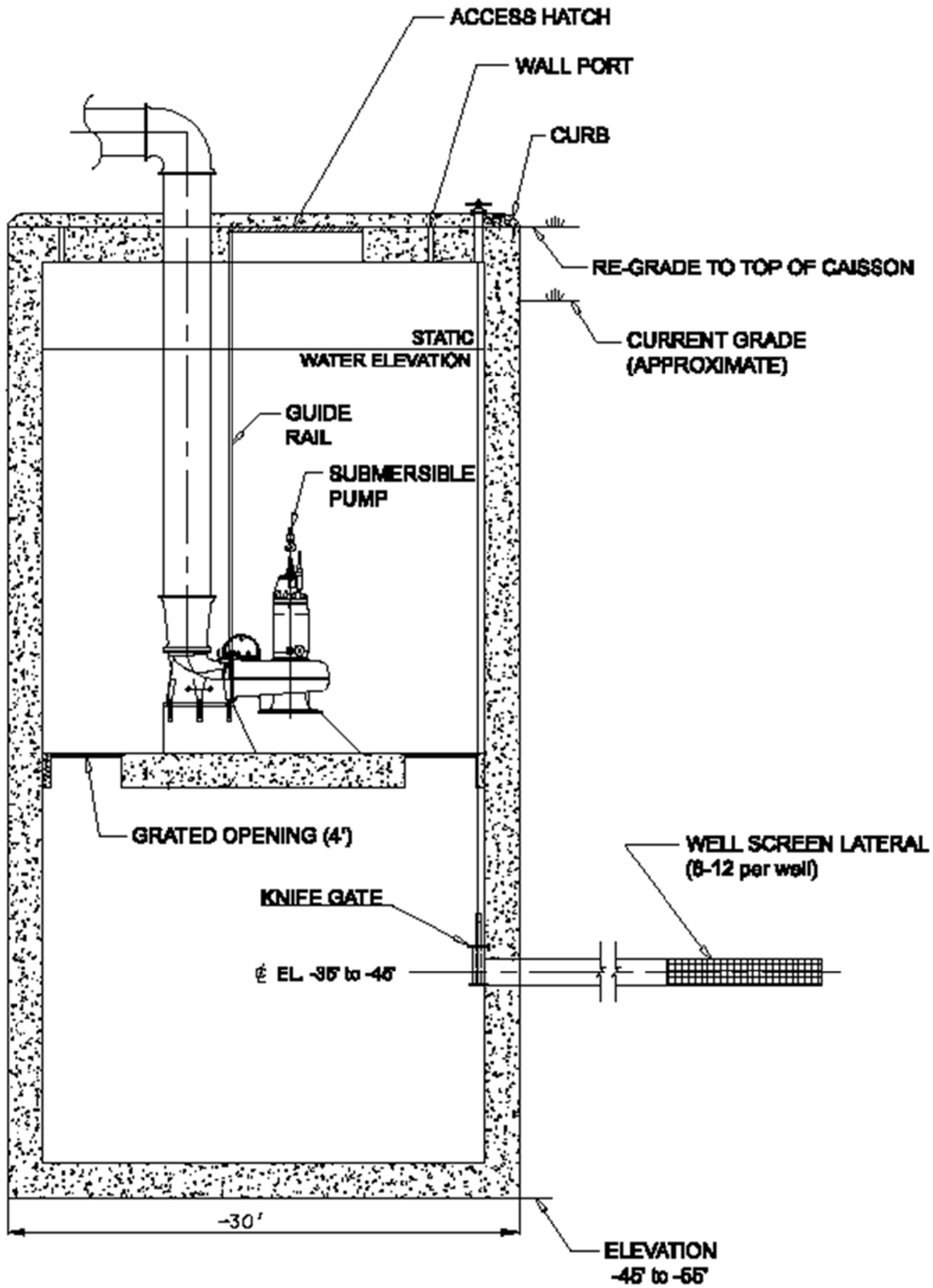

Figure 3-6. Cross-Section View of a Typical Radial Collector Well System (FPL 2014-TN4058)

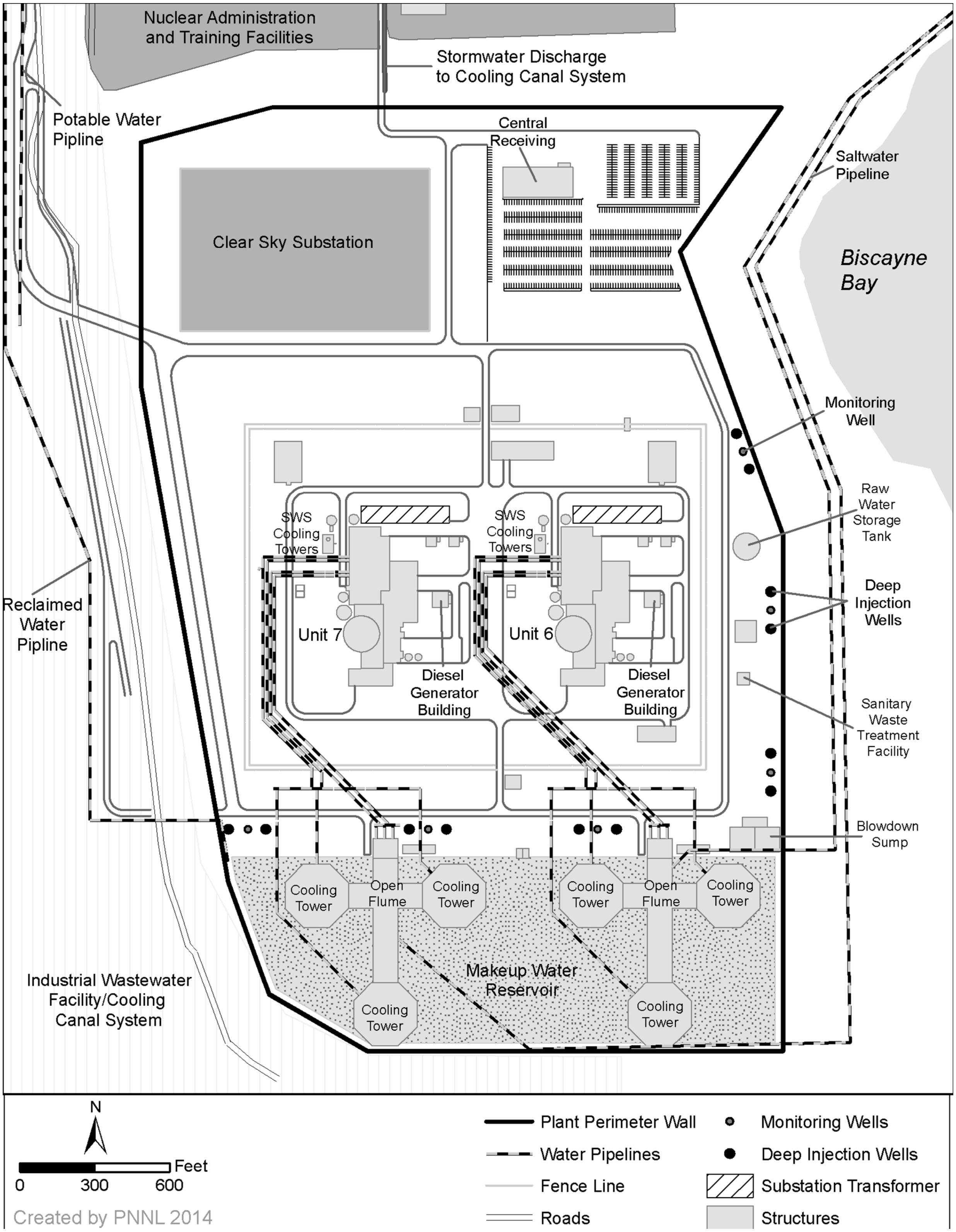

Figure 3-7. Turkey Point Proposed Units 6 and 7 Layout Detail

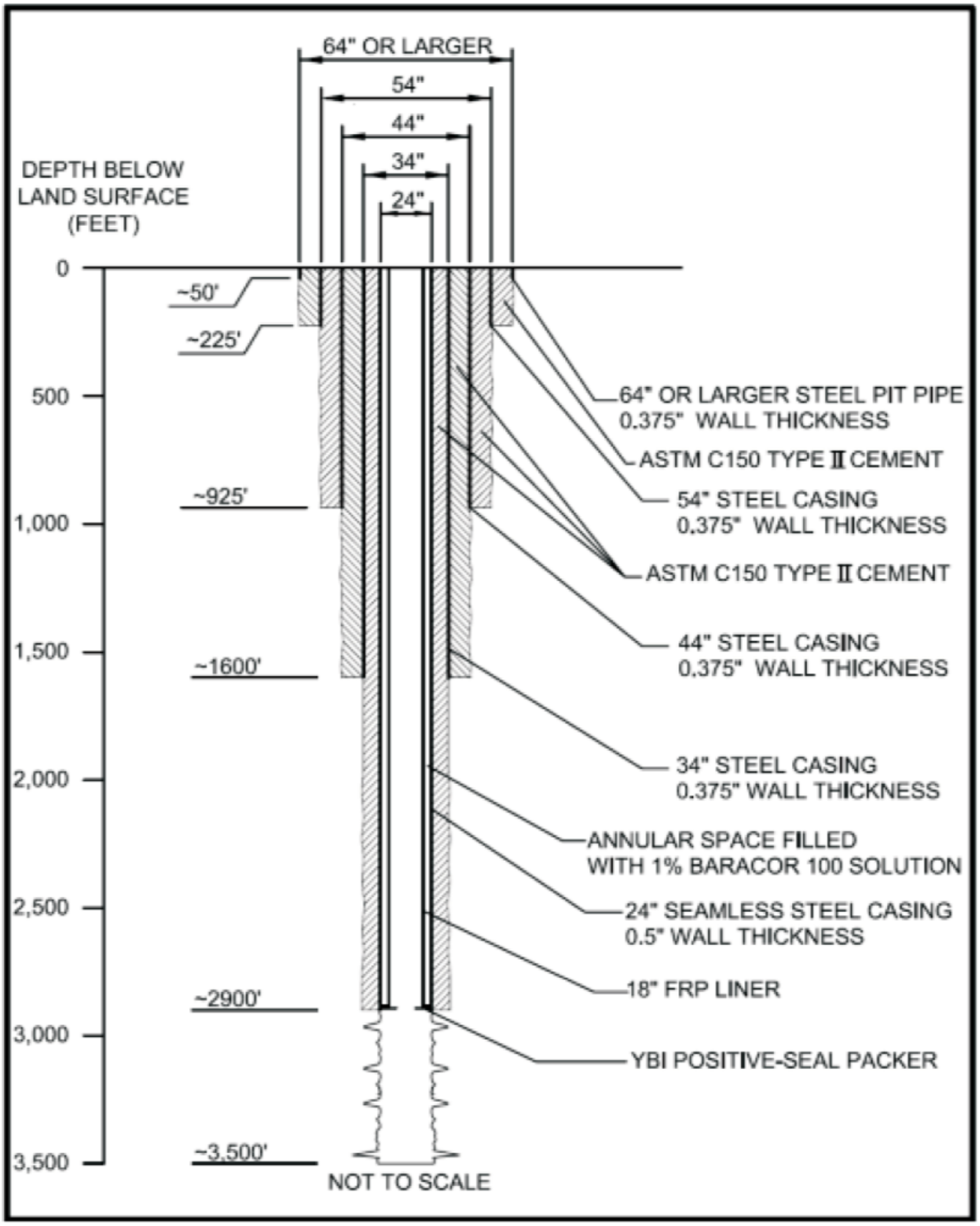

Figure 3-8. Cross-Section View of a Typical Injection Well Design (FPL 2014-TN4058)

As noted in Section 2.3.1.2, FPL drilled an exploratory well, EW-1, to determine the subsurface characteristics of the site. This well and associated dual-zone monitoring well DZMW-1 are located on a berm of the industrial wastewater facility outside and to the southwest of the main plant area for proposed Turkey Point Units 6 and 7 (FPL 2012-TN1577). FPL has obtained a permit to convert EW-1 to an operating deep-injection well for operational testing, and for later injection of construction wastewater from Units 6 and 7 (FDEP 2013-TN4784). FPL has also requested a modification to the permit to allow injection of hypersaline water pumped from proposed groundwater extraction wells for remediation of the hypersaline plume associated with the industrial wastewater facility (see Section 2.3.1.1) (FPL 2016-TN4785, FDEP 2016-TN4625, FDEP 2016-TN4787).

Cooling Towers

Proposed Turkey Point Units 6 and 7 would use closed-cycle wet-cooling towers to dissipate heat from both the CWS and the SWS. As described in Section 3.1, each unit uses three cooling towers for the CWS. The CWS cooling towers would be mechanical draft towers, octagonal in shape, approximately 67 ft high and 246 ft in diameter, with fiberglass-reinforced plastic structural members and casings (FPL 2014-TN4058). In each tower, fans would blow air across water sprayed through fine nozzles, removing heat from the water and rejecting that heat to the atmosphere. The six towers would be located south of the reactor units within the perimeter wall of the makeup water reservoir (Figure 3-7). Each new unit would also have one cooling tower for the SWS, located adjacent to the AP1000 turbine building. These would also be mechanical draft cooling towers, each divided into two cells.

3.2.2.3 Other Structures with a Permanent Environmental Interface

Many of the structures and features needed to support the proposed Units 6 and 7 would have a permanent environmental interface on or off the Turkey Point site. These include local transportation facilities, buildings, parking lots, fill source areas, spoils disposal areas, and the transmission system.

Roads

An existing road network on the Turkey Point site would provide access to and between the existing facilities. To support the building of the proposed Turkey Point Units 6 and 7, approximately 3.3 mi of existing paved roads would be improved, and approximately 7 mi of unpaved roads would be paved to provide access to the site (FPL 2010-TN272). As stated in the SCA:

> The improvements to existing paved roadways consist of widening from two lanes to four lanes the following:
>
> - SW 328th Street/North Canal Drive from SW 137th Avenue/Tallahassee Road to SW 117th Avenue (approximately 2 mi);
> - SW 344th Street/Palm Drive from SW 137th Avenue/Tallahassee Road West to SW 137th Avenue/Tallahassee Road East (approximately 0.3 mi); and
> - SW 117th Avenue from SW 328th Street/North Canal Drive to SW 344th Street/Palm Drive (approximately 1 mi).
>
> The improvements to existing unpaved roadways consist of the following:
>
> - SW 359th Street will be improved to three lanes from SW 137th Avenue/ Tallahassee Road to SW 117th Avenue; and to four lanes from SW 117th Avenue to the proposed Units 6 and 7 construction parking areas and site (approximately 5 mi). This segment will require a bridge over the L-31E Canal.

- SW 137th Avenue/Tallahassee Road will be improved to three lanes from SW 344th Street/Palm Drive south to SW 359th Street (approximately 1 mi).
- SW 117th Avenue will be improved to four lanes from SW 344th Street/Palm Drive south to SW 359th Street (approximately 1 mi) (FPL 2010-TN272).

In addition, a heavy-haul road would be created between the barge-unloading facility and the building site, which would disturb approximately 5 ac. The heavy-haul road would be 2 mi long and 24 ft wide, and would include new heavy-haul bridges across the existing discharge and return cooling canals (FPL 2014-TN4058).

Rail Lines

No rail line currently provides access to the site. FPL does not plan to add a rail line.

Barge-Unloading Facility

An existing canal connects the Turkey Point site with the Florida Intracoastal Waterway. The existing Turkey Point barge-unloading facility, used for unloading fuel oil for Unit 1, would be enlarged to accommodate the larger barges used to deliver components for the proposed units (Figure 3-4, grid reference D2) (FPL 2014-TN4058). An area approximately 90 ft by 150 ft would be excavated on the northwest edge of the existing barge-turning basin resulting in a total disturbed area of 130 ft by 250 ft or 0.75 ac (FPL 2014-TN4058). This area includes a concrete apron for unloading equipment and components for the proposed units. The expansion of the barge-unloading facility would require dredging a 4,356 ft^2 (0.1 ac) area in the turning basin (FPL 2011-TN42). Excavated and dredged materials would be placed in the designated spoils areas (FPL 2014-TN4058).

Spoils Areas

Spoils areas would be established to allow dewatering and storage of muck, soils, and woody debris that were cleared, grubbed, or excavated during site preparation for Units 6 and 7 facilities. Three long, narrow spoils areas would be established on the berms of the industrial wastewater facility south of Units 6 and 7 (Figure 3-1, grid reference D3, D4, D5). Spoils Areas A and C would be located on the western and eastern sides, respectively, of the main return canal. Spoils piles in Areas A and C would be up to 5 mi long. Spoils Area B would be located along the southern edge of the industrial wastewater facility; it would be approximately 1.8 mi long. The available footprint areas for Spoils Areas A, B, and C are 77, 18, and 116 ac, respectively, providing capacity to store approximately 2 million cubic yards of material. The berms along the main return canal and the southern cooling canal vary from 100 ft to 220 ft wide, and their top elevation is approximately 6 ft NAVD88. The width of the spoils piles would depend upon the available width remaining between the berm access road and the far edge of the berm. The final elevation of the spoils piles would be approximately 16 to 20 ft NAVD88, or 10 to 14 ft above the current berm elevation (FPL 2014-TN4058; FPL 2011-TN1042).

Fill Source (Borrow) Areas

FPL estimates that 13 to 14.4 million cubic yards of fill would be needed to build proposed Units 6 and 7 and associated facilities (including transmission system and access roads), with the majority of the fill (almost 11 million cubic yards) needed on the Turkey Point property (Table 3-1). Borrow areas would supply the quantities of fill material needed to raise the elevation of the proposed Units 6 and 7 main plant site as well as the locations for associated facilities such as the reclaimed water-treatment facility, laydown areas, roads, and parking areas. Although some material excavated during site preparation could be suitable for reuse as fill, most fill material would come from offsite borrow areas. FPL proposes to obtain the offsite fill from established regional sources. A number of fill sources in the region could meet the needs of FPL at the Turkey Point site.

To provide context for the potential impacts of fill mining, the review team considered the Atlantic Civil, Inc. mine located about 10 mi west of the Turkey Point site as a viable commercial fill source (USACE 2013-TN3473). The review team also considered a rock mine in the Lake Belt region as another viable commercial source of fill. This allowed the review team to consider a nearby location with limited capacity and a more distant site with extensive capacity. The Atlantic Civil rock mine is located about 10 mi west of the FPL site; it is a complex of quarries, fill areas, and mitigation areas occupying approximately 3,200 ac (SFWMD 2010-TN3553; SFWMD 2014-TN3554). Atlantic Civil was issued a Department of the Army permit (SAJ-1995-6797) to expand an existing 71.2 ac quarry by 494.2 ac over the next 20 years. With the additional permitted acreage, the area available for excavation will be 565.4 ac (USACE 2013-TN3473). If this area was mined to the maximum depth allowed by its Department of the Army permit (67.2 ft), approximately 53 million cubic yards of material could be mined at this location.

An alternative source of fill would be rock mines in the Lake Belt region in northwest Miami-Dade County approximately 40 road miles northwest of the Turkey Point site. The USACE issued project-specific permits to several companies including to Cemex Construction Materials Florida for its FEC Quarry, named for the Florida East Coast (FEC) Railway that serves the quarry. The FEC Quarry and rail center are located near the intersection of the Florida Turnpike and Okeechobee Road (USACE 2010-TN3555; SFWMD 2010-TN3556). Other permitted quarries in the Lake Belt region include White Rock Quarries (North and South), Tarmac America, Florida Rock Industries, and APAC-Southeast, Inc. (USACE 2010-TN3559; USACE 2010-TN3560; USACE 2010-TN3561).

Table 3-1. Volume of Fill Needed for Turkey Point Units 6 and 7 and Associated Facilities

Plant Area	Volume of Category II Fill Needed
Reactors, Cooling Towers, Clear Sky Substation	7.8 million cubic yards
Reclaimed Water-Treatment Facility	1.6 million cubic yards
Laydown Areas	0.7 million cubic yards
Nuclear Administration and Training Facilities	0.6 million cubic yards
Transmission Access Roads and Tower Pads	2.0−3.0 million cubic yards
Access Roads	0.4−0.7 million cubic yards

Source: FPL 2014-TN4058

Sanitary Waste-Treatment Plant

FPL plans to build a new sanitary waste-treatment plant to support proposed Units 6 and 7. It would be sized to serve the operational workforce of both units (approximately 800 workers) as well as the workforce expected to be onsite during an outage (approximately 600 to 1,000 temporary workers). The plant would be sized to also treat sanitary waste from existing Units 1 through 5. The treatment plant would be located east of the location of the proposed Units 6 and 7 (Figure 3-7). FPL plans to use portable sanitary facilities until the permanent system is operational (FPL 2014-TN4058).

Effluent from the sanitary waste-treatment plant would be discharged to the blowdown sump where it would be mixed with cooling-tower blowdown before being discharged to the Boulder Zone through the deep-injection well system.

Power Transmission System

In Section 3.7 of its ER, FPL described the power transmission system that would connect proposed Turkey Point Units 6 and 7 to the grid that distributes power to the FPL service territory. Existing transmission system voltages range from 69 kV to 500 kV; existing transmission lines serving the area of the proposed Units 6 and 7 are 230 kV lines. The proposed Clear Sky substation, a new 230 kV/500 kV switchyard/substation, would be constructed within the perimeter wall for Units 6 and 7, just northwest of the new units (Figure 3-4, grid reference B4,C4). Once the Clear Sky substation is completed, it would be fenced off to limit access; the switchyard is considered to minimally interface with the environment during normal operation.

Underground transmission lines on the site are proposed to connect Units 6 and 7 to the 230 kV section of the new Clear Sky substation. Two 230 kV/500 kV autotransformers are proposed to be located in the 500 kV section of the substation; these would connect the 230 kV section of the substation to the 500 kV transmission lines.

FPL proposes to connect the proposed Clear Sky substation to the existing FPL transmission system with two new 500 kV lines and three new 230 kV lines (Table 3-2). The two new 500 kV lines would terminate at the Levee substation. One of the new 230 kV lines would share a corridor with the 500 kV lines as far as Levee, but it would bypass the Levee substation and continue on another 9 mi to terminate at the Pennsuco substation. As described in Section 2.2.2, FPL considered two transmission line corridor options for the Clear Sky to Pennsuco lines, the West Preferred Corridor and the West Consensus Corridor. The West Consensus Corridor would be similar to the West Preferred Corridor in length (Figure 2-5), but its width would vary between 1,000 ft and 5,000 ft (FPL 2013-TN2941). Another new 230 kV line would connect the Clear Sky substation to the Davis substation and would continue north to the Miami substation. These new transmission line routes are shown in Figure 2-5. The third new 230 kV line would supply an alternate feed of offsite power to the existing Turkey Point substation serving existing Units 1, 2, 3, 4, and 5, providing a path for offsite power between the substations in the event of loss of transmission at either substation (FPL 2014-TN4058).

The existing Turkey Point substation would need to be expanded by 0.9 ac to add two new 230 kV line terminals and to enlarge an existing relay vault building. The Levee substation would need to be expanded by 2.3 ac to connect the two proposed new 500 kV lines and to accommodate a stormwater-retention system. The Pennsuco substation would need to be expanded by 2.42 ac to connect the proposed new 230 kV line as well as install a stormwater-retention system. The Davis substation would need to be expanded by 1.12 ac to add two new 230 kV terminals and other equipment. The Miami substation would be modified and upgraded, but would not require additional area for expansion (FPL 2014-TN4058).

The State of Florida has approval authority over transmission line corridors under the Florida Power Plant Siting Act (Fla. Stat. 29-403.501 2011-TN1068). As a part of the State certification process, FPL performed a route study and corridor selection in which it defined the study area, delineated candidate routes, and evaluated the routes for land-use constraints.

Table 3-2. Summary of New Transmission Lines for Proposed Turkey Point Units 6 and 7

Corridor	Route	Size (kV)	Total Length (mi)	Length within Existing Corridor (mi)	Length of New Corridor Proposed (mi)	Corridor Width (ft)
West Preferred Corridor	Clear Sky – Levee 1 and 2 Clear Sky – Pennsuco, Clear Sky to Levee portion	Two 500 kV One 230 kV	43	30	13	330[(a)]
	Clear Sky – Pennsuco, Levee to Pennsuco portion	One 230 kV	9	9	0	170
East Corridor	Clear Sky – Turkey Point	One 230 kV	0.4	0	0.5	Varies, 150 to 2,200
	Clear Sky – Davis		19	19	0	
	Davis – Miami		18	0	18	
Total Transmission Corridors			89.5	58	31.5	

(a) In the new portion of the West Consensus Corridor, widths vary from 1,000 to 5,000 ft.

Sources: FPL 2014-TN4058; FPL 2013-TN2941

Specific information about the proposed transmission line corridors, including options, is presented in Chapter 2 (Section 2.2.2.1). Figure 2-5 shows the locations of the proposed transmission lines and associated substations. As shown in Table 3-2, most of the new lines would occupy existing FPL-owned right-of-way.

Structures associated with the transmission line corridors are support towers and access roads. The 230 kV transmission lines would be supported by single-pole concrete structures that are gray/white in color. Structure heights would be approximately 80 to 90 ft depending on span length and other appropriate design factors. The substation pulloff towers would be galvanized steel or concrete. The 500 kV transmission towers would be 140 to 160 ft tall, made of concrete, galvanized lattice steel, or tubular steel. Tower spans would vary between 900 and 1,000 ft, although FPL states that the distance might vary with site-specific conditions; e.g., to avoid and minimize impacts on wetlands or cultural resources. If tower structures are tubular steel, similar structures with larger gauge steel would be used where the transmission lines turn light angles (15 degrees or less), and three-pole structures with supports would be used where the lines turn heavy angles (55 to 90 degrees).

The transmission lines would be designed to meet or exceed the clearance-to-ground requirements of the National Electrical Safety Code (NESC) (IEEE 2007-TN1087), and to keep the electric field at the conductor surface below corona inception. The electric-field-induced current from transmission lines would be required to meet the allowable NESC code (IEEE 2007-TN1087) and State (Fla. Admin. Code 62-814-TN644) requirements.

3.2.2.4 Other Structures with a Temporary Environmental Interface

Temporary plant-environment interfacing structures include a concrete batch plant and dewatering systems.

Concrete Batch Plant

A concrete batch plant would be located north of Turkey Point Units 6 and 7 in the area that will ultimately become the parking lot for the operating workforce (Figure 3-4, grid reference C4). This area would house the equipment and facilities needed for delivery, materials handling and storage, and preparation of concrete. Water for the concrete batch plant would be supplied by Miami-Dade County (FPL 2014-TN4058). Wastewater from the batch plant would be discharged to the industrial wastewater facility (FPL 2014-TN4058).

Dewatering Systems

Dewatering is expected to be a localized activity associated with excavation. Dewatering systems would be installed for the excavation for the nuclear island. Surface water and groundwater seepage would be removed and discharged to the cooling canals of the industrial wastewater facility (FPL 2014-TN4058).

3.2.3 Structures with a Minor Environmental Interface

The structures described in the following sections would have minimal environmental interface during plant operation.

3.2.3.1 Nuclear Island and Other Reactor Buildings

Each AP1000 nuclear island would consist of a containment building, a shield building, and an auxiliary building. The foundation for the nuclear island would be an integral basemat that supports these buildings. The steel containment vessel would be completely surrounded by the shield building and the auxiliary building. The containment foundations would be approximately 40 ft below grade. The construction materials would be concrete and steel. The tallest building would be the shield building at approximately 229 ft above the plant grade of 25.5 ft NAVD88. The auxiliary building would be rectangular, approximately 254 ft by 116 ft, and rise to a height of approximately 81 ft above grade.

Annex Building

The annex building would be a 285 ft by 132 ft concrete-and-steel structure that would rise to a height of approximately 83 ft above grade and provide personnel access to the plant and house plant-support systems and equipment.

Turbine Building

The turbine building would be a metal-sided 310 ft by 156 ft rectangular structure rising 146 ft above grade. The turbine building would have a drain system that discharges to a wastewater-retention basin connected to the blowdown sump. Prior to discharge to the blowdown sump, wastewater would flow through an oil separator to remove oils and through a radiation detector so that water could be isolated if radiation were detected (FPL 2014-TN4058). The turbine building would also include a vent system for the condenser and turbine.

Radioactive-Waste Facility

The radwaste building would be a steel-framed structure that rises approximately 36 ft above grade (FPL 2014-TN4058). It would house the holding and processing systems for low-level liquid radioactive waste and solid radioactive waste. It also would house the collection and processing system for gaseous radioactive waste. Radioactive-waste management is described in more detail in Section 3.4.3. Packaged solid wastes and liquid mixed wastes would be stored in the radwaste building until shipment offsite for further processing or disposal. The environmental interfaces for the radioactive waste-treatment facility would be liquid effluent discharges to the blowdown discharge line, gaseous effluent venting, and solid-waste handling for offsite shipment.

Diesel-Generator Building

Diesel generators would be installed on the site to provide a backup source of power when the normal power source is disrupted. Combustion emissions would be released to the atmosphere from the generators only during emergency operations and periodic testing. Two diesel generators would be located in the AP1000 diesel-generator building, which is a steel-framed, one-story structure. Ancillary diesel generators would be located in the AP1000 annex building (FPL 2014-TN4058).

3.2.3.2 Cranes and Footings

A crane on a concrete footing would be used to erect Units 6 and 7. Other cranes may be used for materials handling and erection. The tallest crane could reach up to 460 ft (FPL 2014-TN4058).

3.2.3.3 Pipelines

Nine miles of new 72 in. diameter pipeline would be laid to convey water from the MDWASD South District Water Treatment Plant to the proposed reclaimed water-treatment facility at the Turkey Point site. For 6.5 mi, the MDWASD reclaimed water pipeline would follow existing transmission corridors. Approximately 2.5 mi of pipeline would be outside of existing rights-of-way (FPL 2014-TN4058).

Approximately 10 mi of new 30 in. diameter pipeline would convey potable water from an existing MDWASD supply line at the intersection of SW 288th Street and SW 137th Avenue/ Tallahassee Road to Units 6 and 7. The potable water pipeline route would be within existing road rights-of-way and would result in no additional land disturbance (FPL 2015-TN4442). Within Units 6 and 7, MDWASD potable water would supply all other plant water needs outside of the CWS (the SWS, sanitary and potable water, demineralized-water system, fire protection, and equipment/floor washdown) (FPL 2014-TN4058). The locations of the MDWASD reclaimed and potable water pipelines are shown in Figure 2-5.

Pipelines would also convey treated reclaimed water from the reclaimed water-treatment facility to the makeup water reservoir and from the reservoir to the Units 6 and 7 cooling towers, saltwater from the radial collector wells to the cooling-tower basins, wastewater from various systems to the blowdown sump, and from the blowdown sump to the injection wells (FPL 2014-TN4058). The locations of these structures and the pipeline routes are shown in Figure 3-4 and Figure 3-7.

3.2.3.4 Support and Laydown Areas

Multiple construction-support and laydown areas would be established to support fabrication and erection activities and might be maintained as laydown areas for future maintenance and refurbishment of the plant. The largest laydown area would be 46 ac located west of the main plant area (Figure 3-4, grid reference B3, B4, B5). A smaller 6 ac laydown area would be located near the barge-unloading facility. A 3 ac laydown area would be located north of the proposed nuclear administration and training facilities near the existing Turkey Point and McGregor substations. This laydown area would be used for the transmission system (Figure 3-4, grid references D2 and B3) (FPL 2014-TN4058).

3.2.3.5 Parking

Parking areas would be created to support the construction workforce and some parking would be retained for the operating workforce once plant installation is completed. Temporary parking areas would be in the vicinity of the plant, support, and laydown areas identified in Figure 3-4. A permanent parking area would replace the concrete batch plant north of Turkey Point Unit 6 (Figure 3-7) and would have a finished elevation of 23 ft NAVD88 (FPL 2015-TN4502).

3.2.3.6 Miscellaneous Buildings

A variety of small miscellaneous buildings would exist throughout the site to support worker, fabrication, building, and operational needs (e.g., shop buildings, support offices, warehouses, guard houses). Most of these buildings would be temporary and would be removed after the plant begins operation.

3.3 Construction and Preconstruction Activities

The NRC’s authority is limited to construction activities that have a reasonable nexus to radiological health and safety or common defense and security (72 FR 57416) (TN260). Examples of construction (defined in 10 CFR 50.10(a) [TN249]) activities for safety-related structures, systems, or components include pile driving, subsurface preparation, placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing of specified structures, systems, or components.

Other activities related to building the plant that do not require NRC approval (but may require a Department of the Army permit) may occur before, during, or after NRC-authorized construction activities (as defined by 10 CFR 50.10(a) [TN249]). These activities are termed "preconstruction" in 10 CFR 51.45(c) (TN250) and are typically regulated by local, State, Tribal, or Federal agencies other than the NRC. Preconstruction includes activities such as site preparation (e.g., clearing, grading, and installation of erosion control, and other environmental mitigation measures), erection of fences, excavation, erection of support buildings or facilities, building service facilities (e.g., roads, parking lots, rail lines, transmission lines, sanitary-treatment system, potable water system), and procurement or fabrication of components occurring at other than the final, in-place location at the site. Further information about the delineation of construction and preconstruction activities is presented in Chapter 4 of this EIS.

This section describes the structures and activities associated with building Turkey Point Units 6 and 7. Table 3-3 provides general definitions and examples of activities that would be performed in building the new units. This section characterizes the activities for the principal structures to provide the requisite background for the assessment of environmental impacts; it is not a complete discussion of every activity or a detailed engineering plan.

Table 3-3. Definitions and Examples of Activities Associated with Building Turkey Point Units 6 and 7

Activity	Definition	Examples
Clearing	Removing vegetation or existing structures from the land surface.	Cutting vegetation in an area to be used for construction laydown.
Grubbing	Removing roots and stumps by digging.	Removing stumps and roots of trees or shrubs removed from the construction laydown area.
Grading	Reforming the elevation of the land surface to facilitate operation of the plant and drainage of precipitation.	Leveling the site of the reactors and cooling towers.
Hauling	Transport of material and workforce along established roadways.	Driving on new access road by construction workforce.
Paving	Laying impervious surfaces, such as asphalt and concrete, to provide roadways, walkways, parking areas, and site drainage.	Paving the parking area.
Shallow excavation	Digging a hole or trench to a depth reachable with a backhoe. Shallow excavation may not require dewatering.	Placing pipelines; setting foundations for small buildings.
Deep excavation	Digging an open hole in the ground. Deep excavation requires equipment with greater vertical reach than a backhoe. Deep excavation generally requires dewatering systems to keep the hole from flooding.	Excavating for the basemat for the reactor.
Excavation dewatering	Pumping water from wells or pumping water directly to keep excavations from flooding with groundwater or surface runoff.	Pumping water from reactor building deep excavation.
Dredging	Removal of substrates and sediment in navigable waters, or wetlands.	Enlarging the barge-unloading facility to accommodate larger barges.
Spoils placement	Placement of construction (earthwork) or dredged material in an upland location.	Placing muck removed from the proposed Units 6 and 7 plant area in the spoils areas established on the cooling canal berms.
Erection	Assembly of all modules into their final positions, including all connections between modules.	Using a crane to assemble reactor modules.

Table 3-3. (contd)

Activity	Definition	Examples
Fabrication	Creating an engineered material from the assembly of a variety of standardized parts. Fabrication can include conforming native soils to some engineered specification (e.g., compacting soil to meet some engineered fill specification).	Preparing concrete for pours; laying rebar for the basemat.
Vegetation management	Thinning, planting, trimming, and clearing vegetation.	Maintaining the switchyard free of vegetation.
Filling a wetland or waterbody	Discharge of dredge and/or fill material into waters of the United States, including wetlands.	Placing fill material into wetlands to bring it to grade with the adjacent land surface.

3.3.1 Major Activity Areas

Construction and preconstruction activities for proposed Turkey Point Units 6 and 7 would occur within the boundaries of FPL property, with the exception of the new transmission lines described in Sections 2.2.2 and 3.2.2.3, pipelines for reclaimed and potable water from the MDWASD, offsite road improvement areas, and the offsite fill source (borrow) areas. Access roads for Units 6 and 7 would enter the property from the northwest. The radial collector wells would be at the east end of the Turkey Point property. The following sections briefly describe FPL's proposed construction and preconstruction activities associated with the structures described in Sections 3.2.2 and 3.2.3.

3.3.1.1 Landscape and Stormwater Drainage

Preparing to build and operate proposed Turkey Point Units 6 and 7 would involve clearing, excavating, filling, and grading land for the main reactor buildings and support facilities and additional space for material and equipment laydown areas. The site surface would be significantly altered to allow the proposed reactors to be built on the Turkey Point site. The details of the alterations are discussed in the following sections. After the site alterations and facilities are complete, a stormwater-drainage system of catch basins, storm drains, and swales would be created around the facilities to direct site stormwater away from the operational areas. Stormwater runoff would be directed to the cooling canals of the industrial wastewater facility (FPL 2014-TN4058). EIS Section 3.2.2.1 provides a description of the drainage system.

The separate stormwater-management system for the reclaimed water-treatment facility would involve grading and paving of the filled area, excavation of the retention ponds, lining of the ponds, and placement of riprap around the outlets to protect receiving areas from erosion (FPL 2011-TN303; FPL 2011-TN495).

3.3.1.2 Main Plant Area, Cooling Towers, and Makeup Water Reservoir

FPL describes the preparation of the site for constructing the proposed units as follows:

> Significant earthwork would be required to establish finish grades at the Units 6 and 7 plant area, especially to raise the power block (i.e., Nuclear Island) to its required finished-floor elevation of 26.0 feet NAVD 88. Approximately 7.8 million cubic yards of general area (Category II) backfill would be required to raise the

existing grade elevation of approximately –1.0 feet NAVD 88 to the finished grade elevation adjacent to the power block of 25.5 feet NAVD 88. Also, backfilling around the major power block Seismic Category I (safety-related) embedded structures would require approximately 130,000 cubic yards of safety-related (Category 1) engineered structural backfill. (FPL 2014-TN4058; FPL 2011-TN42)

As described in Section 3.2.2.2, the new reactor units, Clear Sky substation, and permanent parking facilities would be built on a filled “island” enclosed by a mechanically stabilized earth perimeter wall on three sides and a reinforced concrete wall on the south side. Prior to placing backfill to raise the site elevation, the existing soil on the site would need to be removed. Sheet pile would be installed around the area to be excavated prior to soil removal to minimize the impact of the excavation on the cooling canals of the industrial wastewater facility. The existing soil, or muck, would be removed to the top of the Miami Limestone Formation at approximately -3 ft NAVD88 and replaced with fill. Removal of the existing soil and emplacement of fill would be coordinated to minimize groundwater inflow (FPL 2014-TN4058). Once the main plant site (excluding the makeup water reservoir and cooling-tower area) has been “demucked” and filled to establish a dry working surface at 0 ft NAVD88, a mechanically stabilized earth perimeter wall would be constructed along the north, east, and west sides of the area to a height of 20 to 21 ft NAVD88. The area would be filled to approximately 0 ft NAVD88. Near the center of the demucked area within the earthen perimeter wall, deep excavation, temporary dewatering, fill placement, and large-scale fabrication and erection activities would be involved in building the AP1000 units. Construction of the reactor containment and auxiliary buildings would involve excavation to the top of the Fort Thompson Formation, approximately -35 ft NAVD88. To minimize groundwater flow into the excavation, a diaphragm wall would be constructed around the area to be excavated. The wall would extend into the Key Largo Formation to about -60 ft NAVD88 or into a confining layer of the aquifer, thus sealing off the excavation from lateral groundwater inflow. The bottom of the deep excavation would be sealed off from vertical groundwater inflow by a grout plug approximately 25 ft thick. The diaphragm wall and grout plug would be left in place once building is complete (FPL 2014-TN4058).

Building the diesel-generator facility and other modular reactor buildings would involve fabrication and erection. Pipelines would be installed before the entire area was backfilled and brought to final grade.

3.3.1.3 Reclaimed Makeup Water Reservoir and Cooling Towers

The 37 ac makeup water reservoir and cooling-tower area would also be stabilized by placing sheetpile into the Miami Limestone; it would then be demucked to the Miami Limestone surface but not backfilled. Excavated spoils would be placed in the designated spoils disposal areas. Other than temporary local dewatering for the cooling-tower foundations, dewatering would not be needed because the surface would be sealed by concrete (placed underwater if necessary) to exclude groundwater seepage. A concrete slab would be poured to bring the reservoir floor elevation to -2 ft NAVD88. The reservoir walls would be reinforced concrete extending to 24 ft NAVD88 (FPL 2014-TN4058). Building the cooling towers would involve fabrication and erection activities in addition to the shallow excavation and possible dewatering discussed above.

3.3.1.4 Excavation Dewatering

Dewatering systems would be installed in the deep excavations if required. At a minimum, FPL expects to install drainage sumps at the bottom of the excavations to facilitate the removal of water that collects there, but these would be temporary—in place until the diaphragm wall and grout plug were completed and functional. Dewatering would also likely be necessary for the excavations associated with the cooling towers. It would be minimized by pressure grouting the limestone into which the excavation would occur. Some deeper excavations for piping (for example beneath the condenser) are also expected to involve dewatering. FPL estimated that the maximum dewatering rate would be 1,200 gpm (1.73 Mgd), and would occur for 1 year. Once the grouting and excavation phases are completed, the expected dewatering rate would be 200 gpm or less during foundation construction (FPL 2014-TN4058). Water from the excavations would be pumped to the cooling canals of the industrial wastewater facility (FPL 2014-TN4058).

3.3.1.5 Radial Collector Wells

Installation of radial collector wells on the Turkey Point peninsula would involve excavation to a depth of greater than 40 ft and fabrication of the central caisson followed by horizontal drilling to install the lateral collector wells. Lateral collector wells would extend up to 900 ft from the central caisson beneath Biscayne Bay (FPL 2014-TN4058).

3.3.1.6 Deep-Injection and Monitoring Wells

The 12 deep-injection wells would be installed to between 2,900 and 3,500 ft below ground surface using standard deep-well injection drilling and completion techniques. Six dual-zone monitoring wells would be installed by standard drilling and completion techniques to approximately 1,900 ft below land surface. One zone would be used to monitor the deepest underground source of drinking water in the area and one zone would be open to a monitoring zone beneath the deepest underground source of drinking water. As noted in Section 3.2.2.2, exploratory well EW-1 was converted to a permitted deep-injection well that could be used to dispose of wastewater from construction-related activities. All injection and monitoring well installation methods would be stipulated and permitted by the Florida Department of Environmental Protection in accordance with its underground injection control program (FPL 2014-TN4058).

3.3.1.7 Spoils Disposal

FPL has indicated that the organic soil or “muck” on the proposed building site would be removed and disposed of in several locations on the berms alongside the main return canal and southern canal of the industrial wastewater facility, as described in Section 3.2.2.3 and shown in Figure 3-1. Prior to placement of spoils material, part of the surface would be excavated, and small containment berms would be created to form a shallow excavation in which to place the spoils. Material that is removed from the excavations and is not suitable for reuse would be placed in these areas for dewatering and disposal. FPL has indicated that measures such as berms, riprap, sedimentation filters, and detention ponds would be used to control drainage from the spoils piles to the industrial wastewater facility (FPL 2014-TN4058; FPL 2011-TN1042).

3.3.1.8 Roads

Building the heavy-haul road and the site-access roads would involve clearing and grading of land along the proposed routes to allow the roads to be widened and improved (Figure 3-4) (FPL 2014-TN4058). Drainage ditch installation, culvert installation, and fill placement would be needed, and new and upgraded roadways would be paved. Improvements to SW 359th Street would include a bridge to be installed over the L-31E Canal (FPL 2010-TN272). Four other new bridges would be built to serve Units 6 and 7, including two where the heavy-haul route crosses the industrial wastewater facility. Installation of the bridges may involve excavation for footings and fabrication of bridge components. Temporary bridges would be installed and used until the permanent bridges were completed.

3.3.1.9 Barge-Unloading Facility

Expanding the barge-unloading facility would involve excavation, dredging, and installing sheet piles to isolate the excavation from the barge-turning basin. Turbidity curtains would be used to isolate the area from Biscayne Bay and the National Park (FPL 2014-TN4058).

3.3.1.10 Reclaimed Water-Treatment Facility

Building the reclaimed water-treatment facility would involve shallow excavation (demucking), significant earthwork to raise the elevation of the site above the 100-year flood elevation, fabrication, and erection on a raised, graded area. FPL has indicated that 1.6 million cubic yards of fill would be needed to raise the approximately 44 ac site to its final grade elevation of about 14 ft NAVD88 (FPL 2011-TN42; FPL 2011-TN303).

3.3.1.11 Sanitary Waste-Treatment Plant

Building the sanitary waste-treatment plant would involve shallow excavation and limited fabrication and erection. The facility would be designed in accordance with industry standards and in compliance with Florida Department of Environmental Protection discharge requirements for deep-injection well disposal under the provisions of Underground Injection Control Rule in Fla. Admin. Code 62-528 (TN556) (FPL 2014-TN4058).

3.3.1.12 Pipelines

Pipelines would be installed between the MDWASD South District Wastewater Treatment Plant and the reclaimed water-treatment facility at the Turkey Point site (FPL 2014-TN4058). Pipelines would also be installed in several areas on the site including from the reclaimed water-treatment facility to the makeup water reservoir, from the radial collector wells to the cooling-tower basins, and from the blowdown collection sump to the injection wells. New pipelines would also be installed for the potable water system. The potable water line would include approximately 10 mi of new pipeline, most of it along existing roads or corridors, but approximately 2.5 mi would involve new land disturbance (FPL 2014-TN4058). The reclaimed water pipeline would include approximately 9 mi of new pipeline, approximately 2.5 mi of which would be in a new pipeline corridor.

Pipelines would generally be buried in trenches in areas outside the Turkey Point Units 6 and 7 perimeter wall, but some pipelines would be above ground within the plant area. Offsite pipelines would be buried; installation would involve the clearing of land along the pipeline corridor, shallow excavation (trenching), and backfilling.

3.3.1.13 Concrete Batch Plant

Erecting the temporary concrete batch plant would occur on graded fill in the northeastern part of the plant area (within the perimeter wall) (Figure 3-4).

3.3.1.14 Construction-Support and Laydown Areas

Establishing and preparing laydown areas would be necessary for staging of activities. Prior to and during construction and preconstruction, materials would be brought to the site and stored in laydown areas. FPL expects to clear and grade laydown areas in various locations near the proposed Turkey Point Units 6 and 7 (Figure 3-4). Some filling would be necessary to bring laydown areas to appropriate grade. Support and laydown areas would be graded relatively level and covered with crushed stone or gravel. Normally only limited vegetation is allowed in laydown areas.

3.3.1.15 Parking

Parking areas would be filled if necessary, graded, and paved.

3.3.1.16 Miscellaneous Buildings

Excavation for shallow foundations would be needed prior to fabrication and erection of miscellaneous buildings. In most cases, fill would be needed to create a stable base and to bring the area up to an appropriate final grade.

3.3.1.17 Switchyard and Substation Expansions

Excavation, backfilling, and grading would be needed for the proposed Clear Sky substation, which would be built within the Units 6 and 7 plant perimeter wall. Electrical switching structures would be erected and the switchyard would be fenced. The existing Levee and Pennsuco substations would both be expanded; substation expansions would involve excavation, filling, grading, fencing, and creation of stormwater-retention areas. The Davis and Miami substations would not be expanded, but bringing new lines into these substations would involve limited excavation and installation activities within the existing footprints (FPL 2014-TN4058).

3.3.1.18 Transmission Lines

Installation of transmission lines would involve the removal of trees and shrubs along portions of the transmission line corridor and access roads, movement of construction equipment, and shallow excavation for the foundations of the transmission line towers. Dewatering may be needed to build footings for transmission towers. Some tower footings and access roads would need filling, and bridges to access berms would be needed to install new towers located at the industrial wastewater facility (FPL 2014-TN4058; FPL 2011-TN42).

3.3.1.19 Cranes and Crane Footings

Fabrication of footings and erection of cranes would be necessary to build the larger plant structures.

3.3.2 Summary of Resource Parameters During Construction and Preconstruction

Table 3-4 provides a list of the significant resource commitments associated with construction. The values in the table combined with the affected environment described in Chapter 2 provide the basis for the construction and preconstruction impacts assessed in Chapter 4. These values were stated in the ER and the review team has confirmed that the values are reasonable.

Table 3-4. Summary of Parameters and Resource Commitments Associated with Construction and Preconstruction of Proposed Units 6 and 7

Resource Areas	Value	Parameter Description	Reference
All Resource Areas	123 mo (10 yr)	Duration of construction and preconstruction activities for two AP1000 units	FPL 2014-TN4058; FPL 2015-TN4502
Land Use, Terrestrial Ecology, Cultural and Historic Resources (Site and Vicinity)	591 ac	Disturbed area footprint onsite; 6 ac temporarily disturbed for reclaimed water pipeline, 585 ac permanently disturbed of which 218 ac is main plant area.	FPL 2014-TN4058, FPL 2014-TN3569
	128 ac	Disturbed area offsite but in vicinity (road improvements); 128 ac permanently disturbed	
Land Use, Terrestrial Ecology, Cultural and Historic Resources (Offsite, Transmission Lines)	2,213 ac	Total area for MDWASD water pipelines to site; none permanently disturbed	FPL 2014-TN4058
	5,373 ac	Total area for the preferred transmission line corridors, access road corridors, and substations; approximately 376 ac permanently disturbed for access roads and 6 ac permanently disturbed at substations	
Hydrology – Groundwater	-60 ft NAVD88	Maximum excavation depth (to install diaphragm wall)	FPL 2014-TN4058
	-35 ft NAVD88	Maximum excavation depth (containment and auxiliary buildings)	
Hydrology-Surface Water, Socioeconomics	565 gpm (0.8 Mgd)	Construction water use; source would be potable water supply of existing Turkey Point units	FPL 2014-TN4058
Hydrology-Surface Water, Hydrology-Groundwater	1,200 gpm (1.73 Mgd)	Maximum construction wastewater and dewatering discharge rate to the cooling canals of the industrial wastewater facility	FPL 2014-TN4058

Table 3-4. (contd)

Resource Areas	Value	Parameter Description	Reference
Socioeconomics, Transportation	3,950 workers	Peak construction and preconstruction workforce	FPL 2014-TN4058
	3,983 workers	Peak workforce during construction period (includes 33 operations workers)	
Terrestrial Ecology, Socioeconomics	460 ft (crane)	Height of tallest structure or equipment during construction and preconstruction	FPL 2014-TN4058
Terrestrial Ecology, Nonradiological Health, Socioeconomics	100 dBA	Noise level 100 ft from construction source	FPL 2014-TN4058
	80 dBA	Noise level 400 ft from 100 dBA source	FPL 2010-TN272 FPL 2014-TN4058
	124 dBA	Peak construction noise at source	
	90 dBA	Peak construction noise level 50 ft from source	
	75 dBA	Noise level 200 ft from source	
	65 dBA	Noise level 400 ft from source	
	64 dBA	Peak construction noise level at nearest permanent private residence	

3.4 Operational Activities

The operational activities considered in the review team's environmental review are those associated with structures that interface with the environment, as described in Section 3.2.2. Examples of operational activities include withdrawing water for the cooling system, discharging blowdown water and sanitary effluent, and discharging waste heat to the atmosphere. Activities within each AP1000 unit are discussed by FPL in the FSAR portion of its application (FPL 2015-TN4502) and are reviewed by the NRC as part of its safety review and will be documented in its Safety Evaluation Report.

The following sections describe the operational activities, including operational modes (Section 3.4.1), plant-environment interfaces during operations (Section 3.4.2), and the radioactive and nonradioactive waste-management systems (Sections 3.4.3 and 3.4.4). The values of resource parameters likely to be encountered during operations are summarized in Section 3.4.5.

3.4.1 Description of Operational Modes

The operational modes for proposed Turkey Point Units 6 and 7 considered in the assessment of operational impacts on the environment (Chapter 5 of this EIS) are normal operating conditions and emergency shutdown conditions. These are considered the conditions under which maximum water withdrawal, heat dissipation, and effluent discharges occur. Cooldown, refueling, and accidents are considered alternative modes to normal plant operation. During these alternative modes, water intake, cooling-tower evaporation, water discharge, and radioactive releases may change from normal operating or emergency shutdown conditions.

3.4.2 Plant-Environment Interfaces during Operation

This section describes the operational activities related to structures that have an interface to the environment.

3.4.2.1 Stormwater-Management System

FPL's stormwater-management system for Turkey Point Units 6 and 7 and associated facilities would be designed to handle a 25-year, 72-hour design storm event. As described in Section 3.2.2.1, the stormwater-drainage system around the proposed Turkey Point Units 6 and 7 facilities (within the plant perimeter wall) would direct stormwater to catch basins that would discharge to the cooling canals of the industrial wastewater facility. Runoff from the laydown area west of the main plant site, and from the nuclear administration and training facility area north of the main plant site, would also discharge to the industrial wastewater facility. The reclaimed water-treatment facility stormwater-drainage system would consist of graded surfaces draining to two stormwater-management basins; the basins would discharge to the surrounding wetland. The stormwater-management basins would be designed to handle the design storm event and to meet Miami-Dade County and South Florida Water Management District (SFWMD) design criteria for detention volumes. Runoff from any areas that could be contaminated with oil would be sent through oil/water separators and then discharged (FPL 2011-TN495; FPL 2011-TN303).

3.4.2.2 Circulating-Water System

Cooling-Water Sources

<u>Reclaimed Water</u>

As noted in Section 3.2.2, FPL proposes to use reclaimed water from the MDWASD as the primary source of water for the condenser cooling system for the operation of proposed Turkey Point Units 6 and 7. The reclaimed water would be provided and used in accordance with Fla. Admin. Code 62-610 (TN1269). It would receive secondary treatment and high-level disinfection before leaving the MDWASD South District Wastewater Treatment Plant. Under normal operating conditions with both units using 100 percent reclaimed water, the delivery rate from MDWASD South District Wastewater Treatment Plant to the reclaimed water-treatment facility would be approximately 50,481 gpm (FPL 2014-TN4058). Treated reclaimed water would be pumped to the makeup water reservoir at a rate of 40,686 gpm. From the makeup water reservoir, the normal flow rate to the CWS would be 38,400 gpm. Up to 2,286 gpm of reclaimed makeup water could be pumped directly to the blowdown sump if alternative dilution was needed to manage effluent constituents.

Saltwater (Radial Collector Wells)

Under conditions when reclaimed water cannot be obtained in sufficient quantity and/or quality for the CWS, radial collector wells approximately 25 to 40 ft below the bottom of Biscayne Bay would supply the water needed. Under normal operating conditions for both units using 100 percent saltwater from the radial collector well system, the pumping rate would be approximately 86,400 gpm (FPL 2014-TN4058). Saltwater would be pumped directly to the cooling-tower basins and would not go into the makeup water reservoir. Higher delivery rates would be necessary when using saltwater because saltwater is limited to fewer cycles of concentration to maintain appropriate dissolved solids concentrations in the circulating-water (1.5 cycles of concentration using saltwater vs 4 cycles of concentration using reclaimed water) (FPL 2014-TN4058).

Water-Treatment Facilities

Reclaimed water from MDWASD for the CWS would be delivered to a reclaimed water-treatment facility on the Turkey Point site (Figure 3-4, grid reference A-2). The reclaimed water would have received high-level disinfection by MDWASD prior to delivery to the site. The FPL reclaimed water-treatment facility would reduce concentrations of iron, magnesium, oil and grease, total suspended solids, nutrients, and silica in the water to prepare it for use in the CWS (FPL 2014-TN4058; FPL 2015-TN4502). This water would also be treated to prevent biofouling in the pipelines supplying raw water to the cooling towers. The treated water would be stored in the proposed makeup water reservoir. Water would be withdrawn from the reservoir as needed to provide makeup water to the cooling-tower basins for each unit.

Prior to being used in the CWS cooling towers, reclaimed water or saltwater from the radial collector wells would receive additional treatment to maintain a noncorrosive, nonscale-forming condition and limit biofouling within the system (FPL 2014-TN4058). Chemicals including biocides, antiscalants, and dispersants would be injected by a local chemical feed system into the piping of the CWS as necessary to maintain proper concentrations. The chemicals used in the CWS and the concentrations in the blowdown water are discussed in Section 3.4.4.2 under nonradioactive waste streams.

Cooling Towers

Waste heat is a byproduct of normal power generation at a nuclear power plant. FPL proposed that Turkey Point Units 6 and 7 would each have three closed-cycle wet-cooling towers to dissipate heat from the CWS to the atmosphere. The CWS cooling towers are designed to dissipate a heat load of 7.63×10^9 Btu/hr (1.53×10^{10} Btu/hr for both units) (FPL 2014-TN4058). Each unit would also have one SWS cooling tower, which, during normal operation, is expected to dissipate a heat load of 103×10^6 Btu/hr through one of its two cells. If increased cooling capacity were needed, such as during plant cooldown, both cells would be used to dissipate a maximum heat load of 346×10^6 Btu/hr (692×10^6 Btu/hr maximum for both units) (FPL 2014-TN4058).

Excess heat in the cooling water would be transferred to the atmosphere by evaporative and conductive cooling in the cooling tower. In addition to evaporative losses, a small percentage of water would be lost in the form of droplets (drift) from the cooling towers. Water lost to evaporation and drift is considered consumptive use because the water is not available for reuse. The CWS normal and maximum evaporation rates would both be 28,800 gpm. The SWS normal and maximum evaporation rates would be 366 and 1,248 gpm, respectively. The combined drift rates for both new units would be 7 gpm for the CWS and 1 gpm for the SWS (FPL 2014-TN4058). These evaporation and drift rates are independent of the makeup water source, meaning consumptive losses are similar whether reclaimed water or saltwater is used for cooling.

3.4.2.3 Injection Wells

Cooling-tower blowdown water and other plant wastewater would be discharged to the deep Boulder Zone via Class I industrial injection wells. Cooling-tower blowdown water is the cooling water that does not evaporate or drift from the towers, but is routed back to the cooling-tower basin at the base of each tower. Because evaporation of water from the cooling tower increases the concentration of dissolved solids in the cooling water, a portion of the blowdown water would be removed and replaced with makeup water from the makeup water system on a continual basis. FPL plans to maintain the chemical concentration factor for the CWS cooling tower between one and a-half and four cycles of concentration. As noted previously, the CWS would be operated at four cycles of concentration when using reclaimed water as the source of cooling water and at one and a-half cycles of concentration when using saltwater from the radial collector wells (FPL 2014-TN4058). The blowdown water from each cooling tower would collect in a basin at the base of the tower. Time spent in the basin allows for settling of suspended solids, and chemical treatment if needed, prior to discharging to the blowdown sump and eventually to the Boulder Zone through deep-injection wells. The estimated concentrations of chemical constituents in the blowdown are discussed in Section 3.4.4.2, Liquid-Waste Management.

In addition to blowdown water from the cooling towers, wastewater from the sanitary waste-treatment plant, wastewater-retention basin, and liquid radioactive waste-treatment system would be discharged to the Boulder Zone via the injection wells. These internal liquid-waste–management systems are described further in Sections 3.4.3.2 and 3.4.4.2. Up to 10 injection wells would be used during normal operations, leaving 2 available as backup wells. The maximum injection rate of 58,922 gpm (85 Mgd) would occur when saltwater is used for cooling; the normal injection rate when saltwater is used for cooling would be 58,175 gpm (84 Mgd). The normal and maximum injection rates when 100 percent reclaimed water is used for cooling would be 12,461 gpm (18 Mgd) and 12,914 gpm (18.6 Mgd), respectively.

3.4.2.4 Other Environmental Interfaces during Operation

Water Systems Other Than CWS

Potable water from MDWASD would be used for plant potable-water, service-water, demineralized-water, and fire-protection systems. Under normal conditions operation of the proposed units would call for 936 gpm, and under maximum conditions 2,553 gpm to meet these needs (FPL 2014-TN4058). Potable water delivered to the proposed units by MDWASD would not need additional treatment for use as potable water and for fire protection. The potable water used in the service-water and demineralized-water systems would need additional treatment to meet the criteria for use in these systems .

Chemistry in the SWS would be controlled by the turbine island chemical feed system. The system would inject chemicals into system piping to maintain a noncorrosive, nonscale-forming condition and limit the formation of biological film. Here again, the chemicals used are generally classified as biocides, antiscalants, and dispersants.

Potable water from the MDWASD would feed the demineralized-water system. The water would receive additional filtration and demineralization to produce the highly purified water used for various plant systems. Demineralization processes would include reverse osmosis to reduce dissolved solids, salts, and organic elements. The water would then be treated to remove dissolved carbon dioxide and most of the remaining ions through electrodeionization (FPL 2014-TN4058).

Power Transmission System

As noted in Section 3.2.2.3, transmission lines and corridors are considered to interface with the environment during plant operation, because there are potential continuing impacts from electric fields, noise, and corridor inspection and maintenance. Regular inspection of the structures, insulators, and access areas would be performed by FPL using trucks and aircraft (either airplanes or helicopters). Corridor maintenance includes controlling woody vegetation and maintaining access roads. FPL has established procedures for maintenance of transmission line corridors using both chemical (herbicides or growth regulators) and mechanical (trimming, mowing) means of vegetation control. Growth regulators and herbicides would be required to be used in a manner meeting Federal, State, and local regulations (FPL 2014-TN4058).

3.4.3 Radioactive Waste-Management System

Liquid, gaseous, and solid radioactive waste-management systems would be used to collect and treat the radioactive materials produced as byproducts of operating the proposed Turkey Point Units 6 and 7. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as is reasonably achievable. Waste-processing systems would be designed to meet the design objectives of 10 CFR Part 50 (TN249), Appendix I ("Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents"). The radioactive waste-management systems would not be shared between existing Units 3 and 4 and proposed Units 6 and 7. Radioactive materials in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes from operation of the two new AP1000 units. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products would be contained in the sealed fuel rods, but small quantities could escape the fuel rods into the primary coolant loop. Neutron activation of the primary coolant loop would also add radionuclides to this coolant.

The Offsite Dose Calculation Manual (ODCM) for the Turkey Point site describes the methods and parameters used for calculating offsite radiological doses from liquid and gaseous effluents (FPL 2013-TN3944). The ODCM also describes the methodology for calculation of gaseous and liquid monitoring alarm/trip set points for release of effluents from the existing Turkey Point units. Operational limits for releasing liquid and gaseous effluents are also specified in the ODCM to ensure compliance with NRC regulations.

The systems used for processing liquid waste, gaseous waste, and solid waste are described in the following sections. A more detailed description of these systems for proposed Turkey Point Units 6 and 7 is provided in Chapter 11 of the AP1000 DCD (Westinghouse 2011-TN261). Solid radioactive wastes produced from operating proposed Turkey Point Units 6 and 7 would be both dry and wet solids.

3.4.3.1 Liquid Radioactive Waste-Management System

The liquid radioactive waste-management system would control, collect, process, handle, store, and dispose of liquid radioactive waste generated as a result of normal operations and anticipated operational occurrences, including refueling operations. The liquid radioactive waste-management system would be managed using several process trains consisting of tanks, pumps, ion exchangers, filters, and radiation monitors, and is shown in DCD Figure 11.2-1 (Westinghouse 2011-TN261). Normal operations would include processing of (1) borated, reactor-grade wastewater, (2) liquids collected through floor drains and other liquid wastes with potentially high suspended solid contents, (3) detergent wastes, and (4) chemical wastes. The liquid radioactive waste-management system would comply with Regulatory Guide 1.143 (NRC 2001-TN1134) regarding liquid radwaste-treatment systems.

In addition, the radioactive waste-management system could handle effluent streams that typically do not contain radioactive material, but that may, on occasion, become radioactive (e.g., steam generator blowdown as a result of steam generator tube leakage). With two exceptions, liquid effluents processed through this system would become part of the liquid radioactive waste-management system effluent discharge. The exceptions are steam generator blowdown that is normally returned to the condensate system after processing and reactor coolant that can be degassed prior to reactor shutdown and returned to the reactor coolant system.

As stated in DCD Section 11.2.1.2.4 (Westinghouse 2011-TN261), the liquid radioactive waste-management system effluent would be stored in monitoring tanks prior to discharge. Liquid radioactive effluent would be discharged to the deep-injection wells. The discharge would be monitored and administratively controlled to ensure that it meets the requirements of 10 CFR Part 20, Appendix B, Table 2 Column 2 (10 CFR Part 20) (TN283). The radiological impacts from liquid effluents are evaluated in Section 5.9.

3.4.3.2 Gaseous Radioactive Waste-Management System

The gaseous radioactive waste-management system functions to collect, process, and discharge radioactive or hydrogen-bearing gaseous wastes. The system is a once-through, ambient-temperature, activated-carbon delay system (Westinghouse 2011-TN261). Radioactive isotopes of iodine and the noble gases xenon and krypton are created as fission products within the fuel rods during operation. Some of these gases escape to the reactor coolant system through cladding defects. Some of these gases are released to the environment through the gaseous radioactive waste-management system or plant ventilation. In addition, various gaseous activation products, such as argon-41, are formed directly in the reactor containment during operation. The gaseous radioactive waste-management system is typically active only when monitored gaseous concentrations reach a given threshold. Waste gas flows through a guard bed that removes iodine, oxidizing chemicals, and moisture. From the guard bed, waste gas flows through two delay beds containing activated carbon, which dynamically adsorbs and desorbs the gases, delaying them long enough for significant radioactive decay to occur. The gaseous system can only delay noble gases, not collect them. If noble gases monitored in the coolant reach a threshold value, then the reactor coolant is diverted to the liquid radioactive waste-management system where the noble gases can be collected using the degasifier.

Radioactive gaseous effluents from the system described above are discharged through the plant vent or the turbine building vent. The plant vent provides the release path for containment venting releases, auxiliary ventilation releases, annex building releases, radioactive waste building releases, and gaseous radioactive waste system discharge (Westinghouse 2011-TN261). The turbine building vents provides the release path for the condenser air removal system, gland seal condenser exhaust, and the turbine building ventilation (Westinghouse 2011-TN261). These releases would be ongoing and there would be no holdup in the gaseous waste-management system and no batching of releases, as would be the case for the liquid effluents. The radiological impacts from gaseous effluents are evaluated in Section 5.9.

3.4.3.3 Solid Radioactive Waste-Management System

The solid radioactive waste-management system would treat, temporarily store, package, and dispose of dry or wet solids. The process flow of the solid radioactive waste-management system is illustrated in Figure 11.4-1 of the AP1000 DCD (Westinghouse 2011-TN261). Solid radioactive waste could be either dry or wet solids, and the source could be an operational activity, maintenance, or another function. Non-fuel solid wastes would be generated from separating and treating radioactive material from gases and liquids and from removing contaminated material from various reactor areas. Solid wastes would consist of spent ion-exchange resins, deep-bed filtration media, spent filter cartridges, dry active wastes, mixed wastes, reactor components, equipment, and tools removed from service, as well as contaminated protective clothing, rags, and other trash generated from plant design modifications, operations, and maintenance activities. The system would have a 60-year design objective and be designed to handle both normal and anticipated operational occurrences. The packaged wastes would be temporarily stored in the auxiliary and radwaste buildings prior to being shipped to a licensed disposal facility. As discussed in ER Section 3.5.3, if additional temporary radwaste storage were needed, then onsite facilities could be constructed for temporary storage of low-level waste (FPL 2014-TN4058). The solid radioactive waste-management system releases no gaseous or liquid effluent directly to the environment. Instead, this system discharges effluent through the liquid and gaseous waste-management systems.

As shown in Table 11.4-1 of the AP1000 DCD, excluding spent fuel, the per unit annual total expected volume of solid waste (wet and dry) to be shipped would be approximately 1,964 ft^3/yr and the per unit annual total maximum volume of solid waste (wet and dry) to be shipped could be approximately 5,717 ft^3/yr. In addition, by combining the results of Tables 11.4-5 and 11.4-9 of the AP1000 DCD, the per unit maximum total activity of radioactive material is estimated to be approximately 33,670 Ci/yr (Westinghouse 2011-TN261).

Solid wastes may be shipped to a waste processor for volume reduction before disposal at a licensed disposal facility. Wet solid wastes include spent resins and sludge from powdered resins and filter backwashing. Spent resins and filters would typically be dewatered before packaging for shipment to a licensed offsite processing or disposal facility.

The storage and transportation of used reactor fuel is discussed in Chapter 6.

3.4.4 Nonradioactive Waste-Management Systems

The following sections describe the nonradioactive waste-management systems proposed for the Turkey Point site, including systems for solid waste, liquid waste, gaseous waste, hazardous waste, and mixed waste.

3.4.4.1 Solid-Waste Management

The expected nonradioactive solid-waste streams during operational activities include water-treatment wastes, laboratory wastes, trash, spent filters, sanitary sludge, and debris from cooling-basin forebay and catch basin screens.

Solid waste generated during operation would be segregated and recycled to the extent practicable, and the balance of the waste would be disposed of in an offsite permitted landfill. FPL would institute a waste-minimization program during operation to promote pollution prevention, recycling, and reuse (FPL 2014-TN4058). Typical solid nonradioactive and nonhazardous wastes generated during operation may include office paper, aluminum cans, laboratory waste, glass, and metals. Recyclable materials such as paper, scrap metal, and batteries would be recycled by a commercial recycler to the extent practicable. The remaining solid wastes would be collected by a licensed waste hauler and disposed of in a municipal landfill. None of these solid wastes would be burned or disposed of onsite. FPL estimates that during operation, Units 6 and 7 would generate an average of 1,000 tons of dry solid waste annually (FPL 2014-TN4058).

Solid wastes from the plant water systems would include debris removed from the cooling-basin forebay screens, backwashed solids from the reverse osmosis membranes, spent resin from the demineralized-water deionization process, spent filters, and sludge from the reclaimed water-treatment facility. The reclaimed water-treatment facility is estimated to produce 435 tons of sludge per day when reclaimed water provides 100 percent of the cooling-tower makeup water (FPL 2014-TN4058). Solid waste from the plant water systems and debris from the catch basin screens would be disposed in an offsite permitted landfill. Waste sludge from the sanitary waste-treatment plant would be managed by a licensed waste transportation and disposal contractor and disposed of in a permitted landfill.

3.4.4.2 Liquid-Waste Management

The expected nonradioactive liquid-waste streams include cooling-tower blowdown, water-treatment wastes, discharge from floor and equipment drains, effluents from the sanitary-treatment system, and stormwater runoff.

Within each power plant, the turbine building drain system would collect discharges from the floor and equipment drains, the fire-protection water system, and the demineralized-water users and direct the combined flow to the oil/water separator. Turkey Point Units 6 and 7 are predicted to produce about 1,550 gal/yr of waste oil. The collected oil would be temporarily stored in the waste oil storage tank and ultimately disposed offsite, most likely following the current practice at Turkey Point Units 1 through 5, which is to recycle the waste oil for heat reclamation (FPL 2014-TN4058).

The plant design consolidates the nonradioactive liquid effluent streams from the CWS, the sanitary waste-treatment plant, and the wastewater-retention basin into the blowdown sump for discharge into the Boulder Zone via deep-injection wells (FPL 2014-TN4058). Deep-injection well discharge would be subject to the provisions of the Underground Injection Control Rule in Fla. Admin. Code 62-528 (TN556) and the conditions of the Underground Injection Control Permit (FPL 2014-TN4058).

Chemicals that would likely be added to the plant CWS, SWS, demineralizer water system, steam generator blowdown system, and reclaimed water-treatment facility include a biocide (sodium hypochlorite), pH adjusters (sulfuric acid, lime, carbohydrazide, hydrazine), proprietary scale inhibitors, a proprietary dispersant (high stress polymer), a coagulant (ferric chloride), and oxygen scavengers (sodium bisulfite, morpholine) (FPL 2014-TN4058).

The cooling-water system would use closed-cycle cooling, with a chemical concentration factor between 1.5 (for 100 percent saltwater cooling) and 4.0 (for 100 percent reclaimed water cooling). When operating with any combination of saltwater and reclaimed water, the concentration factor would remain between these limits (FPL 2014-TN4058).

The expected levels of constituents in the discharge to the deep-injection wells are summarized in Table 3-5. The table shows the expected concentrations for the two limiting operating conditions, i.e., when the plant uses 100 percent reclaimed water and when the plant uses 100 percent saltwater from the radial wells. All other operating conditions, and therefore the expected concentration of each constituent, lie between these limiting conditions. The concentrations for the constituents within reclaimed water listed in Table 3-5 were reported in the FPL ER Rev. 6 (FPL 2014-TN4058) and were based on sampling performed from 2007 through 2011 at the SDWWTP. After implementation of advanced treatment at the SDWWTP in FY 2013 (Miami-Dade County 2014-TN4758) additional sampling was performed to determine the concentrations of the constituents, heptachlor, ethylbenzene, tetrachloroethylene, and toluene in treated wastewater (NRC 2015-TN4773). Concentrations determined through this sampling were below laboratory method detection limits, as indicated in the footnotes to Table 3-5.

Table 3-5. Expected Constituents and Concentrations Discharged to the Deep-Injection Wells

Constituent Name	Concentration Using 100% Reclaimed Wastewater (mg/L)	Concentration Using 100% Saltwater (mg/L)
Ammonia as N	Not Calculated	Not Calculated
Biochemical oxygen demand	Not Calculated	Not Calculated
Boron	No Data	8.65
Bromide	No Data	166
Hexavalent chromium	0.065	No Data
Fluoride	2.46	0.00162
Alkalinity, total as $CaCO_3$	72	149
Nitrate as N	16.1	4.19
Sulfate	484.0	4,272
Total organic compounds	118	7
Total dissolved solids	2,721	39,506–53,168
Total suspended solids	33.6	13.3
Phosphorous	0.73	1.05
Phosphate	2.40	1.110
Aluminum	3.02	(a)
Antimony	0.0245	(a)
Arsenic	0.0131	(a)
Barium	1.86	0.1214
Beryllium	0.0933	(a)
Cadmium	0.00718	0.00107
Chromium	0.0653	0.00441
Copper	0.0433	0.0144
Iron	1.63	0.281
Lead	0.112	0.00496
Nickel	0.088	0.0260
Selenium	0.0359	0.019
Silver	0.0163	(a)
Zinc	0.646	10.8
Calcium	355	787
Magnesium	63	2,615
Manganese	0.379	0.0400
Sodium	426	19,164
Silica as SiO_2	26.4	15.4
Chloride	1,247	30,009
Nitrite as N	4.02	0.0966
Conductivity (µmhos/cm)	5,577	23,027–31,639
pH (standard units)	7.89	7.89
Total residual chlorine	2	No Data
Thallium	0.00620	(a)
Mercury	0.00653	(a)

Table 3-5. (contd)

Constituent Name	Concentration Using 100% Reclaimed Wastewater (mg/L)	Concentration Using 100% Saltwater (mg/L)
Heptachlor	0.000023(b)	No Data
Ethylbenzene	(a) (b)	No Data
Toluene	0.00174(b)	No Data
Tetrachloroethylene	0.00359(b)	No Data

(a) Constituent concentration was below the method detection limit.
(b) Constituent concentrations were below method detection limits in South District Wastewater Treatment Plant effluent samples collected in March 2013, July–August 2013, October 2013, and March 2014 (NRC 2015-TN4773).
mg/L = milligrams per liter.
Sources: FPL 2014-TN4058, NRC 2015-TN4773

Stormwater runoff would flow overland and ultimately reach the existing industrial wastewater facility, i.e., the closed-loop system of canals used for cooling, which would need a new or modified industrial wastewater permit. Runoff from paved areas and transformer areas would pass through oil/water separators prior to discharge to the industrial waste facility (FPL 2011-TN303). Any stormwater discharges during operation would need to comply with all applicable provisions of the National Pollutant Discharge Elimination System Permit No. FL0001562 upon modification, as well as any subsequent modifications, amendments, and/or renewals (FPL 2010-TN1231; FPL 2010-TN272; FPL 2010-TN1520).

During operation, the Units 6 and 7 sanitary drain systems would connect the restrooms and locker room facilities outside of radiologically controlled areas to the sanitary waste-treatment plant. For each new unit, the sanitary waste-treatment plant would be designed to process 25,000 gpd during normal operations and 50,000 gpd during plant shutdowns (FPL 2014-TN4058). The sanitary waste-treatment plant would also service Turkey Point Units 1 through 5 and the FPL reclaimed water-treatment facility. The sanitary waste-treatment plant would generate about 1,300 gpd of residual sludge with a 1.5 to 2 percent biosolids content and would comply with all Florida Department of Environmental Protection effluent restrictions (FPL 2014-TN4058).

FPL also plans to construct and operate a fleet vehicle maintenance facility, which would generate waste oil, waste coolant, and potentially solvent from the solvent wash tank. The maintenance facility would be served by a local septic tank (FPL 2014-TN4058).

3.4.4.3 Gaseous Waste Management

Gaseous emissions would be produced by the combustion of diesel fuel in the diesel engines that would power the two fire pumps, the four 4,000 kW standby generators, and the four 35 kW auxiliary ancillary generators. Based on four operating hours per month for each engine, the estimated annual emissions from these 10 engines would be 1,220 lb of particulates, 12.7 lb of sulfur oxides, 12,296 lb of carbon monoxide, and 23,660 lb of hydrocarbons and nitrogen oxides (FPL 2014-TN4058). These emissions would be subject to the requirements of the Prevention of Significant Deterioration Permit, when issued. The Florida Prevention of Significant Deterioration Program implements the Federal Clean Air Act requirements for the prevention of significant deterioration of air quality (see http://www.dep.state.fl.us/air/emission/psd.htm).

Each of these diesel engines would have an associated fuel oil storage tank. The four tanks for the 4,000 kW standby generators would each hold 60,000 gal, the four tanks for the 35-kW ancillary generators would each hold 650 gal, and the two tanks for the fire pumps would each hold 240 gal. Each of the four standby generators would also have an associated 1,300-gal fuel oil storage day tank. Total estimated hydrocarbon emissions from these tanks is 26 lb/yr due to volatilization of the diesel fuel (FPL 2014-TN4058).

Small amounts of volatile organic compounds would also be generated from the use of common building maintenance materials such as paints, adhesives, and caulk; from mechanical maintenance materials such as oils and solvents; and periodically from activities such as asphalt resealing.

3.4.4.4 Hazardous- and Mixed-Waste Management

Hazardous waste generated during operation could include waste industrial cleaning products, petrochemical products, water-treatment chemicals, used antifreeze, and small quantities of additional regulated substances, such as laboratory chemicals. Petroleum wastes could include waste gasoline, diesel fuel, oils, solvents, and grease. Rags or other materials contaminated with these substances could also be considered hazardous waste. FPL estimates that Units 6 and 7 would generate approximately 4,800 lb of nonradioactive hazardous solid waste annually (FPL 2014-TN4058).

All transportation, storage, and disposal of regulated hazardous wastes would be in accordance with applicable regulations of the Resource Conservation and Recovery Act of 1976, as amended (RCRA) (42 U.S.C. § 6901 et seq.) (TN1281). All hazardous wastes would be collected and stored onsite until being transported offsite by a licensed and permitted RCRA waste hauler, and treated or disposed of offsite at a RCRA-permitted facility (FPL 2014-TN4058).

Mixed wastes contain both hazardous and low-level radioactive waste. Small amounts of mixed solid waste could be generated during maintenance, refueling, and laboratory activities. The AP1000 design includes a solid-waste–management system that is designed to collect and store mixed wastes generated during normal plant operation. The packaged waste would be stored in the auxiliary and radwaste buildings until it is shipped offsite to a licensed disposal facility (FPL 2014-TN4058).

Although the DCD estimates that an AP1000 unit would generate approximately, 25 ft^3/yr of mixed waste, FPL anticipates that little to no mixed waste would be generated during operation (FPL 2014-TN4058). FPL expects Units 6 and 7 to each produce about 7.5 ft^3/yr of solid mixed waste for disposal (FPL 2014-TN4058). Any mixed waste from Units 6 and 7 would be handled and managed in a manner consistent with FPL's current operations by a third-party contractor and in accordance with the applicable Federal and State regulations (FPL 2014-TN4058).

3.4.5 Summary of Resource Parameters During Operation

Table 3-6 summarizes the operational parameters that are relevant to assessing the environmental impacts of operating proposed Turkey Point Units 6 and 7.

Table 3-6. Resource Parameters Associated with Operation of Proposed Turkey Point Units 6 and 7

Resource(s)	Value	Description
Hydrology-Surface Water, Hydrology-Groundwater	50,481 gpm (72.7 Mgd)	Normal MDWASD reclaimed wastewater supply to Turkey Point reclaimed wastewater-treatment facility (actual supply would fluctuate)
	40,686 gpm (58.6 Mgd)	Normal and maximum water supply from reclaimed wastewater-treatment facility to makeup water reservoir[(a)]
	38,400 gpm (55.3 Mgd)	Normal and maximum CWS makeup flow rate (100% reclaimed water)
	86,400 gpm (124.4 Mgd)	Maximum saltwater supply from radial collector wells to makeup water reservoir
	86,400 gpm (124.4 Mgd)	Normal and maximum CWS makeup flow rate (100% saltwater)
Hydrology-Surface Water, Meteorology-Air Quality	28,800 gpm	Normal CWS evaporation rate
	28,800 gpm	Maximum CWS evaporation rate
	366 gpm	Normal SWS evaporation rate
	1,248 gpm	Maximum SWS evaporation rate
Meteorology-Air Quality, Terrestrial Ecology	7 gpm	Normal and maximum CWS drift rate
	1 gpm	Normal and maximum SWS drift rate
Hydrology-Surface Water, Hydrology-Groundwater	29,230 gpm	Normal consumptive water use (100% reclaimed water)
	30,112 gpm	Maximum consumptive water use (100% reclaimed water)
	29,174 gpm	Normal consumptive water use (100% saltwater)
	30,056 gpm	Maximum consumptive water use (100% saltwater)
Hydrology-Groundwater	12,461 gpm (17.944 Mgd)	Normal discharge flow rate to injection wells (100% reclaimed water)
	12,914 gpm (18.596 Mgd)	Maximum discharge flow rate to injection wells (100% reclaimed water)
	58,175 gpm (83.772 Mgd)	Normal discharge flow rate to injection wells (100% seawater)
	58,922 gpm (84.848 Mgd)	Maximum discharge flow rate to injection wells (100% seawater)
Terrestrial Ecology, Meteorology-Air Quality	67 ft	CWS cooling-tower height
Terrestrial Ecology	229 ft	Tallest building height
Socioeconomics	806 workers	Normal operating workforce for two units
	1,000 workers	Maximum workforce during refueling outages occurring every 18 months, lasting approximately 30 days
Terrestrial Ecology, Nonradiological Health, Socioeconomics	88 dBA	CWS cooling-tower sound level at 3 ft
	73 dBA	CWS cooling-tower sound level at 200 ft
	65 dBA	CWS cooling-tower sound level at 400 ft
Uranium Fuel Cycle, Need for Power	1,200 MW(e)	Gross-electrical output per unit
	108 MW(e)	Station and auxiliary service load
	1,092 MW(e)	Net electrical output per unit
	93 percent	Expected annual capacity factor

(a) The 40,686 gpm treated reclaimed water supplied to the makeup water reservoir is used for CWS makeup flow (38,400 gpm) and for effluent dilution if needed (2,286 gpm). Any excess treated reclaimed water from the reclaimed water-treatment facility would be used by potential future users other than Units 6 and 7.

Source: FPL 2014-TN4058

4.0 CONSTRUCTION IMPACTS AT THE TURKEY POINT SITE

This chapter examines the environmental issues associated with building proposed Units 6 and 7 at the Florida Power & Light Company (FPL) Turkey Point Nuclear Power Plant (Turkey Point) site as described in the application for combined construction permits and operating licenses (COLs) submitted to the U.S. Nuclear Regulatory Commission (NRC) by FPL (2011-TN127). As part of its application, FPL submitted an environmental report (ER) (FPL 2014-TN4058), which discusses the environmental impacts of building, operating, and decommissioning proposed Turkey Point Units 6 and 7 and a Final Safety Analysis Report (FPL 2011-TN128), which addresses safety aspects of construction and operation.

On June 30, 2009, FPL submitted a Site Certification Application (SCA) to the State of Florida Department of Environmental Protection for the proposed Turkey Point Units 6 and 7 and ancillary facilities (FPL 2010-TN1231). The SCA process provides a certification that encompasses all licenses and permits needed for affected Florida State, regional, and local agencies. It also includes any regulatory activity that would be applicable under these agencies' regulations for proposed Turkey Point Units 6 and 7 (FDEP 2013-TN2629). On May 19, 2014, the State of Florida issued final Conditions of Certification to FPL authorizing construction, operation, and maintenance of proposed Turkey Point Units 6 and 7 and associated facilities (State of Florida 2014-TN3637). The final Conditions of Certification issued are binding and subject to the requirements listed in State of Florida (2014-TN3637). The NRC staff is aware that on April 20, 2016, a Florida court issued an opinion in which it ruled that the Florida Siting Board should have considered whether to require FPL to bury a portion of the transmission lines, and that the record was inadequate to support certain mitigation measures associated with transmission lines in the East Everglades (State of Florida 2016-TN4781). Although the opinion remands the Conditions of Certification to the Florida Siting Board for consideration of the possibility of burying a portion of the transmission lines and reconsideration of the specified mitigation measures, the NRC staff understands that the court's opinion is not yet final as of this writing (October 3, 2016). Accordingly, for the purposes of the FEIS evaluation of impacts, the NRC staff considers the transmission line route and conditions reviewed and approved by the Florida Siting Board as the most current information regarding the transmission line and associated potential mitigation measures. Even if the Conditions of Certification are revisited, the NRC staff considers it reasonable to expect that Conditions of Certification similar to or no less effective than those originally issued will be in place before construction and operation of the proposed units begins. As discussed in Section 3.3 of this environmental impact statement (EIS), the NRC's authority related to building new nuclear generating units is limited to construction "…activities that have a reasonable nexus to radiological health and safety and/or common defense and security" (72 FR 57416) (TN260). The NRC has defined "construction" according to the bounds of its regulatory authority. Many of the activities required to build a nuclear power plant are common to all major industrial construction projects (e.g., clearing and grading, excavation, and erection of support buildings), but do not involve radiological health and safety or common defense and security and, therefore, are not construction as defined by the NRC. Such activities are referred to as "preconstruction" activities in Title 10 of the *Code of Federal Regulations* (CFR) 51.45(c) (TN250). The NRC staff evaluates the direct, indirect, and cumulative impacts of the construction activities that would be authorized with the issuance of a

COL. The environmental effects of preconstruction activities are included as part of this EIS in the evaluation of cumulative impacts.

The U.S. Army Corps of Engineers (USACE) is a cooperating agency on this EIS consistent with an updated Memorandum of Understanding (MOU) (USACE and NRC 2008-TN637). The NRC and USACE concluded that entering into a cooperative agreement on the preparation of this EIS is the most effective and efficient use of Federal resources in the environmental review of impacts associated with building proposed Turkey Point Units 6 and 7. The goal of this cooperative agreement is to develop one EIS that provides all of the environmental information and analyses needed by the NRC to make a license decision and to provide information needed by the USACE to perform analyses, draw conclusions, and make a permit decision in its Record of Decision documentation. To accomplish this goal, the environmental review described in this EIS was conducted by a joint NRC/USACE review team. The review team was composed of NRC staff, its contractors' staff, and USACE staff.

The USACE needs information to perform analyses to determine whether the proposed action is (1) the least environmentally damaging practicable alternative (LEDPA) pursuant to Section 404 of the Clean Water Act, and (2) not contrary to the public interest pursuant to 33 CFR § 320.4 (TN4127). To perform the public interest review, the USACE considers the following public interest factors: conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, and mineral needs.

On June 20, 2009, the USACE received an application for a Department of the Army (DA) permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) (33 U.S.C. § 1251 et seq.) (TN662) and Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768). The USACE evaluation of the application will consider both construction and preconstruction activities.

Many of the impacts the USACE must address in its LEDPA analysis are the result of preconstruction activities. Also, most of the activities conducted by a COL applicant that would require a DA permit would be related to preconstruction. On June 20, 2009, FPL submitted an DA permit application to the USACE for a permit to conduct the following activities that result in alterations of waters of the United States, including jurisdictional wetlands: (1) discharge of dredge and fill into waters of the United States associated with construction of the nuclear reactor site, the reclaimed water facility, the transmission line and pipeline corridors, access roads, and radial collector wells; (2) the dredging of navigable waters of the United States associated with construction of the barge-unloading area.

While both the NRC and the USACE must meet the requirements of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4321 et seq.) (TN661), both agencies also have mission requirements that must be met in addition to the NEPA requirements. The NRC's regulatory authority is based on the Atomic Energy Act of 1954, as amended (42 U.S.C. § 2011 et seq.) (TN663). The USACE's regulatory authorities over the proposed action are Section 404 of the Clean Water Act (CWA) (33 U.S.C. § 1344) (TN1019), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE;

Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768), which prohibits work in navigable waters of the United States without a permit from the USACE; and Section 14 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 408) (TN4769), which prohibits modification, alteration, or construction upon or adjacent to a Federal project. Therefore, an applicant may not commence preconstruction or construction activities in jurisdictional waters, including certain wetlands, without a DA permit from the USACE. The permit would typically be issued after the USACE's evaluation of and public feedback in the form of public comments on its environmental review. Because the USACE is a cooperating agency under the MOU for this EIS, the USACE's Record of Decision of whether to issue, issue with modifications, or deny a DA permit will not be made until after public comment on the draft EIS has been received and considered and the final EIS has been issued. The USACE will conclude its CWA Section 404(b)(1) Guidelines and public interest analyses in its Record of Decision.

The collaborative effort of the NRC and the USACE in presenting their discussion of the environmental effects of building the proposed project, in this chapter and elsewhere, must serve the needs of both agencies. Consistent with the MOU, the NRC and the USACE staffs collaborated in (1) the review of the COL application and information provided in response to Requests for Additional Information (RAIs; developed by the NRC and the USACE) and (2) the development of the EIS. NRC regulations (10 CFR 51.45(c)) (TN250) require that the impacts of preconstruction activities be addressed by the applicant as cumulative impacts in its ER. Similarly, the NRC's analysis of the environmental effects of preconstruction activities on each resource area would be addressed as cumulative impacts, normally presented in Chapter 7. However, because of the collaborative effort between the NRC and USACE in this environmental review, the combined impacts of construction activities that would be authorized by the NRC with its issuance of a COL and the preconstruction activities are presented in this chapter. For each resource area, the NRC also provides an impact characterization solely for construction activities that meet the NRC's definition of construction at 10 CFR 50.10(a) (TN249). Thereafter, the assessment of the impacts of 10 CFR 50.10(a) (TN249) construction activities, the assessment of the combined impacts of construction activities, and the assessment of the combined impacts of construction and preconstruction activities are used in the description and assessment of cumulative impacts in Chapter 7 of this EIS.

For most environmental resource areas (e.g., aquatic ecology), the impacts are not the result of either solely preconstruction or solely construction activities. Rather, the impacts are attributable to a combination of preconstruction and construction activities. However, for most resource areas, the majority of the impacts would occur as a result of preconstruction activities such as clearing and grading the site.

This chapter is divided into 12 sections. In Sections 4.1 through 4.10, the review team evaluates the potential impacts on land use, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health effects, radiological health effects, and nonradioactive waste. The review team has assigned an impact category level—SMALL, MODERATE, or LARGE—of potential adverse impacts for each resource area using the definitions for these terms established in Chapter 1. In some resource areas the impacts may be considered beneficial (e.g., in the socioeconomic area where the impacts of taxes are analyzed), and are stated as such. The review team's determination of the impact category levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and County governments, such as infrastructure upgrades (discussed throughout this chapter), are implemented. Failure to implement these upgrades might result in a change in the impact category level. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.11. A summary of the construction impacts is presented in Section 4.12. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10 of this EIS.

The review team's evaluation of the impacts of building proposed Turkey Point Units 6 and 7 draws on information presented in FPL's ER, supplemental documents, the USACE's permitting documentation, and other government and independent sources.

4.1 Land-Use Impacts

This section provides information about the land-use impacts associated with preconstruction and construction of proposed Units 6 and 7. Topics discussed include land-use impacts at the site and in the vicinity and land-use impacts associated with building the transmission lines and other offsite facilities.

4.1.1 The Turkey Point Site and Vicinity

This section covers land-use impacts of construction and preconstruction activities for proposed Units 6 and 7 on the Turkey Point site, as well as offsite facilities other than transmission lines within the vicinity, including the proposed makeup-water systems and fill borrow areas.

Other associated temporary and permanent facilities would be built completely within the Turkey Point site boundaries, and would therefore be unlikely to affect nearby land uses. Development of the entire project, including proposed Units 6 and 7 and ancillary structures such as the radial collector wells (RCWs), reclaimed wastewater-treatment facilities, pipelines, access roads, and transmission lines would be consistent with local zoning and applicable local land-use plans.

Road improvements just off of the Turkey Point site would not affect areas now used for parks or recreational uses, or any other existing development. The offsite road improvements would also not disturb areas planned for future development.

Section 4.1.1.1 below addresses land-use impacts resulting from building the project facilities proposed for the FPL Turkey Point site. Section 4.1.1.2 addresses land-use impacts from building the proposed reclaimed wastewater pipelines northward into the City of Miami. Section 4.1.1.3 addresses land-use impacts from building multiple proposed construction equipment access roads entering the site from the west. Note that the analyses for the pipelines in Section 4.1.1.2 and the access roads in Section 4.1.1.3 encompass both the offsite and onsite portions of these linear facilities.

4.1.1.1 Onsite Land-Use Impacts

FPL proposes to build the proposed Units 6 and 7 power blocks and most of the associated infrastructure, including the mechanical draft cooling towers, makeup-water reservoir, substation, underground injection control (UIC or deep-injection) wells, and various small associated buildings, on a presently vacant 218 ac island referred to from here on as the plant area. In addition, a temporary concrete batch plant would be built and operated in the northeastern part of the plant area (as shown in Figure 3-4, grid 3C) and a new substation designated as the Clear Sky substation would be built in the northwestern part of the plant area. Building proposed Units 6 and 7 would permanently occupy the entire 218 ac plant area (FPL 2014-TN4058).

While most support buildings would be situated within the 218 ac plant area, certain support facilities would have to be built on other FPL lands on the Turkey Point site. These include nuclear administration and training buildings, an equipment barge-unloading area, RCWs, a reclaimed wastewater-treatment facility (RWTF), security buildings, onsite segments of a heavy-haul road, several pipelines, transmission lines, bridge and access road improvements, and spoils areas (see Figure 3-4). Table 4-1 quantifies proposed land disturbances on the FPL Turkey Point site using the Florida Land Use, Cover, and Forms Classification System (FLUCFCS). The review team is assuming that all of the land-use impacts listed in Table 4-1 are permanent.

FPL stated that most of the land on which the proposed facilities would be built has been previously disturbed during development and operation of Units 1 through 5 (FPL 2014-TN4058). Most other land needed for building and operating proposed Units 6 and 7 is undeveloped land adjacent to land currently used for power generation and associated uses, such that using it for construction and operation of proposed Units 6 and 7 would not result in substantial changes in land uses or disturbance of existing land uses. Of note, Units 6 and 7 are proposed to be constructed on an area known colloquially as “Mud Island.” This area is predominantly a mudflat, which is a special aquatic site according to the 404(b)(1) Guidelines. Special aquatic sites have special ecological characteristics that significantly influence or positively contribute to the general overall environmental health or vitality of the entire ecosystem of a region. See 40 CFR Sections 230.3 (g-1), 230.10(a)(3), and 230.42. The USACE will consider this designation during the review of the DA permit application.

FPL would be required to conduct site-preparation and site-development activities for proposed Units 6 and 7 in accordance with applicable Federal, State, and local regulations (ER Section 4.1.1.2) (FPL 2014-TN4058). FPL would be required to acquire the necessary permits and authorizations (see Appendix H) and implement environmental controls such as stormwater-management systems, fugitive dust control, and spill-containment controls before initiating earth disturbance. Building activities that could potentially affect land use include clearing, grubbing, grading and excavating, filling, dewatering, and stockpiling soils. FPL’s proposed project includes implementing standard dust-control measures and stabilizing, contouring, and re-vegetating permanently disturbed lands (ER Section 4.1.1.2) (FPL 2014-TN4058).

Because the RCWs would be built on previously disturbed land, they would not disturb surface land on any previously undeveloped property. Building the laterals (horizontal collector lines) extending underground from the collection caisson under Biscayne Bay would not require surface land disturbance in offsite areas.

Table 4-1. Summary of Proposed Disturbance on the FPL Turkey Point Site in Acres

FLUCFCS Level 2 Code	100	200	300	400	500	600	700	800
Project Element	Urban and Built-Up Land	Agriculture	Range-land	Upland Forest	Water	Wetlands	Barren Lands	Transp., Communications, and Utilities
Plant Area					8.7	194.2	15.4	
Western Laydown Areas					15.3	16.9	19.6	0.2
Training Parking						7.5	1.6	0.02
Nuclear Admin. Parking						18.7	3.4	0.7
Heavy-Haul Roads					0.2		0.2	4.8
Transmission Laydown Area					0.02	0.3		2.6
Equipment Barge-Unloading Area					0.02			0.7
Spoils Area A, B, and C				4.4	1.1	0.0	202.5	3.4
Radial Well Collector Area							3.3	
Radial Collector Well Laydown Area							2.7	
Radial Collector Well Delivery Pipelines					0.2	4.0	9.2	
FPL Reclaimed Wastewater-Treatment Facility				7.8	3.4	32.5		0.3
Treated Wastewater Delivery Pipelines					0.5	3.5	0.3	1.3

Source: Adapted from FPL 2014-TN4058

Zoning and Consistency with Land-Use Plans

As noted in Section 2.2, the project area has been zoned by Miami-Dade County in the Interim Use District (GU). Nuclear reactors are a permitted use in the Interim Use District (GU) following approval by the County of an Unusual Use application. Miami-Dade County issued Unusual Use Resolution Z-56-07 (Miami-Dade County 2007-TN1085) in 2007 authorizing development of proposed Units 6 and 7 and ancillary structures and equipment in accordance with the Interim District zoning. The Resolution requires protective measures related to protection and mitigation of biological and water resources, which would limit the effects on land uses and resources in the vicinity. For example, Condition 20 of the Resolution requires that impacts on any Miami-Dade County-designated Natural Forest Community (NFC), as a result of any FPL transmission line corridor improvement, be minimized and consistent with County NFC standards and requirements (Section 4.3) (Miami-Dade County 2007-TN1085). Impacts on biological and water resources are discussed in greater detail in Sections 4.2 and 4.3.1, respectively. Impacts on trees are discussed in Section 4.3.1.1.

Miami-Dade County separately issued Resolution Z-1-13 in 2013 authorizing development of the proposed RCW system and reclaimed water-treatment facilities, both proposed for siting within the project area (Miami-Dade County 2012-TN3638).

Mineral Resources

As stated in Section 2.2.1.1, there are no known oil or gas wells nor any mining activities located within or directly adjacent to the Turkey Point site boundary. Therefore, the review team expects that there would be no impacts on oil, gas, or mineral resources from onsite project development activities.

Agriculture and Prime or Unique Farmland

No part of the FPL Turkey Point site is used for agriculture. Agricultural land does, however, compose approximately 5 percent (around 2,860 ac) of land use within the 6 mi vicinity of the FPL Turkey Point site (Table 2-3). Most of this land is concentrated west-northwest of the site. As indicated in Section 2.2.1.6, no prime farmland or unique farmland, as defined in the Farmland Protection Act (7 U.S.C. § 4201(b)) (TN708), occurs anywhere on the Turkey Point site or in the vicinity. Therefore, the review team expects that there would be no impacts on agricultural land uses or on prime or unique farmland from onsite project development activities.

Coastal Zone Consistency

The Florida Coastal Management Act (Fla. Stat. 28-380-TN1147) authorizes the Coastal Zone Management Section of the Florida Department of Environmental Protection (FDEP) to certify consistency with the Florida Coastal Management Program for all Federal licenses, permits, activities, and projects when such activities affect land or water use. Section XXIII of the Conditions of Certification issued to FPL for Units 6 and 7 by the FDEP constitutes the State's concurrence that the project is consistent with the Florida Coastal Management Program.

Comprehensive Everglades Restoration Plan

Building Units 6 and 7 is not expected to substantially interfere with the objectives or implementation of the Comprehensive Everglades Restoration Plan (CERP). As discussed in Section 7.3.1 of this EIS, one CERP element involves restoring wetlands adjacent to Biscayne Bay and Biscayne National Park through the re-establishment of natural sheet flow and runoff patterns. Even though some of the pipelines and eastern corridor transmission lines do cross wetlands near the western shore of Biscayne Bay, these crossings follow existing rights-of-way and therefore use of the crossings to build pipelines or transmission lines is not expected to further fragment habitats or permanently alter surface flow patterns. Furthermore, many of the proposed wetland mitigation activities discussed in Section 4.3.1.6 would beneficially further the objectives of CERP. One wetland mitigation element FPL has proposed is to purchase credits in the Everglades National Park "Hole-in-the-Donut" in-lieu fee project, where the National Park Service (NPS) is restoring wetlands on abandoned agricultural land within Everglades National Park. Additionally, FPL is proposing to buy credits in the Everglades Mitigation Bank and proposing permittee-responsible mitigation for the enhancement of more than 800 ac of wetlands on FPL's Turkey Point site property. This too would benefit the objective of restoring wetlands close to the Biscayne Bay shoreline.

4.1.1.2 Pipelines

Reclaimed Wastewater Pipelines: As described in Section 2.2.2, FPL would build reclaimed wastewater pipelines in a corridor of approximately 9 mi long connecting proposed Units 6 and 7 and the Miami-Dade Water and Sewer Department (MDWASD) South District Wastewater Treatment Plant (SDWWTP) to the north (Figure 2-5) (FPL 2014-TN4058). For about 6.5 mi, the pipelines would be collocated with the existing Clear Sky to Davis transmission line right-of-way and adjacent road and canal rights-of-way, described below. The pipelines would then diverge from the existing right-of-way for another 2.5 mi. Current land uses within the corridor are listed in Table 4-2, and consist primarily of tree nurseries, streams and waterways, mangrove swamps, mixed wetland hardwoods, roads and highways, sanitary waste treatment, and solid waste disposal, of which approximately 10 percent (approximately 13 ac, as shown in Table 4-1) would be at least temporarily disturbed by building the pipelines and associated right-of-way (FPL 2014-TN4058). Building the pipelines would involve trenching beneath or along an existing access road on the west side of the corridor, resulting in vegetation changes and temporary habitat disruption (FPL 2014-TN4058). FPL proposes to grade the disturbed portions of the corridor to the contours of the surrounding landscape and revegetate or return these areas to previous land uses (FPL 2014-TN4058). FPL proposes to use environmental Best Management Practices (BMPs) to minimize impacts on adjoining sensitive habitats (FPL 2014-TN4058).

The portion of the pipeline route not already planned for roadway improvements is the north-south section along SW 137th Avenue/Tallahassee Road from SW 288th Street to SW 328th Street/North Canal Drive. For this portion of the route, primary land uses that would be disturbed are agriculture and wetlands as shown in Figure 2-9 and Table 4-2. Habitat and wetlands impacts are addressed in Section 4.3.1 of this EIS. Impacts on agriculture would be minimal as discussed in Section 4.1.1.1.

Table 4-2. Major Land-Use Acreages along the Reclaimed Water Pipeline to the FPL Reclaimed Wastewater-Treatment Facility (FPL 2014-TN4058)

Level 3	FLUCFCS Land-Use Category	Acres	% of Total
Reclaimed Wastewater Pipeline			
100	Urban and Built-Up Land	0.6	0.4
200	Agriculture	13.6	10.2
300	Rangeland	1.6	1.2
400	Upland Forest	0.3	0.2
500	Water	1.7	1.3
600	Wetlands	41.7	31.2
700	Barren Land	1.7	1.3
800	Transportation, Communications, and Utilities	72.6	54.3
	Total	133.7	100.00

(a) Due to rounding, table values may not exactly sum to the total acres and percentages.
FLUCFCS = Florida Land Use, Cover, and Forms Classification System.

Source: Adapted from RAI Letter 150211 (FPL 2015-TN4442)

The pipeline route is not expected to adversely affect mineral resources, agricultural operations, or prime or unique farmlands.

Potable Water Pipelines: Potable water pipelines would be built within the rights-of-way for other construction activities and would not result in additional land dedication or disturbance (FPL 2015-TN4442). Construction of these pipelines would not conflict or interfere with adjoining land uses.

4.1.1.3 Access Roadways

As described in Section 3.3.1 of this EIS, FPL would have to upgrade several roadways to allow heavy equipment to access the site. The proposed improvements include widening three existing roadways and building new roadways that follow the routes of existing unpaved roads (FPL 2014-TN4058). Approximately 128 ac of land would be used to complete the upgrades. Existing land uses in the areas of the proposed roadway improvements are listed in Table 4-3 (FPL 2014-TN4058). Because the proposed access road upgrades primarily involve land off of the Turkey Point site, the land uses are not tallied as part of the onsite land uses presented in Table 4-1 but are instead tallied separately and presented only in Table 4-3.

The proposed improvements for the existing paved roadways consist of widening roads from two lanes to four lanes on SW 328th Street/North Canal Drive, SW 344th Street/Palm Drive, and SW 117th Street, for a total roadway length of approximately 3.25 mi.

The proposed new roadways include the following:

- SW 359th Street at two locations, three lanes between SW 137th Avenue/Tallahassee Road and SW 117th Avenue (approximately 2 mi) and four lanes between SW 117th Avenue and proposed Units 6 and 7 (approximately 3 mi), and building a bridge over the L-31E Canal.

Table 4-3. Major Land-Use Acreages in Areas of the Access Road Improvement (FPL 2014-TN4058)

Access Road	Urban and Built-Up Land	Agriculture	Upland Forest	Water	Wetlands	Barren Land	Transportation, Communications, and Utilities	Total Acres[(a)]	% of Total
SW 117th Ave N		0.04		1.6	0.2		6.9	8.7	6.8
SW 117 Ave S				0.0	6.5		1.2	7.7	6.0
SW 137 Ave	0.6			1.7	3.5		1.6	7.4	5.8
SW 328 St.	0.5	7.3		2.1	4.0		10.6	24.5	19.2
SW 344 St.	0.6						1.0	1.7	1.3
SW 359 Ave E			0.8	1.9	31.6	6.9	5.6	46.8	36.7
SW 359 Ave W				0.1	27.8		3.1	31.0	24.3
Total Acres	1.8	7.3	0.8	7.3	73.6	6.9	30.0	127.7	100.0
% of Total[(a)]	1.4	5.7	0.6	5.7	57.6	5.4	23.5	100.0	

(a) Due to rounding, table values may not exactly sum to the total acres and percentages.

Adapted from FPL 2014-TN4058 Table 2.2-7.

- Three lanes at SW 137th Avenue/Tallahassee Road between SW 344th Street/Palm Drive and SW 359th Street (1 mi); and four lanes at SW 117th Avenue between SW 344th Street/Palm Drive and 359th Street (1 mi).
- The new paved roadway for SW 359th Street from SW 137th Avenue/Tallahassee Road to the Turkey Point site would also serve as the access road for the new transmission lines along its route. A South Florida Water Management District (SFWMD) canal crosses the L-31E Canal along the SW 359th Street route with FPL-owned property on either side.

Other improvements to existing intersections as well as development of two new intersections are proposed to accommodate traffic to and from proposed Units 6 and 7. FPL's proposed improvements include signalization and/or traffic-control personnel assigned to the intersection, depending on the peak traffic period and flow (FPL 2014-TN4058).

An existing FPL-owned right-of-way extends for approximately 5 mi from the Turkey Point site toward the west (SW 359th Street) and along portions of SW 117th Avenue south of SW 344th Street/Palm Drive. This right-of-way would accommodate a portion of the proposed roadway improvements. For the remaining 4 mi of roadway improvements, alignments are proposed to occur along the existing paved and unpaved roads, including private roads, including roads owned by FPL and other roadways to which FPL proposes to obtain access (FPL 2014-TN4058).

Roadway improvements would be located in unincorporated Miami-Dade County and within incorporated areas of the City of Homestead. The roadway corridor would run through lands zoned as follows (FPL 2014-TN4058):

- Agricultural District
- Interim District
- Planned Unit Development.

With the exception of SW 359th Street, all proposed roadways have been designated as roads by Miami-Dade County. FPL may be required to obtain easements or encroachment permits, including an easement from the SFWMD for the crossing of the L-31E Canal.

In its ER, FPL states that roadway design standards and construction would follow the requirements of the Miami-Dade County Public Works Department and the Florida Department of Transportation (FPL 2014-TN4058). Roadway development activities would include installing silt fences, removing vegetation, improving drainage, removing unsuitable soils, installing road base materials, and laying asphalt and striping. The shoulders would be appropriately sloped and surface-water runoff would be managed with the installation of swales and culverts at suitable locations.

Issues raised by Miami-Dade County in both the EIS scoping and the State certification process concerned potential impacts on existing land uses, including agriculture, open space, and recreational land uses, of the construction of new transmission line access roadways or improvement of roadways now not open to the public. Miami-Dade County has recommended conditions to the FDEP for inclusion with the site certification to address these issues (State of

Florida 2012-TN1248). The access roads are not expected to adversely affect mineral resources or prime or unique farmlands.

Considering the conditions and practices noted above, building and using the proposed access roads are not likely to interfere with adjacent land uses.

4.1.1.4 Fill Material – Sources and Transportation

FPL proposes to obtain the offsite fill from established regional sources. A number of fill sources in the region could meet the needs of FPL at the Turkey Point site.

To provide context for the potential impacts of fill mining, the review team considered the Atlantic Civil, Inc. mine as a viable commercial fill source. It is located south of Southwest 360th Avenue and east of US-1 and Card Sound Road (USACE 2013-TN3473). The review team also considered a rock mine in the Lake Belt Area as another viable commercial source of fill. This allowed the review team to consider a nearby location with limited capacity and a more distant site with extensive capacity. The Atlantic Civil rock mine is located about 10 mi west of the FPL site. The USACE has issued a permit for this location to expand the mine by approximately 494 ac over the next 20 years. The rock mine expansion described in the permit would occur in approximately 238 ac of jurisdictional wetlands that had been filled and farmed. The majority of this land has been used to raise corn and other row crops (approximately 158 ac). An additional 16 ac are wetlands dominated by exotic species (USACE 2013-TN3473). The review team assumes that SW 359th Street would be improved between the Turkey Point site and the rock mine to facilitate hauling the fill material to the site. Land-use effects of roadway improvements would be similar to those discussed above.

An alternative source of fill would be rock mines in the Lake Belt Area. The USACE signed a Record of Decision (ROD) for rock mining in the Lake Belt Area, and has issued a project-specific permit to Cemex Construction Materials Florida for its FEC Quarry. The quarry is named for the Florida East Coast (FEC) Railway that serves the quarry. The quarry and rail center are located approximately 40 mi north of the Turkey Point site. Portions of the FEC Quarry have been in use for some time. Discharge of dredged or fill material into more than 1,346 additional acres were permitted under a permit issued by the USACE in 2010 (USACE 2010-TN3555). Mines in the Lake Belt Area operate under the conditions of the Lake Belt Mitigation Plan. Under this plan, mine operators are required to document the wetland habitat that will be affected by clearing and mining activities. The operator is then required to perform the mitigation identified in the Lake Belt Mitigation Plan. The Cemex mine would not be operated solely to provide fill material to the FPL site. Therefore, only a portion of the preconstruction and construction impacts resulting from conversion of wetlands and farmland to mining would be considered directly attributable to the Turkey Point Units 6 and 7 project if this mine were to be used as the fill source for the project. The review team assumes fill material would be hauled over existing rail lines to a location near Homestead and then trucked to the FPL site using the roads FPL has proposed to improve to facilitate movement of fill material to the site.

Land-use changes resulting from conversion of wetlands and farmland to mining would be limited and would occur with or without FPL obtaining fill materials for the Turkey Point Units 6 and 7 project.

4.1.2 Transmission Line Corridors and Associated Offsite Areas

This subsection addresses the land-use impacts caused by the development of the preferred transmission line corridors and offsite substations.

4.1.2.1 Transmission Line Corridors

The land uses potentially affected by building the proposed transmission lines are presented by corridor in Table 4-4 (first the East corridor then the West corridor). While the table indicates the potentially affected land uses that exist along the corridors, the actual ground disturbance to build the transmission lines would affect only a small portion of the indicated land.

The transmission lines built in the East corridor from the Clear Sky substation (to be built within the plant area) to the Davis substation would traverse a mostly rural landscape composed mostly of agricultural lands with some wetlands and other naturally vegetated lands. They would traverse a mostly urban landscape from the Davis to Miami substations, but most of this segment would be built following existing roadways. A portion of the East corridor passes close to the western boundary of Biscayne National Park. A short segment of the East corridor (less than 2,000 ft in length) passes just inside the park boundary (FPL 2014-TN4058). Because the corridor already exists and would not be widened, its use would not constitute a new encroachment into the park.

The transmission lines built in the West corridor, regardless of whether the West Preferred or West Consensus corridor is used, would traverse a rural, mostly agricultural landscape as well as an area of limerock mining just east of Everglades National Park. Short segments of the West Preferred and West Consensus corridors abut the western perimeter of Everglades National Park along a canal levee. On March 16, 2016, the NPS signed a Record of Decision transferring approximately 260 ac of land along the western perimeter of the park to FPL for transmission line use in exchange for receipt from FPL of approximately 360 ac of land comprising an unused transmission line right-of-way traversing the eastern part of the park (NPS 2016-TN4532). As a result, no part of either the West Preferred or West Consensus corridors would encroach into Everglades National Park.

FPL worked to minimize land-use impacts from the transmission lines by using the Florida corridor selection process. Under that process, the State approves a corridor and the applicant chooses a specific right-of-way within the approved corridor. The objective of this process is to select a corridor balancing land use, socioeconomic, environmental, engineering, and cost considerations for certification by the State. Finalized siting plans and permitting conditions that would be imposed by the various affected State and local agencies would minimize impacts within the corridors. Engineering considerations and costs are likely to suggest designs that favor collocation with existing transmission lines in existing corridors. The siting criteria include land-use considerations to minimize potential disruption to such areas as national, state, and county parks; wildlife refuges; estuarine sanctuaries; landmarks; and historical sites. FPL states in its application that it attempted to select corridors that would allow collocation with existing

Table 4-4. Major Land-Use Acreages within the Proposed Transmission Line Corridors

Transmission Line Route	Urban and Built-Up Land	Agriculture	Range-land	Upland Forest	Water	Wetlands	Barren Land	Transportation, Communications, and Utilities	Total
East Corridor									
Clear Sky – Davis	9.4	418.3	76.1	1.1	17.7	71.7	1.6	38.9	634.9
Davis – Miami	483.0	13.6	19.2	2.1	16.7			465.4	1000.0
West Corridors									
Clear Sky – Levee Preferred	8.5	848.9	89.3	67.3	401.3	1,346.6	69.9	198.9	3,030.6
Clear Sky – Levee Consensus[(a)]		835.4	67.1	18.4	15.1	2,700.0	59.3		3,695.3
Levee – Pennsuco	86.93	0	0	0	1.77	169.41	19.42	34.76	312.3

(a) Does not include urban and built-up land as well as transportation, communications, and utilities; and streams and waterways acreages.
Source: Adapted from FPL 2014-TN4058 and FPL 2015-TN4442.

linear features, such as existing farm roads, canals, railroads, other existing FPL transmission line corridors, or highway or roadway or rail rights-of-way. The proposed corridors for the new transmission lines to serve proposed Units 6 and 7 would be built within Miami-Dade County; they are described in Section 2.2.3 and shown in Figure 2-5. The land uses along these proposed transmission line corridors are identified in Table 4-4 (FPL 2014-TN4058).

Miami-Dade County Unusual Use Resolution Z-56-07 Condition 20 (Miami-Dade County 2007-TN1085) states that "except as expressly pre-empted by State law, impacts on Miami-Dade County-designated NFC as a result of any FPL transmission line corridor improvement shall be minimized and consistent with the NFC standards and requirements of Chapter 24, Miami-Dade County" (Section 4.3).

As described in Section 2.2.2.1 of this document, the connection between proposed Units 6 and 7 and the proposed new Clear Sky substation would be an underground line, which would use only land within the 218 ac island comprising the plant area. For this reason, no new construction land-use impacts would be anticipated.

As described in Section 2.2.2.1, FPL proposes to build the new transmission lines originating from a proposed new onsite substation (Clear Sky substation, located within the 218 ac plant area) and connecting to the existing Levee substation (500 kV circuits), and to the existing Turkey Point, Davis, and Pennsuco substations (230 kV circuits) (Table 2-4 and Figure 2-5). Two major corridors are proposed – the West and the East corridor, with several transmission lines proposed within these corridors.

As part of the West Preferred corridor alignment, two access corridors would be established to provide access to the transmission line corridor and right-of-way. No transmission structures are proposed to be built in these access corridors, only access roads or improvements to existing roadways. The two access corridors (see Section 2.5.3, Figure 2-34) are the Tamiami Trail Corridor (U.S. Highway 41 [US-41]) and the Krome Avenue Corridor (State Route 997 [SR-997]) (FPL 2014-TN4058). Existing land uses for the transmission line access corridors are presented in Table 4-5.

Local communities have raised concerns about the visual impacts and potential indirect blight impacts as a result of the transmission lines (State of Florida 2011-TN1261; State of Florida 2012-TN1248; State of Florida 2011-TN1260). The NPS has also expressed concern about aesthetics and land-use effects of the location of transmission lines near Everglades National Park (NRC 2010-TN516). The State of Florida Siting Board considered the transmission lines and their environmental impacts, and issued Conditions of Certification in which the Siting Board approved the proposed transmission lines. Although the Florida Siting Board did not consider whether the transmission lines should be installed underground in certain areas, it did consider and impose a variety of other mitigation measures as part of the Conditions of Certification. The NRC staff is aware that on April 20, 2016, a Florida court issued an opinion in which it ruled that the Florida Siting Board should have considered whether to require FPL to bury a portion of the transmission lines, and that the record was inadequate to support certain mitigation measures associated with transmission lines in the East Everglades (State of Florida 2016-TN4781). Although the opinion remands the Conditions of Certification to the Florida Siting Board for consideration of the possibility of burying a portion of the

Table 4-5. Major Land-Use Acreages within Transmission Line and Substation Access Corridors

Transmission Line Corridor	Urban and Built-Up Land	Agriculture	Rangeland	Upland Forest	Water	Wetlands	Barren Land	Transportation, Communications, and Utilities	Grand Total
West Preferred									
Tamiami Ave.					2.7	3.1		4.7	10.5
Krome Ave.					85.3	200.2		79.2	364.7
Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**88.1**	**203.3**	**0.0**	**83.9**	**375.2**
West Consensus									
88th St.	2.1		0.8	12.0	0.0	18.3	0.3		33.5
L-31 Canal					11.4	4.7	21.0		37.1
NW 12th St.	13.3	6.5	0.1	0.4					20.2
Tamiami Trail						19.6			19.6
Subtotal	**15.4**	**6.5**	**0.8**	**12.3**	**11.4**	**42.6**	**21.4**	**0.0**	**110.4**
Substation									
Davis (East)		1.1							1.1
Levee (West)						1.8		0.5	2.3
Pennsuco (West)	2.4								2.4
Subtotal	**2.4**	**1.1**	**0.0**	**0.0**	**0.0**	**1.8**	**0.0**	**0.5**	**5.9**

(a) Due to rounding, table values may not exactly sum to the total acres and percentages.

Source: Adapted from FPL 2014-TN4058.

transmission lines and reconsideration of the specified mitigation measures, the NRC staff understands that the court's opinion is not yet final as of this writing (October 3, 2016). Accordingly, for the purposes of the FEIS evaluation of impacts, the NRC staff considers the transmission line route and conditions reviewed and approved by the Florida Siting Board as the most current information regarding the transmission line and associated potential mitigation measures. Even if the Conditions of Certification are revisited, the NRC staff considers it reasonable to expect that Conditions of Certification similar to or no less effective than those originally issued will be in place before construction and operation of the proposed units begins.

FPL has indicated that it plans to use existing rights-of-way within the West and East corridors to the extent practicable, to limit the areas of new disturbance (FPL 2014-TN4058). Building new transmission structures, tower pads, conductors, and access roads would result in vegetation loss and temporary habitat disruption. Land used for structure pads and access roads would be permanently converted to transmission line use. FPL has indicated that it would restore the areas between the towers along the transmission line alignment after construction and make these areas available, upon approval by FPL, for joint uses that do not jeopardize the safe and reliable operation of the transmission lines (FPL 2014-TN4058). Although the proposed transmission line corridors and associated access road routes cross agricultural land and some prime and unique farmland, the transmission lines could be constructed in a manner that does not interfere with current or future agricultural uses of the affected land or substantially degrade soil properties

FPL has further indicated that it routinely uses standard industry construction practices, environmental BMPs, and mitigation measures to ensure adverse environmental effects of construction are avoided, minimized, or mitigated (FPL 2014-TN4058). The following environmental protection and impact mitigation measures identified by FPL would also reduce land-use effects of construction within transmission line rights-of-way (FPL 2014-TN4058):

- use of restrictive land-clearing processes in forested wetland areas (right-of-way clearing and preparation)
- use of turbidity screens and erosion-control devices in areas of wetlands and water resources (access road/structure pad construction)
- use of existing access roads for ingress and egress to rights-of-way where available (access road/structure pad construction)
- use of standard industry construction practices for foundation and structure excavation and construction (line construction).

FPL would also be required to comply with applicable laws, regulations, and permit requirements. Standard industry construction practices that FPL proposes to use include erosion-control devices, matting to reduce compaction caused by equipment, use of wide-track vehicles when crossing wetlands, and restoration activities after the transmission lines are built. Impacts on wetlands are addressed in more detail in Section 4.3.1 of this EIS.

Based on information provided by FPL and the review team's independent review, the review team concludes that new and expanded transmission line corridor development impacts may potentially be noticeable to the public, including users of nearby national park lands, and affect existing land uses. This is because of the amount and extent of land that may be affected by new and expanded transmission line corridor development, and the extensively developed urban areas and sensitive national park lands adjacent or close to areas where some of the expanded transmission line corridor development activities would take place.

4.1.2.2 Substations

Upgrading and expanding offsite substations, in addition to the onsite Turkey Point substation expansion would require approximately 6.75 total ac of additional property for the expansions. Specific details for each substation are presented below.

- Improvements at the existing Levee substation would require expansion to include approximately 2.33 ac of additional land to accommodate a new bay with two 500 kV line terminals. The affected land comprises approximately 0.52 ac of existing electric power facility land (FLUCFCS Code 831) already designated by FLUCFCS for the Levee substation, plus approximately 1.81 ac of adjoining land designated as exotic wetland hardwoods (FLUCFCS Code 619). Construction activities would include filling, grading, and placing rock in the expansion area for construction of a new bay and associated equipment, and construction of a new stormwater-retention system.
- Improvements at the existing Pennsuco substation would require expansion to include approximately 2.42 ac of land currently mapped by FLUCFCS as being used for rock quarry uses (FLUCFCS Code 163) to accommodate the addition of a stormwater-retention system and installation of new equipment. Because work would be confined to a small area directly adjoining an existing substation, the review team does not expect that it would adversely affect quarry operations.
- Improvements at the existing Davis substation would require expansion to include approximately 1.12 ac of land currently used for tree nurseries (FLUCFCS Code 241), to accommodate the addition of two new 230 kV line terminals and installation of equipment to control power flow for the line connecting to the Miami substation.
- Improvements at the existing Turkey Point substation would be expansion by approximately 0.88 ac of land already designated by FLUCFCS as electric power facility land (FLUCFCS Code 831).
- Improvements at the existing Miami substation would take place within the footprint of the existing substation and not require any expansion or change in land use.

Work to carry out the proposed substation expansions would have to meet all environmental regulatory requirements. It could interfere with adjacent land uses or affect agricultural land or prime or unique farmland.

4.1.3 Summary of Land-Use Impacts

The review team evaluated potential land-use impacts from construction and preconstruction activities related to building the proposed Units 6 and 7 and associated facilities on the Turkey Point site and vicinity, in the region, in the proposed offsite transmission line corridors, and in offsite rights-of-way for roads and pipelines. The proposed activities in the project area would be compatible with existing and reasonably foreseeable land uses elsewhere on the Turkey Point site. Mitigation proposed by FPL and required by Miami-Dade County would ensure compatibility with regional land-use plans and land uses outside the site boundaries.

Building the transmission lines and other offsite facilities, including improving substations, installing pipelines, and building and improving access roads may interfere with existing offsite agricultural and open space land uses. Local communities have raised concerns about visual impacts and potential indirect blight impacts resulting from installation of the proposed new transmission lines. These issues were raised and considered in the State permitting process for the transmission lines. Miami-Dade County recommended an extensive list of conditions related to land use through the State certification process (State of Florida 2012-TN1248), and many of these conditions became Conditions of Certification, including the following:

- securing access to transmission line rights-of-way
- using pole designs that reduce visual effects and limit conflicts with tree canopy maintenance
- planting trees
- using design measures for compatibility with MetroRail
- using design measures for compatibility with pedestrian and bicycle pathways and trails.

Because the Conditions of Certification would be enforceable under state law, the review team considers actions specified by those conditions to be reasonably foreseeable mitigation. In addition, the review team expects that FPL would use BMPs when building any project facilities, including the transmission lines, as required by the State and County. These practices are designed to reduce the effects on surrounding lands.

Based on information provided by FPL and the review team's independent evaluation, the review team concludes that the land-use impacts of the construction and preconstruction activities would be MODERATE. This conclusion accounts for the location of the new plant facilities close to Biscayne National Park and the passage of the transmission lines close to Everglades National Park and to urban areas. However, considering the position of the new facility within an already established industrial setting and the mitigation required under the state Conditions of Certification, any conflicts with land-use objectives for the affected park areas would not be destabilizing.

The Limited Work Authorization (LWA) rule (72 FR 57416) (TN260) specifically states that site-preparation work, as well as building transmission lines, pipelines, heavy-haul roads and other offsite facilities are not included in the definition of NRC-authorized construction. NRC-authorized construction would be limited to activities necessary to develop safety-related structures on the Turkey Point site, a subset of the total development activities analyzed above for land-use impacts. All NRC-authorized construction would take place on property owned by FPL on a site zoned for use by energy-generating facilities. The proposed safety-related facilities would be constructed in an area of the Turkey Point site close to only undeveloped lands or lands already used by existing FPL power-generation facilities. Based on this analysis, the NRC staff concludes that the land-use impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted in regard to the NRC action.

4.2 Water-Related Impacts

Water-related impacts involved in building a nuclear power plant are similar to impacts associated with building any large industrial construction project. Prior to initiating building activities including any site-preparation work, FPL would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. The authorizations, permits, and certifications potentially required from Federal, State, regional, and local agencies are listed below. Additional detail regarding the items listed is contained in Appendix H.

- Clean Water Act (CWA) (33 U.S.C. § 1251 et seq.) (TN662) Section 401 is at 33 U.S.C. § 1341 (TN4764) certification. This certification is issued by the FDEP as part of Florida's Power Plant Siting Act (PPSA) Certification (Fla. Stat. 29-403.501 2011-TN1068) and ensures that the project does not conflict with State water-quality standards. This certification is required before the NRC can issue a COL to FPL. State of Florida's final Conditions of Certification include conditions identified by the SFWMD to ensure that water use is consistent with State standards. The Conditions of Certification are binding on FPL (State of Florida 2014-TN3637). If a DA permit is issued, the 401 Water Quality Certification would be required in addition to a Coastal Zone Consistency Determination, both of which are provided by the State of Florida.
- Department of the Army Permit. Authorization from the USACE would be required under CWA Section 404 (33 U.S.C. § 1344) (TN1019) for the discharge of dredge or fill material into waters of the United States associated with the site-preparation activities and construction of the nuclear power plant and its associated components. Authorization would also be required under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768) for the construction of structures or work in, under, or over navigable waters of the United States associated with the construction of the nuclear power plant and its associated components. The USACE will conclude its Clean Water Act Section 404(b)(1) Guidelines and public interest analysis for this permit decision in its Record of Decision. Furthermore, Section 14 of the Rivers and Harbors Act (33 U.S.C. § 408) (TN4769) requires authorization for any components of the project that would in any way impair the usefulness of a USACE Civil Works Project; a separate 408 review will be conducted to ensure there will be no inconsistency with the intended use that was authorized by Congress.
- Clean Water Act (33 U.S.C. § 1251 et seq.) (TN662) Section 402 is at 33 U.S.C. § 1342 (TN4765) National Pollutant Discharge Elimination System (NPDES) permit. This permit would regulate limits of pollutants in liquid discharges to surface water. The U.S. Environmental Protection Agency (EPA) has delegated the authority for administering the NPDES program in Florida to the FDEP. The NPDES permits are part of PPSA certification. A stormwater pollution prevention plan (SWPPP) for construction would also be required.
- Water-use permit. Consumptive use of surface water and groundwater would require a permit from the FDEP or the water-management district.
- Groundwater well drilling and operating permits. Construction of water wells would require a permit from the SFWMD.

- FDEP Class I Industrial Waste UIC Permits (Fla. Admin. Code 62-528-TN556). UIC wells are required to be constructed, maintained, and operated so that the injected fluid remains in the injection zone, and the unapproved interchange of water between aquifers is prohibited. Class I injection wells are monitored so that if migration of injection fluids were to occur it would be detected before reaching the underground source of drinking water (USDW).

4.2.1 Hydrological Alterations

Hydrologic alterations during building of proposed Turkey Point Units 6 and 7 may occur as a result of the following:

- clearing land and building infrastructures, such as roads, water lines (including reclaimed water), sewer lines, transmission lines, and stormwater-drainage systems, etc.
- modifications to the barge-turning basin
- dewatering foundation excavations of the nuclear island and discharge to the industrial wastewater facility (IWF) and its associated cooling canals
- construction of the RCWs and UIC wells
- demucking of the nuclear island and spoils disposal
- discharge of fill into wetlands.

The primary water resources that could be affected by building activities related to proposed Turkey Point Units 6 and 7 are listed below and discussed in the following subsections:

- Biscayne Bay
- Biscayne aquifer
- Floridan aquifers and Boulder Zone
- IWF (cooling canals)
- Offsite and adjacent areas.

4.2.1.1 Biscayne Bay

Hydrological alterations to Biscayne Bay during building of proposed Turkey Point Units 6 and 7 may occur as a result of (1) stormwater runoff, (2) building activities in the barge-turning basin, and (3) interactions between the IWF cooling canals and Biscayne Bay during dewatering of excavations. Concerning the potential effect of direct surface drainage from spoils disposal piles on Biscayne Bay during building of proposed Turkey Point Units 6 and 7, the review team is unaware of any reason that would preclude the use of engineering design solutions to prevent drainage into the C107 Canal, which would be the only potential direct surface-water pathway into Biscayne Bay. Seepage originating in the cooling canals and moving through the berms and the upward movement of groundwater that originated in the cooling canals does provide a pathway from the IWF to Biscayne Bay.

Stormwater Runoff

As discussed in Section 3.3.1.1, stormwater runoff from the plant area and the laydown area during building activities would be directed to the cooling canals of the IWF. Table 2-10, in the Local Site Drainage subsection of Section 2.3.1.1, provides annual discharge volumes from the building areas within the site as computed by the review team. As discussed in FPL's Stormwater Management Plan (FPL 2011-TN303), all stormwater runoff from the RWTF area, except the equipment area runoff would be routed to stormwater-management basins before being released to its surrounding wetland area. The review team determined that the building within the plant area and laydown area would not detectably alter the amount of runoff entering the cooling canals (which the review team currently estimate to have an average annual runoff of 1,163 ac-ft [Table 2-10]) because the area to be disturbed for the proposed units already drains into the cooling canals. While in Section 2.3.1.1 the review team acknowledges a hydrologic connection between the IWF and Biscayne Bay exists, it is reasonable to postulate that if the IWF is not altered by the construction of the plant there will be no associated changes to the Biscayne Bay.

Barge-Turning Basin

There is an existing barge-turning basin on the eastern edge of the Turkey Point plant property. As discussed in Section 3.3.1.11, the barge-turning basin would be enlarged by dredging a 4,356 ft^2 (0.1 ac) area to accommodate large barges for delivery of reactor components (reactor vessel, steam generators, steam turbines, the electric generator, and transformers). Sheet piles and curtain walls would be installed to separate the excavation area from the barge-turning basin and to prevent turbid waters from entering Biscayne Bay.

The review team examined the information provided in the ER (FPL 2014-TN4058). FPL would be required to comply with requirements of Section 10 of the River and Harbors Appropriation Act of 1899 (33 U.S.C. § 403) (TN4768), the USACE public's interest review (33 U.S.C. § 320.4) (TN424), and FDEP permits. FPL would also use BMPs to minimize the effect of disturbance of bottom sediment. Since the required permits, certifications, and the SWPPP that are protective of the environment would be implemented, and the preconstruction activities would result in temporary and localized impacts, the review team concluded that the effect on Biscayne Bay water quality of enlarging the turning basin would be minimal.

Dewatering and the Cooling-Canal System

As discussed in Sections 3.2.2.4 and 3.3.1.5, water removed during dewatering of the plant excavations would be routed to the IWF. FPL (2014-TN4058) estimated that a maximum of 1,000 gpm of groundwater would be pumped for up to 13 weeks at each of the two deep excavation pits of proposed Units 6 and 7 during the initial excavation and grouting phase. This would be followed by a 24-month period of pumping at up to 200 gpm at each plant excavation. Because the start of plant excavation would be staggered, the total maximum dewatering flow rate into the IWF is expected to be 1,000 gpm for 6 months, followed by 1,200 gpm for 6 months, followed by 400 gpm for 18 months and then 200 gpm for 6 months. However, taking a conservative approach, FPL's analysis assumed that the maximum dewatering flows would be 1,200 gpm for 1 year followed by 400 gpm for a period of about 24 months. The review team compared these conservative flow estimates to the volume capacity of the approximately 4,370 ac IWF cooling canals and found that, with no evaporation or infiltration of the added water, the level of the cooling canals would increase less than 6 in. during 12 months of dewatering inflow at 1,200 gpm. If evaporative losses were considered, any increase in IWF water level would be reduced further. This potential increase in volume and hydraulic head due to the addition of dewatering flows from the excavations is minimal and would cause a negligible change in the hydraulic head and groundwater fluxes from the IWF. The effect of these hydrological alterations on the IWF is minimal.

4.2.1.2 Biscayne Aquifer

Hydrological alterations to Biscayne aquifer during building of proposed Turkey Point Units 6 and 7 may occur as a result of (1) installation and testing of RCWs, (2) excavation of fill material from the Biscayne aquifer, (3) extraction of groundwater during dewatering of the plant excavations, (4) installation of the UIC wells and associated monitoring wells, and (5) increased use of potable water.

Installation and Testing of Radial Collector Wells

Installation of the RCWs would involve installation of pipelines and caissons on the Turkey Point peninsula and drilling of lateral collector wells in the Biscayne aquifer beneath Biscayne Bay. Design details are discussed in EIS Section 3.2.2.2. The pipeline and caisson excavation would require limited extraction of groundwater over a period of several months. Groundwater inflow to excavations would be controlled by sheet piles if needed. Extracted water would be discharged to the IWF (FPL 2012-TN126). Drawdown should be localized and confined to the area around the wells. FPL has stated that, if needed, the drilling area would be isolated and drawdown would be minimized through the use of sheet piling technology or the equivalent (FPL 2012-TN126). Drilling of the RCW laterals and initial test pumping of the wells would result in extraction of small amounts of groundwater compared to the volume that would be extracted during RCW operation, which is discussed in EIS Section 5.2.

Excavation of Fill Material

As discussed in EIS Section 3.2.2.3, up to about 14.4 million cubic yards of fill material would be needed to raise the ground-surface elevation of the proposed plant area and facilities associated with proposed Units 6 and 7. FPL has not made a final determination regarding the source of the fill material for the FPL site; however, FPL has indicated that it would use commercial fill sources in the vicinity of the Turkey Point site.

To provide context for the potential impacts of fill mining on the Biscayne aquifer, the review team considered the Atlantic Civil mine as a viable commercial fill source located south of SW 360th Avenue and east of US-1 and Card Sound Road in Sections 28, 29, 32, and 33 Township 57 South and Range 39 East, Florida City Florida (USACE 2013-TN3473). The review team also considered a rock mine in the Lake Belt Area as another viable commercial source of fill. This allowed the review team to consider a nearby location with limited capacity and a more distant site with extensive capacity.

The Atlantic Civil rock mine is located about 10 mi west of the FPL site. The USACE has issued a permit for this location to expand the mine by 494.2 ac over the next 20 years. The rock mine expansion described in the permit would occur in 238.4 ac of jurisdictional wetlands that had been filled and farmed. The majority of this land has been used to raise corn and other row crops (158.3 ac). An additional 16.3 ac are wetlands dominated by exotic species would be mined (USACE 2013-TN3473). The review team assumed that SW 359th Street would be improved between the Turkey Point site and the rock mine to facilitate hauling the fill material to the site.

An alternative source of fill would be rock mines in the Lake Belt Area. On January 22, 2010, the USACE signed an ROD for rock mining in the Lake Belt Area, and has issued a project-specific permit to Cemex Construction Materials Florida for its FEC Quarry. The quarry is named for the Florida East Coast (FEC) Railway, which serves the quarry. The quarry and rail center are located approximately 40 mi north of the Turkey Point site.

Portions of the FEC Quarry have been in use for some time. Discharge of dredged or fill material into over 1,346 additional acres was permitted under a permit issued by the USACE in 2010 (USACE 2010-TN3555). Mines in the Lake Belt Area operate under the conditions of the Lake Belt Mitigation Plan. Under this plan, mine operators are required to document the wetland habitat that will be affected by clearing and mining activities. The operator is also required to perform the mitigation identified in the Lake Belt Mitigation Plan.

The Cemex mine would not be operated solely to provide fill material to the FPL site. Therefore, if this mine were to be used as the fill source, only a portion of the preconstruction and construction land use impacts resulting from conversion of wetlands and farmland to mining would be considered directly attributable to the proposed Turkey Point Units 6 and 7 project.

Extraction of Groundwater during Dewatering of the Plant Excavations

Because of the high permeability of some sediments in the Biscayne aquifer, FPL would control inflow of groundwater to the excavations by placing a low-permeability grout curtain around each of the excavations and injecting grout into the sediments below the plant excavation. The review team determined that FPL would take additional measures to reduce groundwater inflow if needed, such as additional grouting or sheet piles. FPL (2014-TN4058) estimated that a maximum of 1,000 gpm of groundwater would be pumped for up to 13 weeks at each of the two deep excavation pits during the initial excavation and grouting phase, followed by a 24-month period of pumping at up to 200 gpm at each plant excavation. In their analysis, FPL conservatively assumed that the maximum dewatering flows would be 1,200 gpm for 1 year followed by 400 gpm for a period of about 24 months.

The review team determined that groundwater removed during excavation and building of the plants would come from the Biscayne aquifer, the IWF cooling canals, and Biscayne Bay. As discussed in Section 2.3, hypersaline water from the cooling canals has already migrated downward into the Biscayne aquifer beneath the cooling canals and also beneath the “mud island” location of the proposed plants (FPL 2012-TN3439). Therefore, groundwater removed during dewatering will contain some hypersaline groundwater that has migrated downward from the cooling canals. Dewatering of the excavations will create a hydraulic gradient toward the excavations. However, the review team determined that groundwater from the inland portions of the Biscayne aquifer is unlikely to move toward the excavations because the IWF and the L31-E Canal create sources of recharge that will replace water removed from the aquifer.

Installation of the UIC Wells and Associated Monitoring Wells

Construction of the UIC wells and associated deep monitoring wells requires drilling through the Biscayne aquifer and setting cemented well casings at each well location in order to reach the target formations. Saline fluids, drilling mud, and cuttings will be circulated to the surface. Additional information about the deep-well drilling activities is provided in Chapter 3. Potential impacts and safeguards are discussed in Section 4.2.3.

4.2.1.3 Floridan Aquifers and Boulder Zone

Hydrological alterations to Floridan aquifers and Boulder Zone during building of proposed Turkey Point Units 6 and 7 may occur from the installation of UIC wells and associated monitoring wells, and from the use of one or more of the wells for construction-related wastewater disposal while building the plants.

UIC Well Installation

As discussed in Chapter 3, 10 UIC wells, 2 backup wells, and 6 dual-zone monitoring wells would be built to support the UIC disposal of blowdown and other wastewater during plant operation. The UIC wells would be drilled to more than 3,000 ft below ground surface and completed in the Boulder Zone of the Lower Floridan aquifer. As planned, each monitoring well would have separated completions in the Middle Confining Unit of the Lower Floridan aquifer and in the lowest overlying USDW aquifer (described in Section 2.3). Monitoring would be placed between each pair of UIC wells for a total of six monitoring wells that would provide samples of groundwater in the deepest USDW aquifer and in the confining zone below the deepest USDW. The review team determined that drilling and completing these wells creates a potential for movement of water between aquifers. There is also a possibility of leaks from surface tanks or pits used to hold drilling fluids and saline water removed from the wells. However, construction of the UIC wells is regulated through FDEP Class I Industrial Waste Underground Injection Control Permits (Fla. Admin. Code 62-528-TN556). These regulations specify approved construction techniques, and testing and monitoring requirements to ensure that groundwater quality is not adversely affected by construction of the wells.

UIC Well Use During Construction

FPL (2014-TN4058) has stated that one of the UIC wells could be used to dispose of construction-related and sanitary wastewater in accordance with the UIC permit from the State of Florida. Injection volume restrictions and monitoring requirements of the UIC permit (Fla. Admin. Code 62-528-TN556) would apply. The volume and injection flow rate of this waste is expected to be less than the rates during operation of proposed Units 6 and 7 and would be bounded by use during operations, as discussed in Section 5.2.

4.2.1.4 IWF (Cooling Canals)

Hydrological alterations affecting the IWF (cooling canals) that would be associated with the building of proposed Turkey Point Units 6 and 7 may occur as a result of (1) increased stormwater runoff, (2) demucking of the plant area and muck/spoils disposal, and (3) dewatering from excavation.

Stormwater Runoff

Engineered fill would be used to raise the ground surface in the power block area to 25.5 ft NAVD88 (Zilkoski et al. 1992-TN1232). Raising the grade level in the plant area would permanently change the drainage pattern in the area. As described in Section 3.2.2.1, the stormwater-drainage system around the proposed Turkey Point Units 6 and 7 facilities (within the plant perimeter wall) would direct stormwater to catch basins that would discharge to the IWF. Runoff from the laydown area west of the main plant site, and from the nuclear administration and training facility area north of the main plant site, would also discharge to the IWF. Stormwater runoff from the RWTF area, however, would be routed to two stormwater-management basins, before being released to its surrounding wetland area.

FPL has indicated that environmental control measures such as berms, riprap, sedimentation filters, and detention ponds would be used to control stormwater runoff from the spoils piles to the IWF (FPL 2014-TN4058; FPL 2011-TN1042).

Demucking of Nuclear Island and Muck/Spoils Disposal

As discussed in Section 3.2.2.3, approximately 5 ft of earthen material would be excavated from the plant area and disposed of in spoils disposal areas. Spoils disposals areas would be established at three locations (Figure 3-1): one along the side of the main return canal on the south end of the IWF and one each along the east and west sides of the main return canal. Section 3.3.1.9 discusses BMPs to control drainage from the spoils disposal areas.

The review team independently estimated the volume and depth of spoils on the cooling-canal berms based on information in EIS Figure 3-1. The review team estimated the total length of berms to be used for spoils disposal as approximately 53,400 ft; the average width was estimated to be 165 ft ranging from approximately 95 ft to 250 ft, which provides a maximum disposal area of approximately 210 ac, which would result in complete coverage of the berms by spoils disposal. However, because of the need for structural components and an access road, the review team estimated the actual disposal area available would be half that, or 105 ac.

The review team estimated the volume of spoils disposal based on an excavation area of 219 ac and excavation depth to 5 ft (EIS Section 3.3.1.3), which produces approximately1.8 million cubic yards of material. Based on the spoils volume, the review team estimates the average spoils disposal thickness to be 10 ft over the disposal area. Because the spoils are to be disposed of in a trench, the average elevation of the disposed material would increase by less than 10 ft. However, because the spoils would be mounded, the maximum depth would likely be greater than 10 ft. According to EIS Section 3.2.2.3, the maximum elevations of the spoils piles would be 16 to 20 ft NAVD88 (North American Vertical Datum of 1988) and the height above the berm would be 10 to 14 ft, which agrees with the review team's independent estimate.

A potential concern is pore-water drainage from the spoils piles to the cooling canals during the muck-disposal period. While not a water body regulated for water quality, there is concern related to the potential impact on Federally protected crocodiles, which nest on the cooling-canal berms at several IWF locations and the potential to affect Biscayne Bay water quality from muck disposed of along the southern boundary of the IWF. Round 2 of the Florida SCA review (July 2010) (FPL 2010-TN3664) reports nutrient concentrations measured from muck pore-water samples. The drainable pore-water content is estimated to be 8 to 12 percent by volume. For the total 1.8 million cubic yards (1.38 million cubic meters) of muck to be excavated, the review team computed the maximum drainage volume to be 1.65×10^5 m^3. For the evaluation of the potential maximum impact, the review team made several assumptions: (1) the volume of pore-water drainage was added to the IWF over the pre-construction period (69 months [5.75 years] [FPL 2014-TN4058]), which results in an average pore-water discharge rate of 9.021×10^{-4} m^3/s; (2) the nutrient concentrations in the pore-water drainage were represented by average concentrations reported in the Round 2 SCA documentation (FPL 2010-TN3664); and (3) the constituents were conservative (no loss except by dilution). The average nutrient concentration measured in the muck pore water for total Kjeldahl nitrogen (TKN) was 5.10 mg/L (Round 2 SCA) (FPL 2010-TN3664). For total phosphorus (TP), the geometric mean concentration in the muck pore water was 0.174 mg/L (Round 2 SCA) (FPL 2010-TN3664). Using the estimated average discharge rate and the concentrations, the review team computed the daily load of TKN to be 0.398 kg/d and the daily load of TP to be 0.0136 kg/d.

Using water and mass-balance methods, the review team calculated the concentrations of TKN and TP within the cooling canals from pore-water drainage of spoils piles. To compute the mass balance, the review team first calculated a water balance using the cooling-canal storage information from the *Cooling Canal System Modeling Report* (Golder 2008-TN1072) and the FPL 2012 *Uprate Report* (FPL 2012-TN3439). The water balance data from the FPL 2012 uprate was averaged by month and repeated over a 9-year period to provide inflows and outflows to the cooling canals for use in the mass-balance calculations. Figure 4-1 shows the review team's computed cooling-canal volumes for this period.

Using the computed TKN and TP loads to the cooling canals, the review team computed the maximum incremental concentration increase from pore-water drainage into the cooling canals would be 8.6 µg/L for TKN and 0.29 µg/L for TP. The response curve for TKN is shown in Figure 4-2 as an example of the type of response computed from pore-water drainage. The response curve for TP would have an identical shape but the concentration axis would be rescaled by the ratio 0.29/8.6. The incremental concentration decreased following the end of the pre-construction period when the pore-water discharge to the IWF has reduced to a very small level. For reference, the FDEP limit for TP concentration is 10 µg/L. Note that the actual spoils disposal rate to the disposal areas would be small because the excavation would be done over a period of several years.

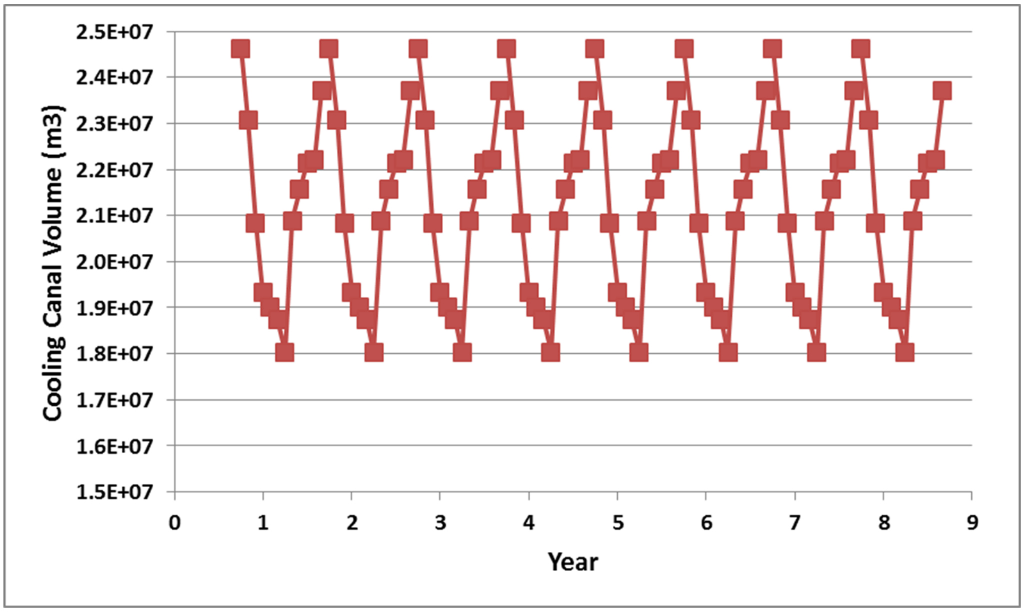

Figure 4-1. Cooling-Canal Volumes Calculated by the Review Team Using Estimated Monthly Fluxes from the FPL Uprate Report 2012 (FPL 2012-TN3439). ***The review team used monthly averages to estimate the repeating seasonal variation in volume. A break in the line occurs between December and January of each year.***

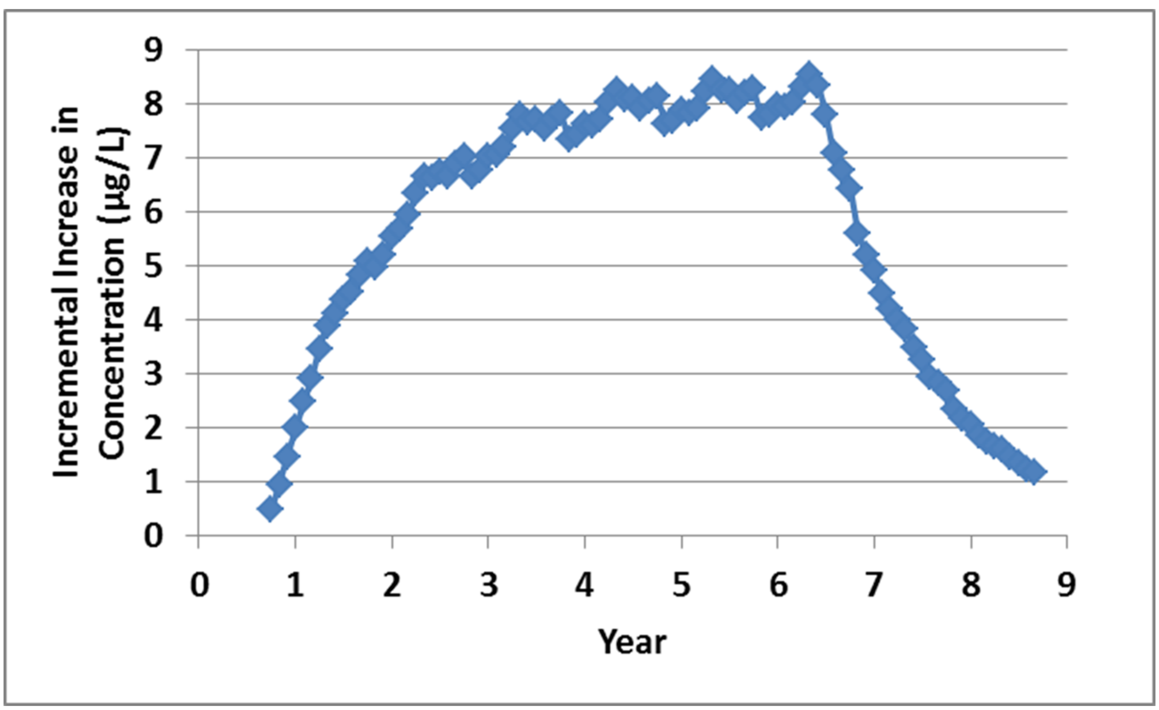

Figure 4-2. Concentrations of TKN Using Estimated Monthly Fluxes from the FPL Uprate Report 2012 (FPL 2012-TN3439). ***Hydrologic conditions are those used to estimate the cooling-canal volumes shown in Figure 4-1.***

Dewatering from Excavation (Water Quality)

As discussed previously regarding alterations to the IWF from the dewatering discharge, the expected volume of water going from the excavations to the IWF is small in comparison to the total volume of the IWF cooling canals. The total dewatering volume produced at the maximum expected dewatering rate of 1,200 gpm (1.7 Mgd) for 1 year is a small percentage of the 4,200-million–gallon volume of the IWF (about 15 percent). After the first year, a maximum dewatering rate of 400 gpm was conservatively predicted to continue for about 24 months (FPL 2014-TN4058). Also, according to FPL (2014-TN4058), the recirculating water in the IWF is 2,747 Mgd so that the maximum dewatering discharge is approximately 0.06 percent of the recirculating water already sent to the IWF. The water quality of the dewatering discharge would be similar to the aquifer water quality, and it would have no greater effect on the water quality of the IWF than does the existing groundwater influx. Consequently, the review team finds the hydrologic alterations on water quality from discharging of dewatering flows to be minimal.

4.2.1.5 Offsite/Adjacent Areas

According to ER Section 3.3.1, offsite activities will be conducted for building transmission lines, pipelines, and road improvement areas (FPL 2014-TN4058). Hydrological alterations of offsite/adjacent areas during building of proposed Turkey Point Units 6 and 7 may occur as a result of (1) building activities related to pipelines and transmission lines and (2) stormwater runoff.

Pipelines and Transmission Lines

As discussed in Section 3.3.1.14, installation of offsite pipelines would require land clearing along the pipeline corridor, shallow excavation (trenching), and backfilling. Potential erosion would be controlled using turbidity screens, erosion-control devices, and BMPs. FPL would obtain an NPDES permit from the FDEP that would include the SWPPP with controls and practices to minimize storm-produced discharges. Localized, short-term, building-related dewatering of shallow excavations associated with pipelines and other utilities would result in limited extraction of groundwater from the Biscayne aquifer, primarily within the footprint of the Turkey Point site boundaries and along the reclaimed water pipeline corridor. Once final designs are submitted, these dewatering activities would require approval from the FDEP and the SFWMD. Consequently, the review team considers the hydrologic alterations due to pipeline building to be minimal.

During installation of the proposed new transmission lines, hydrologic alterations to offsite surface waterbodies could occur. No surface or groundwater would be used in the installation of these lines. In either of the alternative routes proposed, the lines would cross numerous water bodies and wetlands. The review team identified no conditions to suggest that erosion and sedimentation control could not be achieved through the application of BMPs.

Stormwater Runoff

As discussed in Section 3.3.1.8, improvements to roads will require drainage ditch installation, culvert installation, fill placement, road paving, and bridge installation. Requirements of the

Miami-Dade County Public Works Department and the Florida Department of Transportation would be followed. Potential erosion would be controlled using turbidity screens, erosion-control devices, and BMPs. The review team discussed stormwater management with SFWMD experts and they identified no unique conditions at the Turkey Point site to suggest that standard BMPs would not be adequate to mitigate stormwater impacts during construction of Units 6 and 7.

4.2.2 Water-Use Impacts

The impacts of building a nuclear power plant on water use are similar to impacts that would be associated with the development of any large industrial site. This section includes identification of the proposed activities associated with building proposed Turkey Point Units 6 and 7 that could affect water use, and analysis and evaluation of proposed practices to minimize adverse impacts on water use by those activities.

4.2.2.1 Surface-Water-Use Impacts

FPL has indicated that surface water would not be used as a source of water supply for construction and preconstruction activities for proposed Turkey Point Units 6 and 7. Water needed for construction and preconstruction would be obtained through the existing potable water supply from Miami-Dade County.

Therefore, the NRC staff concludes that the impacts on surface-water use during construction and preconstruction activities for the proposed Turkey Point Units 6 and 7 would be SMALL, and no mitigation would be warranted. Also, because NRC-authorized construction activities represent only a portion of the above analyzed activities, the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL, and no mitigation measures would be warranted.

4.2.2.2 Groundwater-Use Impacts

The review team determined that groundwater removed from the Biscayne aquifer through dewatering during excavation and building of the plant foundations would be recharged by nearby surface-water features including the cooling canals, Biscayne Bay, and the L-31E Canal. Some recharge would also come from infiltration of rainfall in the area. The nearest municipal water-supply wells located in the Biscayne aquifer are approximately 7 mi inland. Because of the layered nature of sediments within the Biscayne aquifer, it is possible that some groundwater could move from the inland portion of the aquifer through deeper permeable layers and be captured by excavation dewatering. However, the review team determined that the total volume of groundwater that could be captured from the inland aquifer is a very small percentage of the volume removed during dewatering. Therefore, excavation dewatering would have at most small impact on groundwater users.

Groundwater would be removed from the saline portion of the Biscayne aquifer during RWTF excavation activities. However, relatively small volumes would be removed over a limited time period and no groundwater users are within the area where detectable water table drawdown is expected. Therefore, the dewatering would result in, at most, small impact on groundwater users.

The maximum increased demand for municipal potable water from MDWASD, which is sourced almost entirely from the Biscayne aquifer, is estimated to be 0.814 Mgd for building-related activities and 0.514 Mgd to supply the increased population of construction workers and their families (FPL 2014-TN4058). The total maximum increase in demand of 1.328 Mgd represents less than 0.4 percent of the 349.5 Mgd that MDWASD is permitted to pump each year from the Biscayne aquifer (SFWMD 2012-TN4114). However, the review team expects that the actual rate of water use for building activities will usually be significantly lower and may be offset by using stormwater runoff and water produced from dewatering the excavations. Therefore, increased demand for municipal water for building the plants would have at most a small impact on groundwater users.

The review team determined that groundwater alterations during the building of the proposed plant would not interfere with either the Administrative Order (AO; FDEP 2014-TN4144) or the Consent Agreement (CA; Miami Dade County v. Florida Power & Light 2015-TN4505) activities associated with controlling the IWF salinity and mitigating the hypersaline plume that has extended beyond the site. One well on Mud Island was used as part of the initial freshening efforts soon after the beginning of the algae bloom. This well is open to the Biscayne aquifer, and water from this well is ineffective at lowering salinity in the canals because its salinity is greater than the dilution target for the canals. The location of hypersaline mitigation wells to be drilled is not precisely known at this time. The remediation may be complete before any building activities related to Units 6 and 7 begin, but if the activities overlap in time, ample space at the site exists to support both activities. Site preparation (including dewatering, which is limited by grout barriers) and building activities would only result in very shallow and localized changes in the quality of the Biscayne aquifer.

Based on the information provided by FPL and the review team's independent evaluation, the review team concludes that the water-use impacts of construction and preconstruction activities would be SMALL, and mitigation beyond the State of Florida's final Conditions of Certification (State of Florida 2014-TN3637) for proposed Units 6 and 7 are likely not to be required. Based on the preceding analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the review team concludes that the impacts of NRC-authorized construction activities would be SMALL. The review team also concludes that mitigation beyond the FDEP final Conditions of Certification would not be warranted.

4.2.3 Water-Quality Impacts

Building activities related to proposed Turkey Point Units 6 and 7 may affect the quality of surface water and groundwater as discussed below.

4.2.3.1 Surface-Water-Quality Impacts

Surface-water quality of nearby water bodies could be affected by stormwater runoff from the site during preparation and building of the facilities. Dredging for the equipment barge-unloading area for the barge slip could affect surface-water quality by producing turbidity plumes that could enter Biscayne Bay.

The FDEP requires FPL to develop a SWPPP (FPL 2014-TN4058) in accordance with the guidelines and specifications in the *State of Florida Erosion and Sediment Control Designer and Reviewer Manual* (HydroDynamics 2007-TN3678). The plan would be developed prior to initiation of site-disturbance activities and would identify stormwater BMPs, including erosion and sediment-control measures to be used during site-preparation activities (FPL 2014-TN4058). Because the transport of sediment in the stormwater runoff from the disturbed area would be minimized by the use of BMPs and controlled by a stormwater-retention basin (in the case of the RWTF), the effects on offsite water quality are expected to be minor.

Section 3.2.2.3 discusses the excavation needed to expand the equipment barge-unloading area. Sediment and soils disturbed during excavation of the equipment barge-unloading area would be largely contained by a curtain wall. Because the curtain wall is likely not watertight, tidal exchange would flush some turbid water into the barge canal and possibly into Biscayne Bay; however, the impact would be minor, localized, and temporary.

Section 3.2.2.3 states that muck spoils would be disposed on the berms of the IWF. Pore-water drainage from spoils piles at disposal area B along the C-107 Canal has the potential to enter Biscayne Bay via the C-107 Canal and Card Sound. To evaluate the potential impact on water quality from spoils pore-water drainage, the review team calculated the maximum incremental increase of concentration from a discharge into Card Sound. The review team computed the portion of the disposal area that lies adjacent to the C-107 Canal to be approximately 5 percent of the total disposal area. The review team's calculation also included the duration of muck excavation and disposal of spoils of 69 months (5.75 years), which is the duration of the preconstruction period (EIS Section 3.3.2). For the disposal area and duration, the review team estimated a discharge rate of 4.53×10^{-5} m^3/s. Pore-water concentrations in the muck slated for excavation and disposal are 5.1 mg N/L for TKN and 0.17 mg P/L for TP (FPL 2010-TN3664). Using the USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) water-quality model (USACE 2014-TN4128) and available bathymetry for Biscayne Bay and Card Sound (NOAA 2014-TN3665), the review team made a mass-balance analysis to estimate the maximum increment increase in concentration in Card Sound. The analysis assumed the discharge was directly to Card Sound and that there were no other inflows to or tidal exchange with Card Sound. The only volume into which the discharge would be diluted was that of Card Sound. Using the discharge rate, concentrations, and flow and mass-balance approach, the review team computed the maximum incremental increase in concentration as 2.91×10^{-7} mg/L for TKN and 1.43×10^{-8} mg/L for TP. Because any inflow to Biscayne Bay from Card Sound would be subject to additional dilution by tidal exchange, concentrations in Biscayne Bay would be even smaller due to mixing from tidal exchange.

The review team determined that minimal surface-water quality alterations during the building of the proposed plant would not interfere with either the AO (FDEP 2014-TN4144) or the CA (Miami Dade County v. Florida Power & Light 2015-TN4505) activities associated with controlling the IWF salinity and mitigating the hypersaline plume that has extended beyond the site. Building activities associated with Units 6 and 7 would not change the salinity in the IWF. The increase in nutrients in the IWF from drainage of muck from Mud Island is expected to be minimal and could be controlled via BMPs.

Based on information provided by FPL and the review team's independent evaluation, the review team concludes that the impacts of construction and preconstruction activities on surface-water quality at the site would be temporary and SMALL, and no further mitigation, other than the BMPs discussed, would be warranted. Based on the preceding analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the review team concludes that the impacts of NRC-authorized construction activities on surface-water quality would also be temporary and SMALL, and no mitigation other than BMPs would be warranted.

4.2.3.2 Groundwater-Quality Impacts

Dewatering of the site during construction would result in discharge to the cooling canals of the IWF. The maximum dewatering discharge to the cooling canals is estimated to be 1,200 gpm from dewatering (EIS Section 3.3.1.5). The recirculation rate of the cooling canals is 2,747 Mgd (EIS Section 2.3.1.1), so that the dewatering discharge rate is 0.062 percent of the recirculating flow rate and 15 percent of the IWF capacity over the 1 year of expected dewatering at that rate. The inflow from dewatering would be balanced by additional groundwater outflow from the unlined bed of the cooling canals so that the increase in water-surface elevation would be less than 1 ft (FPL 2012-TN126). The review team's review of this analysis confirms this conclusion based on the information provided by Golder Associates, Inc. (Golder 2008-TN1072). Consequently, the impact of the discharge of dewatering effluent from construction of the plant foundation to the cooling canals would not be detectable in the cooling canal system. The increase in seepage from the cooling canals to the underlying groundwater system would be offset by the removal of groundwater from the excavations and the groundwater in this area has already been affected by years of cooling canal seepage. Therefore, the staff determined that the impacts on the groundwater quality beneath the cooling canals would be minor.

The review team determined that activities related to the construction of injection wells and monitoring wells related to the proposed wastewater injection into the Boulder Zone at proposed Units 6 and 7 would have negligible effects on groundwater quality in the surficial Biscayne aquifer and the deeper Floridan aquifer system. Construction of the UIC wells is regulated by FDEP Class I Industrial Waste Underground Injection Control Permits (Fla. Admin. Code 62-528-TN556). These regulations specify approved construction techniques and testing and monitoring requirements to ensure that groundwater quality is not adversely affected by construction of the wells. For example, drilling of the first deep well (EW-1) required that shallow monitoring wells be placed at each of the four corners of the drilling pad to a depth of 30 ft for determination of water-quality parameters in the Biscayne aquifer based on weekly samples. The UIC construction permit and other local authorities also require approval of disposal sites for drilling fluids, cuttings, or waste generated in constructing or testing the wells. The review team determined that following these regulations would protect groundwater quality during installation and testing of the UIC wells and associated monitoring wells.

One of the UIC wells could be used to dispose of construction-related and sanitary wastewater (FPL 2014-TN4058). Because the volume and injection flow rate of this waste are expected to be less than the rates experienced during operation of proposed Units 6 and 7, the review team determined that the potential impact would be less than the impact of operational use discussed in Section 5.2. Injection volume restrictions and monitoring requirements of the UIC permit (Fla. Admin. Code 62-528-TN556) would also apply.

The plant excavation and building activities create a potential for stormwater infiltration to transport pollutants from spills (e.g., gasoline) to the surficial aquifer. FPL has committed to cleanup any such spills to prevent them from affecting groundwater (FPL 2014-TN4058). Impacts on groundwater quality would be monitored and controlled using the Florida BMPs for stormwater management (FDEP 2012-TN1539). Cleanup of spills or other contaminants that could affect groundwater would also be required by the final Conditions of Certification issued by the State of Florida (2014-TN3637).

The review team determined that alterations in groundwater quality during the building of the proposed plant would not interfere with either the AO (FDEP 2014-TN4144) or the CA (Miami Dade County v. Florida Power & Light 2015-TN4505) activities associated with controlling the IWF salinity and mitigating the hypersaline plume that has extended beyond the site. Site preparation and building activities would only result in very shallow and localized changes in the quality of the Biscayne aquifer.

Based on information provided by FPL and the review team's independent evaluation, the review team concludes that the impacts of building activities on groundwater quality at the site would be temporary and SMALL, and no further mitigation, other than the BMPs discussed, would be warranted. Based on the preceding analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the review team concludes that the impacts of NRC-authorized construction activities on groundwater quality would be temporary and SMALL, and no mitigation would be warranted.

4.2.4 Water Monitoring

Both surface-water and groundwater monitoring would be performed during building activities at the proposed Turkey Point site.

4.2.4.1 Surface-Water Monitoring

Prior to initiating building activities, FPL would be required to develop an SWPPP by FDEP (FPL 2014-TN4058). During building activities for proposed Turkey Point Units 6 and 7, the SWPPP would be in effect and may include a monitoring program (FPL 2014-TN4058). As required by FDEP, FPL states that monitoring would occur at the following locations (FPL 2014-TN4058):

- cooling canals
- barge-turning basin
- Biscayne Bay.

As required by FDEP, Turbidity is listed as a constituent to be monitored for each of these locations; water level is listed for the cooling canals (FPL 2014-TN4058). Other locations may be monitored as required by FDEP (FPL 2014-TN4058).

Chemical monitoring during construction is discussed in the ER (FPL 2014-TN4058). FPL states that surface-water quality monitoring of the industrial discharge to the cooling canals would continue as required by the IWF permit (FDEP 2014-TN3676). In addition, water-quality monitoring would be established at construction monitoring points, including the barge-turning basin and Biscayne Bay.

Because the review team anticipates only minor impacts on surface waters from building of proposed Turkey Point Units 6 and 7, no additional monitoring would be warranted.

4.2.4.2 Groundwater Monitoring

Most pre-application monitoring wells completed in the Biscayne aquifer are located within the disturbance footprint and would need to be decommissioned in accordance with FDEP or SFWMD regulatory guidelines. Section 6.6.2 of the ER (FPL 2014-TN4058) describes that new monitoring wells would be installed and sampled to monitor dewatering and construction impacts on the Biscayne aquifer at the two nuclear island excavations. Monitoring and reporting of groundwater quality in the vicinity of the UIC well installation activities would be required by FDEP to ensure that shallow groundwater in the Biscayne aquifer is not affected by fluids generated during installation and testing of the deep wells by FPL (FDEP 2010-TN1578; FPL 2012-TN1577). The report describes the shallow monitoring wells and sampling results associated with installation and testing of these deep wells. FPL could inject construction-related and sanitary wastewater into the Boulder Zone using one of the deep-injection wells after the injection permit is obtained from FDEP (FPL 2014-TN4058). Monitoring of the Upper Floridan aquifer and the underlying confining zone would be required in accordance with the FDEP UIC permit. Because the review team anticipates only minor impacts on groundwater from building of proposed Turkey Point Units 6 and 7, no additional monitoring would be warranted.

4.3 Ecological Impacts

This section describes the potential impacts on ecological resources resulting from development of proposed Turkey Point Units 6 and 7 and associated offsite facilities, including transmission lines required to tie into the Florida electrical grid system and pipelines to deliver potable water and reclaimed water for the cooling system. These facilities and their associated construction and preconstruction activities are described in Section 3.2 and Section 3.3, respectively. Impacts on terrestrial resources and wetlands are presented in Section 4.3.1, and impacts on aquatic resources are addressed in Section 4.3.2.

4.3.1 Terrestrial and Wetland Impacts

This section evaluates impacts on terrestrial and wetland resources from site-preparation activities and build-out for the proposed Turkey Point Units 6 and 7 and associated offsite facilities.

4.3.1.1 Terrestrial Resources – Site and Vicinity

The review team assumes that all terrestrial habitats within the proposed approximately 585 ac within the Units 6 and 7 project area would be permanently disturbed (Table 4-6). Building activities affecting terrestrial habitats on the site and in the vicinity include the following: land clearing and site preparation; building the power blocks and associated buildings; building the cooling system, RCWs, and cooling towers; storage of spoils; plant access road building and modification; and underground injection controlled well installation.

Table 4-6. Extent of Proposed Impacts on Cover Types at the Turkey Point Site

Cover Type (Habitat)	FLUCFCS Code[(a)]	Availability in 6 mi Vicinity (ac)	Permanent Turkey Point Site Impacts (ac)	Total Impact Relative to Availability in 6 mi Vicinity (%)
Fill Areas	744	517	232	45
Non-Vegetated	650	394	182	46
Dwarf Mangroves	612-B	113	37	33
Mangrove Swamps	612	3,344	28[(a)]	1
Streams and Waterways	510	302	12	4
Mangrove Heads	612-A	12	12	100
Reservoirs >500 ac	531	13	12	93
Sawgrass Marsh	6411	14	12	85
Disturbed Land	740	121	10	9
Wetland Spoils	743-WET	9	9	99
Ditches	511	19	9	45
Australian Pine	437	16	8	49
Electrical Power Facilities	831	5,725	7	0.1
Spoil Areas	743	62	6	10
Roads and Highways	814	103	6	5
Mangrove Swamp/Willow and Elderberry	612/618	2	2	100
Exotic Wetland Hardwoods	619	45	1	1
Australian Pine	619-AP	1	>1	28
Total		10,812	585	5.4

(a) Although FPL regards impact to 3.98 ac of mangrove swamp from radial collector well delivery pipeline installation as temporary, the review team regarded impact to mangrove swamp from pipeline installation as permanent. Woody vegetation is not usually allowed to reestablish within pipeline corridors. However, the review team acknowledges FPL proposes to allow in situ regeneration of natural herbaceous wetland vegetation. There would still be a permanent loss of wetland function resulting from the loss of forest cover.

The largest impact on terrestrial habitats on the Turkey Point site would result from land clearing and site preparation for building the power blocks and associated facilities within the proposed 218 ac Units 6 and 7 plant area (Table 4-7). Placement of new spoils within three spoils areas outside of the plant area (Spoils Areas A, B, and C) would affect approximately 211 ac of additional land on previously filled lands within the IWF (generally on elevated berms separating cooling canals). Several other smaller areas to the north and west of the plant area would also be disturbed to accommodate support facilities (Figure 3-1). Other than the exception noted in the next paragraph, the review team's impact determination is based on an expectation that all impacts on habitat would result in permanent loss (at least for the duration of Units 6 and 7 operations).

The one exception involves non-forested wetlands within pipeline corridors. FPL proposes to remove, store, and replace topsoil following pipeline installation and restore the pipeline corridor to its original grade. Revegetation of the pipeline corridors was also proposed either by natural recruitment or supplemental planting if necessary. However, the review team determined the impacts on forested wetlands within pipeline corridors, including areas of mangrove cover, would be permanent (permanently converted from forested to emergent wetlands). Because woody growth is typically restricted from reestablishment within pipeline corridors, forested wetlands within pipeline corridors would be permanently converted to herbaceous wetland.

Table 4-7. Permanent Habitat Loss on the FPL Turkey Point Property Attributed to Building Units 6 and 7 Facilities

Area	Total Acres	Wetland Acres[(a,b)]
Proposed Units 6 and 7 Plant Area	218.27	211.92
Equipment Barge-Unloading Area	0.75	0
FPL Reclaimed Water-Treatment Facility (alternate location)	43.92	35.87
Heavy-Haul Road	5.17	0.15
Nuclear Administration Building	22.73	18.68
Radial Collector Well Laydown Area	2.72	0
Radial Collector Well Area	3.28	0
Radial Collector Well Delivery Pipelines	13.34	4.13
Spoils Area A	77.41	1.06
Spoils Area B	17.88	0
Spoils Area C	116.03	4.39
Training Parking	9.12	7.46
Transmission Laydown Area	2.88	0.33
Western Laydown Areas	51.88	32.17
Total	**585.4**	**316.2**

(a) Acreage calculated from FLUCFCS codes and not verified by the USACE as jurisdictional wetlands.
(b) All 500 and 600 series FLUCFCS codes and 743W are considered in this analysis to be wetlands.

Source: Adapted from Table 4.3-1 of Revision 6 (FPL 2014-TN4058).

Land-Cover Classes (Habitats)

Land-clearing, grubbing, grading, excavation, and the placement of fill would disturb a diverse set of land-cover types (each reflective of a different terrestrial habitat type) within the Turkey Point site. Development of Turkey Point site facilities would require removal of existing vegetation from approximately 585 ac of land (FPL 2014-TN4058). Excluding cover classes already occupied by existing development (electrical power facilities, roads and highways), approximately 573 ac of terrestrial habitat would be lost (Table 4-6). However, about 247 ac of the affected terrestrial habitat area consists of areas that had been substantially altered by deposition of fill during previous land-development activities. Of the remaining 325 ac, another 182 ac, consisting of much of the mud island that is the proposed Units 6 and 7 plant area, are classified as non-vegetated. This area is predominantly a mudflat, which is a special aquatic site according to 404(b)(1) Guidelines. Special aquatic sites have special ecological characteristics that significantly influence or positively contribute to the general overall environmental health or vitality of the entire ecosystem of a region. See 40 CFR Parts 230.3(q-1), 230.10(a)(3), and 230.42 (TN427). The USACE will consider this designation during the review of the DA permit application. Approximately 32 ac are classified as open waters. Australian pine has invaded an additional 9 ac. This leaves about 103 ac of relatively natural terrestrial land cover, including approximately 74 ac of various mangrove types, 12 ac of sawgrass marsh, 2 ac of mangrove/willow and elderberry, and an acre of mixed wetland hardwood. Approximately 4 ac of mangrove swamp within the RCW pipeline corridor would be converted to an herbaceous wetland cover type.

Trees

FPL tree surveys indicate 1,358 individual tree stems of 41 different species could be removed during the building of proposed Units 6 and 7 and the associated facilities and structures on uplands within the project area. As noted in Section 2.4 of the EIS, FPL tree surveys did not identify or address mangroves and other wetland tree species as trees. Most of the trees that would be removed are of six species: the paurotis palm (*Acoelorraphe wrightii*) (307 stems), American mahogany (*Swietenia mahagoni*) (215 stems), green buttonwood (*Conocarpus erectus*) (161 stems), cabbage palm (*Sabal palmetto*) (134 stems), sea grape (*Coccoloba uvifera*) (120 stems), and gumbo limbo (*Bursera simaruba*) (95 stems) (FPL 2011-TN1471; FPL 2011-TN1312). A Miami-Dade County tree-removal permit would be required prior to removal of any trees known to occur in the proposed project area except for poisonwood (*Metopium toxiferum*) (Miami-Dade County 2011-TN601).

Wetlands

Wetlands dominate the landscape of South Florida and the Turkey Point site. Approximately 316 ac of wetlands on the Turkey Point site would be permanently altered by filling and grading, clearing of vegetation, dewatering, erosion, sedimentation, and other alterations to existing hydrology such as road building and culvert installation (Table 4-7). Affected wetland cover classes include various mangrove-dominated wetlands (mangrove swamps, dwarf mangroves, and mangrove heads), reservoirs, streams and waterways, wetland spoils, ditches, willow and elderberry, and mixed wetland hardwoods (see paragraph below). Also included as wetlands are non-vegetated areas, including the tidal flat that occupies most of the 218 ac plant area. Most of 218 ac plant area is classified as non-vegetated because of frequent inundation and high salt content. Also within the plant area are numerous small, scattered mangrove heads (Figure 2-25). Two remnant ditches bisect the area, and the spoils from the ditches are classified as wetland spoils. The area is bordered on the east and west side by active canals that are part of the industrial wastewater cooling system for the existing units. A stand of dwarf mangroves and a reservoir are located on the western border.

Loss of mangrove stands (FLUCFCS Code 612) (including swamps, dwarf mangroves, and mangrove heads) constitutes a 2.2 percent loss of existing mapped mangrove cover within the 6 mi vicinity. This extent of permanent mangrove cover loss in the project vicinity; in a coastal area where mangroves, including dwarf mangroves, play a key role in stabilizing shorelines and providing specialized shoreline habitat; is a noticeable impact. Loss of approximately 30 ac of mangrove swamp related to the installation of the radial collector well system, nuclear administration building, and training parking locations would result in the loss of Aquatic Resources of National Importance (ARNI). The EPA is concerned about impacts on ARNI (EPA Jul 17, 2015 Comment Response Letter). ARNI wetlands are described as being economically important, rare or unique, and important for the protection, maintenance, and enhancement of the nation's waters (EPA 2015-TN4626). Although dwarf mangrove forests and mangrove head habitats do not exhibit typical characteristics of tidal mangrove stands, their extensive root systems still serve to stabilize sediments and associated nutrients. Stunting and decreased plant densities in dwarf mangrove forests may be the result of various environmental factors.

The FLUCFCS codes provided by FPL have not been field verified by the USACE with respect to Federal wetland jurisdictional status. FPL has submitted a wetland mitigation proposal based on the State of Florida requirements. The USACE will review the proposed discharges of fill material into jurisdictional wetlands pursuant to CWA Section (404)(b)(1) Guidelines, which requires a sequential process of avoidance, minimization, and compensatory mitigation. The USACE will conclude its CWA Section 404(b)(1) Guidelines and public interest analyses in its ROD.

Table 4-8. Wetland Types that Would Be Permanently Lost During Building of Proposed Units 6 and 7 and the Associated Facilities on the Turkey Point Site

FLUCFCS Code[(a)]	Description	Permanent Loss (ac)[(b)]
650	Non-Vegetated	182.1
612-B	Dwarf Mangrove	37.0
612	Mangrove Swamp	28.3[(c)]
510	Streams and Waterways	12.4
612-A	Mangrove Head	12.1
531	Reservoirs >500 ac	12.0
6411	Sawgrass Marsh	11.9
743-Wet	Wetland Spoils	9.1
511	Ditches	8.7
612/618	Mangrove Swamp/Willow and Elderberry	1.9
619	Exotic Wetland Hardwoods	0.6
619ap	Exotic Wetland Hardwoods-Australian Pine	0.2
	Total	**316.2[(c)]**

(a) Acreage calculated from FLUCFCS codes and not verified by the USACE as jurisdictional wetlands.
(b) All 500 and 600 series FLUCFCS codes and 743W are considered in this analysis to be wetlands.
(c) Includes approximately 4 ac of mangrove swamp permanently converted to herbaceous wetland cover.

Source: Adapted from Table 4.3-1 of Revision 6 (FPL 2014-TN4058).

Table 4-8 presents the wetland acreage on the Turkey Point property subject to permanent impacts. Most of the wetland impacts would occur in mudflats, which are a special aquatic site, within the proposed Units 6 and 7 plant area. These wetlands would be permanently altered to build the proposed Units 6 and 7, the cooling towers, makeup-water reservoir, substation, concrete batch plant, UIC wells, and a portion of the heavy-haul road. These facilities would also be built on existing mangrove heads and remnant canals. A considerable amount of mangrove wetlands that still persist around the margins of the proposed Units 6 and 7 plant area would also be lost. Approximately 4 ac of mangrove swamp would be converted to a herbaceous wetland cover type. A stand of mangrove swamp and mangrove swamp/willow and elderberry north of the proposed plant area would be converted into the training facilities and nuclear administration buildings and associated parking. The western laydown area that would contain treated reclaimed water-supply pipelines would be built upon dwarf mangrove stands and part of the existing IWF/cooling-canal system. The RWTF would be built on lands that contain mostly dwarf mangrove, sawgrass marsh, Australian pine, and exotic wetland hardwoods. Spoils would be deposited mostly on previously filled areas but would also fill in additional canal acreage classed as streams and waterways.

4.3.1.2 Terrestrial Resources – Associated Offsite Facilities

Potable Water Pipeline Corridor

The potable water pipeline would be installed within existing roadway medians and below temporary construction access roadway improvements (FPL 2015-TN4442). The review team expects that no wetlands or other natural habitat would be lost. Nearby wetlands, including some Miami-Dade County Environmentally Endangered Lands, could be affected by siltation resulting from excavation to install the pipeline. Noise from installation activities could result in the temporary displacement or loss of local wildlife. Erosion and siltation would be reduced through the use of environmental BMPs, and native plants would be allowed to naturally revegetate disturbed areas (FPL 2014-TN4058).

Reclaimed Water Pipeline Corridor

Approximately 134 ac of land within the corridor would be affected to build the pipeline, including 45 ac of undeveloped land that consists almost entirely of wetlands (FPL 2015-TN4442). Approximately 2 ac of uplands and 9 ac of wetlands would be temporarily affected, and 35 ac of forested wetlands would be permanently converted to herbaceous wetlands (FPL 2015-TN4442). Affected habitats include mangrove swamp, mixed wetland hardwoods, freshwater marsh, mangrove swamp/exotic wetland hardwoods, dwarf mangroves, and minor amounts of herbaceous prairie, shrub and brushland, and Brazilian pepper. Vegetation would be cleared prior to digging the pipeline trench. Nearby wetlands could also be affected by siltation resulting from ground-clearing and digging activities. Noise from installation activities could result in the displacement or minor loss of local wildlife. Non-native plant species could also become established as a result of this disturbance. FPL proposed to use environmental BMPs to minimize impacts on sensitive habitats, including regrading of disturbed portions to the original elevation. Revegetation would occur either naturally or from plantings if needed (FPL 2014-TN4058).

Transmission Line Corridors

FPL's proposed transmission line corridors are described in Section 2.2.2, summarized in Table 2-4, and shown in Figure 2-5. FPL would build new transmission lines for proposed Units 6 and 7 in existing transmission line corridors where possible but would still have to install some new transmission lines within new corridors. Within the East corridor, lines would be installed in existing corridors along all 19 mi of the Clear Sky-Davis corridor, and lines within the Davis-Miami corridor would be in a newly developed corridor (ESRI 2012-TN1469). In both West corridors, lines would be installed within approximately 30 mi of existing corridor. If the West Preferred corridor were used, lines would be installed within about 13 mi of new corridor. If the West Consensus corridor were developed, about 18 mi of new corridor would have to be developed. Table 4-9 provides a summary of the upland and wetland terrestrial habitat within the transmission line corridors (Note that other lands reflected in Table 4-4 are not accounted for in Table 4-9). The proposed West Consensus corridor is considerably wider than the right-of-way to actually be selected and used to build the transmission lines, and expected impacts would be less than suggested by Table 4-9.

Table 4-9. Summary of Undeveloped Uplands and Wetlands Found within Transmission Line Corridors

Transmission Line Segment		Uplands[a] (ac)	Wetlands[b] (ac)
East Corridor			
Clear Sky to Davis		78.9	89.4
Davis to Miami		21.3	16.7
	Total	100.2	106.0
West Preferred Corridor[c]			
Clear Sky to Levee		226.5	1,747.9
Levee to Pennsuco		19.4	171.2
	Total	**245.9**	**1,919.1**
West Consensus Corridor[c]			
Clear Sky to Levee		144.8	2,715.1
Levee to Pennsuco		19.4	171.2
	Total	**164.2**	**2,886.3**

(a) Uplands comprise areas mapped as 300-, 400-, and 700-series FLUCFCS codes.
(b) Wetlands comprise areas mapped using 500- and 600-series FLUCFCS codes. Acreage calculated from FLUCFCS codes and not verified by USACE as jurisdictional wetlands.
(c) Corridor widths are highly variable and figures do not represent expected impacts.

Source: Adapted from Table 2.2-3 of FPL 2014-TN4058.

East Corridor

Clear Sky to Davis. The first 1.8 mi of the existing Clear Sky to Davis corridor is within the Turkey Point site and the next 6 mi of this corridor are alongside and within the western boundary of Biscayne National Park. This corridor is approximately 330 ft wide, and, although it occupies approximately 635 ac, only about 168 ac are terrestrial or wetland habitats because the rest has already been developed or converted into agriculture (FPL 2014-TN4058). Most of the undeveloped acres within this corridor are either dry herbaceous prairie or mangrove swamp and over half of the undeveloped lands are wetlands. FPL estimated the maximum amount of wetland that would be affected by building the proposed transmission line structures within this corridor is approximately 0.06 ac (FPL 2011-TN1012, Table 2-5). The USACE has not yet independently reviewed and verified FPL's proposed compensatory mitigation plan for unavoidable impacts to jurisdictional wetlands because avoidance and minimization have not been demonstrated pursuant to CWA 404(b)(1) Guidelines. Additionally, no approved jurisdictional determination has been conducted for the project; however, a preliminary jurisdictional determination was signed by FPL on July 10, 2012. The USACE will proceed with the processing of the application under this preliminary jurisdictional determination. The USACE's CWA Section 404(b)(1) Guidelines analysis, including determination of the sufficiency of compensatory mitigation pursuant to 33 CFR Part 332, will be concluded in the USACE's ROD.

FPL proposes to add a single 230 kV transmission line to this corridor. New concrete poles would be embedded into the ground to support the wires and may or may not require guy wires (FPL 2010-TN272). Much of this corridor follows an existing transmission line right-of-way, and no new access roads would have to be built. Installation of the new transmission line would require clearing of all vegetation where structures would be installed. Non-forested upland areas would be mowed; trees would be sawed down before clearing. All vegetation exceeding 14 ft in height within the corridor would also be cleared (FPL 2014-TN4058). Not all habitats within the proposed corridor would be eliminated. Ground disturbance could lead to the establishment of non-native plant species. Wildlife may also be temporarily displaced during installation activities because of the related noise and the presence of humans.

Davis to Miami. FPL plans to build a single 230 kV transmission line within a new corridor. The proposed corridor would occupy about 1,000 ac (FPL 2014-TN4058). Most of this entire corridor has been previously converted to managed lands. Only about 38 ac of upland and wetland terrestrial habitat in this corridor have not been previously developed (Table 4-9). Habitat types include dry prairie, shrub and brushland, upland hardwood forest, streams and waterways, and reservoirs (FPL 2014-TN4058). This corridor also passes adjacent to but does not encroach into habitat mapped as pine rockland, including the Tamiami Pineland Complex (State of Florida 2014-TN3637). Pine rockland habitats support high biodiversity and are known to support many Federal or State-listed species.

Concrete poles not supported by guy wires would be directly embedded into the ground. Some portions of this line may be collocated with another line and double-circuit concrete poles would be used. Where this line crosses the Miami River, an underground cable would be installed. No new access roads would be built to serve this corridor. FPL has not quantified these small areas of habitat loss from the installation of poles and wires, but it has indicated that there would be no wetland impacts (FPL 2011-TN1012). The statement of "no wetland impacts" would be verified by the USACE during the review of the DA permit application. This analysis will be concluded in the USACE's ROD. Most of this corridor lies within an urbanized environment and areas of remaining natural vegetation are somewhat limited in extent. Establishment of non-native species during ground disturbance could also result in permanent habitat alteration and loss. Previous development has likely resulted in establishment of non-native species and the result of increased disturbance from transmission line installation would not be significant. However, the introduction of non-native species into lands adjacent to the few small remaining pine rocklands adjacent to the proposed corridor could increase the risk of the eventual introduction of these non-native species to the rocklands. Acreages of both permanent and temporary habitat loss would be negligible considering past development within this corridor, with the exception of possible impacts on the few remaining pine rocklands adjacent to the proposed corridor.

West Preferred Corridor

Total acreage within the Clear Sky to Levee portion of the West Preferred corridor is about 3,031 ac. Approximately 1,748 ac consist of various wetland types including mixed wetland hardwoods, freshwater marsh, streams and waterways, exotic wetland hardwoods, mixed wetland hardwoods, wet prairies, dwarf mangroves, and lesser amounts of other various wetland cover classes (FPL 2014-TN4058). Lands classified as wet prairie may represent marl prairie habitat, which supports a very high diversity of native species. About one-third of the corridor has been previously developed. Upland classes constitute approximately 227 ac, consisting mostly of Brazilian pepper, spoil areas, shrub and brushland, and herbaceous prairie. FPL estimated that building within this corridor would result in the loss of approximately 298 ac of wetlands (FPL 2011-TN1012). The USACE has not yet independently reviewed and verified

FPL's proposed compensatory mitigation plan for unavoidable impacts to jurisdictional wetlands because avoidance and minimization have not been demonstrated pursuant to CWA 404(b)(1) Guidelines. Additionally, no approved jurisdictional determination has been conducted for the project; however, a preliminary jurisdictional determination was signed by FPL on July 10, 2012. The USACE will proceed with the processing of the application under this preliminary jurisdictional determination. The USACE's CWA Section 404(b)(1) Guidelines analysis, including determination of the sufficiency of compensatory mitigation pursuant to 33 CFR Part 332 (TN1472), will be concluded in the USACE's ROD.

FPL would build two new 500 kV transmission lines and a single 230 kV line in this corridor to connect the Clear Sky substation to the Levee substation. Poles supported by guy wires would be embedded into the ground. Some portions of this line may also contain steel poles (not supported by guy wires) installed on concrete caisson foundations. Installation of new transmission lines would require clearing of all vegetation across the entire right-of-way width where structures would be installed. Non-forested areas would be mowed and any trees present would be sawed down before clearing. All vegetation exceeding 14 ft in height within the corridor would also be cleared (FPL 2014-TN4058). This corridor contains a substantial portion of the 24 ac King's Highway Pineland NFC within the corridor that would be subject to clearing. The King's Highway Pineland NFC is a pine rockland, and pine rocklands support a very high diversity of native flora and fauna—many that are listed as either Federally or State-threatened or endangered (FNAI 2010-TN3515). Loss of any remaining pine rocklands would be a noticeable impact considering how little remains.

Miami-Dade County placed a number of requirements to minimize the acreage of permanent infrastructure to less than 10 percent of the total King's Highway Pineland NFC acreage (FDEP 2014-TN4371). New access roads would be built outside the NFC boundary. Surface disturbance including clearing and grubbing would be minimized, and BMPs such as the use of mats and rubber-tired vehicles would be used to maintain the substrate and understory. Equipment, materials, and debris would not be staged within the NFC. Cutting, pruning, and topping of native trees would be minimized, and all vegetative debris would be removed from the NFC. Barriers would be used during building to limit disturbance, encroachment of fill, sediment, and debris. Installation of fill would be restricted to backfilling of pole locations. Finally, low-impact methods would be used for stringing conductors over the King's Highway Pineland NFC. FPL has committed to avoiding or minimizing the impact on pine rocklands to the extent practicable, especially within the King's Highway Pineland NFC. To accomplish this, FPL incorporated many of these restrictions into design limits that would include using previously disturbed areas and affecting only 0.84 ac of the NFC (FPL 2015-TN4442). Restrictive clearing techniques including chain saws, low ground pressure shear or rotary type machines, or by removal by hand would be used to limit soil compaction and disturbance of native vegetation.

Habitat would be permanently lost during the installation of poles. Individual animals may also be temporarily displaced during vegetation clearing and access road development. Forest habitat could be changed to lower growing herbaceous habitat. Ground-disturbing activities could result in the establishment of non-native species, thereby reducing habitat quality. Acreages of both permanent and temporary habitat loss are unclear but would be substantial considering the relative lack of previous development within this corridor and the predominance of wetland habitats. Two additional access roads would be required within this corridor (see below for related impacts).

West Consensus Corridor. The Clear Sky to Levee portion of the Consensus corridor contains approximately 3,695 ac. Like the West Preferred corridor, it is also mostly wetlands that total about 2,715 ac. Freshwater marsh is the predominant wetland class, followed by wet Melaleuca, mixed wetland hardwoods/freshwater marsh, sawgrass, mixed wetland shrubs, and lesser amounts of other wetlands classes (FPL 2015-TN4442). Naturally vegetated uplands make up only 145 ac and include spoil areas, herbaceous prairie, shrub and brushland, and minor amounts of other classes. Approximately 835 ac of this portion of the corridor have already been developed into agriculture. This corridor would be built to specifications similar to the preferred option, but this corridor deviates from the path of the preferred option and final design would depend upon the exact route selection within the corridor (FPL 2015-TN4442). The 3,695 ac within this portion represents a corridor that varies in width between 1,000 and 5,000 ft to allow flexibility in the final siting of transmission lines (FPL 2013-TN2941). FPL's conceptual modeling indicates tower pads and access roads would be expected to permanently alter approximately 193 ac of land classified as a wetland cover type, 8 ac of uplands, and 142 ac in agriculture (FPL 2015-TN4442). Adjacent wetlands could also be affected by siltation and runoff. The total amount of habitat permanently lost within this corridor is currently unknown and would be calculated during final design. FPL has not provided similar conceptual modeling information to quantify acreage impacts from tower pads and access roads within the West Preferred corridor. The West Consensus corridor crosses the King's Highway Pineland NFC following the same route as the West Preferred Corridor, and impacts to the NFC would therefore be similar.

Levee to Pennsuco Corridor. The portion of the West corridor between the Levee and Pennsuco substations is the same for both the Preferred and Consensus corridor options and is approximately 8 mi long and 330 ft wide. A new 230 kV transmission line would be installed within this corridor to support proposed Units 6 and 7. As in the other corridors poles would be embedded into the ground. Most land cover within this corridor is either wetlands or disturbed lands. Vegetation would be mowed across the width of the corridor where poles would be installed, and trees and other vegetation exceeding 14 ft in height would be cut. The corridor contains approximately 6 ac of wet prairie that may support many native and/or listed species known to occur in marl prairie habitats. FPL estimated building the proposed transmission line within this corridor would affect 1.3 ac of wetlands (FPL 2011-TN1012).

Other Transmission Activities

Two new access roads would be required to access the transmission line corridors. Five substations would also be built or modified in support of proposed Units 6 and 7.

Transmission Line Corridor Access Roads

Combined, the two new access roads for the West Preferred corridor would affect approximately 365 ac (Table 4-5). The Krome Avenue access road would result in habitat loss or alteration of 143 ac of freshwater marsh and almost 57 ac of exotic wetland hardwoods. However, FPL estimates only 0.2 ac of wetlands would be lost (FPL 2011-TN1012). The Tamiami Trail access road would affect an additional 3.1 ac of freshwater marsh (Table 4-5).The four access roads necessary for the West Consensus corridor would affect a combined 110 ac. Most of the land-cover classes within proposed access road corridors represent previously disturbed habitats. A variety of wetlands would be lost, including 32 ac of canals, dikes, and levees; 22 ac of exotic wetland hardwoods; and 9 ac of freshwater marsh.

Substations

Davis Substation. Modifications of the Davis substation would permanently convert 1.12 ac of agricultural land (tree nursery) to developed land. Some terrestrial wildlife tolerant of agricultural settings would lose a small area of habitat. No substantial ecological impacts are expected at this location.

Clear Sky Substation. The Clear Sky substation would be installed immediately north of the proposed Units 6 and 7, within the plant area (FPL 2014-TN4058). Impacts on terrestrial resources are accounted for in the assessment of the site and vicinity in Section 4.3.1.1.

Levee Substation. The existing Levee substation would be expanded by 2.3 ac to accommodate new transmission lines. The expansion would require clearing, filling, and grading a 130 ft × 850 ft area (FPL 2014-TN4058). Approximately 1.81 ac of the expansion area is classified as exotic wetland hardwoods, and the remaining 0.52 ac is existing electric power facilities (FPL 2014-TN4058). Loss or modification of these habitats is not expected to substantially affect terrestrial wildlife or other ecological resources. A new stormwater-retention system would also be built to support the expansion. FPL estimated the planned expansion and stormwater-retention system would eliminate 7.5 ac of wetlands (FPL 2011-TN1012).

Pennsuco Substation. This substation would be expanded by 2.42 ac. Approximately 0.65 ac would be converted into a new stormwater-retention system and the remaining area would be transmission infrastructure (FPL 2014-TN4058). The expansion would occur entirely on lands classified as rock quarry. Potential effects on terrestrial wildlife and other ecological resources are therefore expected to be minimal.

Miami Substation. Modifications to the Miami substation would not require expansion and should not affect terrestrial resources (FPL 2014-TN4058).

4.3.1.3 Impacts on Important Terrestrial Species and Habitats

This section describes potential impacts on important terrestrial species including Federally listed or proposed threatened and endangered species, State-listed species, and other ecologically important species and habitats, as defined by the NRC in NUREG–1555 (NRC 2000-TN614) (see Section 2.4.1.3), resulting from all activities related to proposed Units 6 and 7. Impacts on species on the Turkey Point site are discussed first, with Federally listed species preceding State-listed species. Impacts on species associated with offsite facilities including transmission lines follow in the same manner. To meet responsibilities under Section 7 of the Endangered Species Act (ESA) (16 U.S.C. § 1531 et seq.) (TN1010), the staff prepared a biological assessment that documents potential project impacts on Federally listed threatened or endangered terrestrial species. The biological assessment is in the NRC Agencywide

Documents Access and Management System (ADAMS) at Accession Number ML15028A372, as indicated in Appendix F-2. Following the publication of the Draft EIS, the review team provided supplemented biological assessment data to the FWS addressing the Miami tiger beetle, which has been proposed for listing as endangered under the ESA (NRC 2016-TN4801).

Onsite Impacts on Listed Terrestrial Species

Federally Listed Terrestrial Species

Federally listed terrestrial plant and animal species that may occur on or in the vicinity of the Turkey Point site and associated offsite facilities are listed in Table 2-13. None of the Federally listed (or proposed) endangered, threatened, or candidate plant species known to occur in the vicinity of the Turkey Point site have been found on the site during biological surveys conducted by FPL during 2009−2011, and no designated or proposed critical habitat for Federally listed terrestrial species occurs within areas proposed for preconstruction or construction activities. However, this does not preclude them from occurring within the proposed project area and does not preclude impacts on Federally listed species and their habitats from proposed project activities. The potential impacts of development activities on individual Federally listed species are described below.

Plants

Crenulate Lead-Plant (*Amorpha herbacea var. crenulata*) – Endangered. The crenulate lead-plant occurs in marl prairie and wet pine rocklands. Neither of these habitats is found on the Turkey Point site, and the species is not known to occur within 6 mi of the Turkey Point site (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

Blodgett's Silverbush (*Argythamnia blodgettii*) – Proposed Threatened. Blodgett's silverbush is found in pine rockland, rockland hammock, and coastal berm habitats. Neither pine rockland nor rockland hammock habitats occur on the Turkey Point site, and this plant is not known to occur on the site (Gann et al. 2012-TN137). However, it has been recorded in both Biscayne and Everglades National Parks, and its occurrence in coastal berm habitats suggests that suitable habitat may exist along the Biscayne Bay shoreline adjacent to the Turkey Point site. The presence and distribution of Blodgett's silverbush on the coastal berm between Biscayne Bay and the Turkey Point site is unknown. The State of Florida requires surveys for sensitive species (Federally Endangered, Federally Threatened, State-Threatened, State Species of Special Concern) within all affected areas prior to the commencement of work (FDEP 2014-TN4371). Individual plants could be affected if they occur in areas affected by the proposed action, but it is reasonable to expect impacts would be minimized to the extent practicable if State surveys indicated this plant occurred within the proposed project footprint. FPL would likely work around or transplant individual plants in the footprint of ground disturbance.

Florida Brickell-Bush (*Brickellia eupatorioides [mosieri] var. floridana*) –Endangered. The Florida brickell-bush is endemic on the Miami Rock Ridge and is not known to occur on or within 6 mi of the Turkey Point site (FNAI 2000-TN139). No impacts on this species are therefore expected on the site.

<u>Deltoid Spurge (*Chamaesyce deltoidea ssp. deltoidea*) – Endangered</u>. The deltoid spurge occurs on exposed limestone and in sand under an open shrub canopy. It has not been recorded on the Turkey Point site and is not known to occur within 6 mi of the site (Gann et al. 2012-TN1322). No impacts on this species are therefore expected on the site.

<u>Pineland Sandmat (*Chamaesyce deltoidea ssp. pinetorum*) – Candidate</u>. This plant occurs in pine rocklands and exposed limestone. It has not been recorded on the Turkey Point site and is not known to occur within 6 mi of the site (FNAI 2000-TN139). No impacts on this species are therefore expected on the site.

<u>Garber's Spurge (*Chamaesyce garberi*) – Threatened</u>. Garber's spurge is only known to occur at two pine rocklands in Miami-Dade County and has been found on beach dune, coastal rock barren, hammock edges, and pine rockland (FWS 2007-TN3529). It has not been recorded on the Turkey Point site but is present within the Everglades National Park (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

<u>Cape Sable Thoroughwort (*Chromolaena frustrata*) – Endangered</u>. The Cape Sable thoroughwort is not found in disturbed habitats and has not been recorded on the Turkey Point site and is not known to occur near the site (FWS 2010-TN1323). No impacts on this species are therefore expected on the site.

<u>Florida Semaphore Cactus (*Consolea corallicola*) – Endangered</u>. This cactus species occurred historically on coastal berms and has been observed with buttonwood between rockland hammocks and coastal swamps. It has not been observed on or within the vicinity of the Turkey Point site, but it does occur within Biscayne National Park (Gann et al. 2012-TN137). Potentially suitable habitat may exist on the Turkey Point site along the Biscayne Bay shoreline. The presence and distribution of the Florida semaphore cactus along the Biscayne Bay shoreline adjacent to the Turkey Point site is unknown. Individual plants could be affected if they occur in areas affected by the proposed action. The State of Florida would require surveys for sensitive species within all affected areas prior to the commencement of work (FDEP 2014-TN4371). It is reasonable to expect that FPL would minimize impacts to the extent practicable if these surveys indicated this plant occurred within the proposed project footprint. FPL would likely work around or transplant individual plants in the footprint of ground disturbance.

<u>Florida Prairie Clover (*Dalea carthagenensis floridana*) – Candidate</u>. This shrub occurs in a variety of upland habitats, none of which is present on the Turkey Point site. Florida prairie clover plants have not been recorded on the Turkey Point site and only five known populations exist, all of which are more than 6 mi from the site (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

<u>Florida Pineland Crabgrass (*Digitaria pauciflora*) – Candidate</u>. Florida pineland crabgrass occurs in marl prairie and pine rockland habitats. Neither of these habitats occurs on the Turkey Point site and this plant has never been recorded on the site (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

<u>Small's Milkpea (*Galactia smallii*) – Endangered</u>. Small's milkpea grows in pine rocklands. Pine rockland habitat does not occur on the Turkey Point site, and this species is not known to occur

within 6 mi of the site (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

Beach Jacquemontia (*Jacquemontia reclinata*) – Endangered. This plant is adapted to grow on stabilized coastal dunes in hammocks and coastal scrub. It is known to occur on nine sites, all of which are more than 6 mi from the Turkey Point site (FNAI 2000-TN139). No impacts on this species are therefore expected on the site.

Sand Flax (*Linum arenicola*) – Proposed Endangered. Sand flax is found in pine rockland and marl prairie, and it also occurs adjacent to disturbed areas. Pine rockland and marl prairie habitats do not occur on the Turkey Point site and this plant species has not been recorded on the Turkey Point site. However, it has been found within Homestead Bayfront Park less than 1 mi north of the site (FNAI 2000-TN139). The presence of sand flax within 1 mi of the site indicates it may be present in suitable habitat within the proposed project area. Individual sand flax plants could be affected if they occur in areas affected by the proposed action. The State of Florida would require surveys for sensitive species within all affected areas prior to the commencement of work (FDEP 2014-TN4371). It is reasonable to expect that FPL would minimize impacts to the extent practicable if these surveys indicated that this plant occurred within the proposed project footprint. FPL would likely work around or transplant individual plants in the footprint of ground disturbance.

Carter's Small-Flowered Flax (*Linum carteri carteri*) – Endangered. Carter's small-flowered flax is another plant species endemic to pine rocklands. It has not been recorded on the Turkey Point site and is known to occur in locations more than 6 mi from the site (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

Tiny Polygala (*Polygala smallii*) – Endangered. The tiny polygala is adapted to a coastal environment, thriving in sandy substrates under a slash pine overstory in Miami-Dade County. There are no habitats on the Turkey Point site that resemble the habitat requirements of this plant species and it has not been recorded on the site (FWS 1999-TN136). No impacts on this species are therefore expected on the site.

Everglades Bully (*Sideroxylon reclinatum ssp. austrofloridense*) – Candidate. This shrub is also endemic to marl prairies and pine rocklands habitats, neither of which occurs on the Turkey Point site. It has not been reported on the Turkey Point site and is known to occur at sites west of the site (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

Florida Bristle Fern (*Trichomanes punctatum ssp. floridanum*) – Endangered. The Florida bristle fern occurs in rockland hammocks and sinkholes as well as on tree trunks in deep shade. It has not been recorded on the Turkey Point site, suitable habitat is not present within the site, and known locations are found more than 6 mi from the site (Gann et al. 2012-TN137). No impacts on this species are therefore expected on the site.

Wildlife

The Florida Fish and Wildlife Conservation Commission (FFWCC) has indicated that many of the species on the Federal Threatened and Endangered Species List that are known to occur in Miami-Dade County do not occur on or near enough to the Turkey Point site to be affected by proposed Units 6 and 7 preconstruction or construction activities (FDEP 2014-TN4371).

Florida Leafwing Butterfly (*Anaea troglodyte floridalis*) – Endangered. The distribution of the Florida leafwing butterfly is closely tied to the pineland croton (*Croton linearis*), its host plant. The pineland croton grows in pine rocklands that are not found on the Turkey Point site (FWS 2012-TN148). This butterfly would not be expected to occur there. No impacts on this species are expected to result from proposed building activities occurring within the Turkey Point site.

Miami Blue Butterfly (*Cyclargus thomasi bethunebakeri*) – Endangered. The Miami blue butterfly is only found within Bahia Honda State Park almost 80 mi from the Turkey Point site and would not be expected to occur on the site or in the vicinity (Daniels 2005-TN141). No impacts on this species are therefore expected on the Turkey Point site.

Schaus Swallowtail Butterfly (*Heraclides [Papilio] aristodemus ponceanus*) – Endangered. This butterfly occurs in hardwood hammocks (FWS 1999-TN136). No hardwood hammock habitats are present on the Turkey Point site, so this species would be unaffected by the proposed action. No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Bartram's Scrub-Hairstreak Butterfly (*Strymon acis bartrami*) – Endangered. Bartram's scrub-hairstreak is a butterfly that relies on the narrow-leafed croton (*Croton linearis*) as a host plant. This plant and butterfly are found in pine rockland habitat that does not occur on the Turkey Point site. Suitable habitat does not exist on the Turkey Point site and Bartram's scrub-hairstreak would not be expected to occur on the site. No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Stock Island Tree Snail (*Orthalicus reses reses*) – Threatened. The Stock Island tree snail occurs in hardwood hammocks, and because this habitat is not present on the Turkey Point site this species would also be unaffected. No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Miami Tiger Beetle (*Cicendelidia floridana*) – Proposed Endangered. There are only two known occurrences of the Miami tiger beetle, both of which occur in pine rocklands. No pine rockland habitat would be affected or otherwise altered by proposed activities occurring within the Turkey Point site, so this species would not be affected by preconstruction and construction activities occurring there.

Eastern Indigo Snake (*Drymarchon corais couperi*) – Threatened. Eastern indigo snakes occur in a wide variety of habitats and thrive in a mosaic of different habitat types, including mangroves. Although not known to occur within the boundaries of the Turkey Point site, this species has been observed nearby and suitable habitat is present on the site (FPL 2014-TN4058; FWS 1999-TN136; FPL 2012-TN1468). FPL has proposed to install fencing along construction access roads, control traffic, and educate all construction personnel about the identification of protected species including the eastern indigo snake. Personnel would be instructed to stop work and notify FPL environmental managers if an indigo snake is observed within a work area. Informational signage in compliance with the U.S. Fish and Wildlife Service (FWS) Standard Protection measures would also be posted along access roads (FPL 2011-TN1012). The adequacy of the fencing to exclude the snakes from work areas is unknown, but the other measures such as the personnel education and stop work measures noted above would help to minimize risk to this species.

Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*) – Endangered. The preferred habitat, mixed marl prairie, is not present on the Turkey Point site and this species would not be affected by the proposed action. No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Florida Grasshopper Sparrow (*Ammodramus savannarum floridanus*) – Endangered. Florida grasshopper sparrows are not known to occur on the Turkey Point site or in the vicinity (FWS 1999-TN136). No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Florida Scrub Jay (*Aphelocoma coerulescens*) – Threatened. Florida scrub jays are not known to occur on the Turkey Point site or in the vicinity (FWS 2012-TN285). No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Red Knot (*Calidris canutus rufa*) – Threatened. The red knot is a shorebird species that winters but does not breed in Florida. It forages along sandy beaches and tidal mudflats. Red knots also use vegetated habitats such as salt marshes and mangroves (FWS 2012-TN146). A red knot was observed during late-winter surveys of the Turkey Point site and suitable habitat for this species on the site would be affected by the proposed action (FPL 2014-TN4058). Loss of the non-vegetated mudflat habitat on the mud island comprising the proposed plant area and loss of mangrove habitat elsewhere would constitute a loss of potentially suitable winter foraging habitat. But the mud island does not contain the beach habitat that is favored by the red knot, and the extensive mangrove habitat remaining along the fringes of Biscayne Bay would continue to provide suitable foraging habitat in the local landscape. Because non-mobile or weakly mobile nesting young are not expected in South Florida, foraging red knots would likely flee habitats subject to disturbance rather than endure direct mortality. The review team therefore expects that impacts would be minimal.

Ivory-Billed Woodpecker (*Campephilus principalis*) – Endangered. Ivory-billed woodpeckers are not known to occur on the Turkey Point site or in the vicinity (FWS 2012-TN286). No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Piping Plover (*Charadrius melodus*) – Threatened. Like the red knot, the piping plover is a migratory shorebird species that winters in Florida. Individuals from three different piping plover populations winter in South Florida. Critical habitat has been designated in Florida, but none exists within Miami-Dade County. Piping plovers forage on mudflats and other sparsely vegetated wetlands. The non-vegetated mudflat habitat of the proposed Units 6 and 7 plant area could attract and hold wintering piping plovers. Land-clearing activities, removal of muck, dewatering, construction of the units, and building of other related facilities could result in permanent loss of winter habitat. Build-out activities, such as alteration of the barge-turning basin and installation of the RCW system, could temporarily displace individual birds that may be present on Biscayne Bay beaches if these activities occurred during the piping plover wintering season. The lack of designated critical habitat in Miami-Dade County indicates nearby habitats are not extensively used by this species and any impact would likely be minimal.

Kirtland's Warbler (*Dendroica kirtlandii*) – Endangered. The Kirtland's warbler is known as a neo-tropical migrant songbird species. It only occurs in Florida during migration between nesting range to the north and winter range to the south. Kirtland's warblers prefer dense and low woody vegetation. No Kirtland's warblers were previously observed on the Turkey Point site. Very little of the affected area on the Turkey Point site would be suitable for this species, because only mangroves would appear to be marginally suitable based on vegetation structure and the density of mangroves within most project areas is sparse. Therefore, the impact on this species would be minimal.

Wood Stork (*Mycteria americana*) – Threatened. The wood stork is a large wading bird that uses wetlands for most of its life history. Wood storks frequent shallow waters to forage where prey items become concentrated. Even though none of the Turkey Point site occurs within the 18.6 mi (29.9 km) core foraging area for any wood stork colony, wood storks have been observed foraging on the Turkey Point site. They have been observed using industrial wastewater canals and wetland habitats immediately west of the proposed Units 6 and 7 plant area that would be converted into a laydown area (FPL 2014-TN4058). Wetlands suitable for wood stork habitat that would be affected by the proposed action also occur elsewhere within the Turkey Point site boundary.

Wetland habitat suitable for wood stork foraging could be dewatered during preconstruction and then permanently lost when converted into the proposed Units 6 and 7 plant area and associated structures. Because none of this habitat intersects with designated wood stork core foraging areas, impacts on foraging habitat would be minimal and mitigation would not be warranted.

Red-Cockaded Woodpecker (*Picoudes borealis*) – Endangered. Red-cockaded woodpeckers are not known to occur on the Turkey Point site or in the vicinity. No suitable habitat is present and no impacts on species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Audubon's Crested Caracara (*Polyborus plancus audubonii*) – Threatened. The Audubon's crested caracara uses wet and dry prairie habitat that contains scattered cabbage palms (*Sabal palmetto*) or lightly wooded areas. None of the Turkey Point site resembles this habitat and no crested caracaras were observed during surveys. No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Everglade Snail Kite (*Rostrhamus sociabilis plumbeus*) – Endangered. The Everglade snail kite is not known to occur on the Turkey Point site. Habitat suitable for the Everglade snail kite is not present within the proposed Units 6 and 7 plant area. Land-cover information does not indicate freshwater marsh habitat suitable for snail kites exists on either the Units 6 and 7 plant area or the Turkey Point site. Although observed within the Everglades Mitigation Bank (EMB) adjacent to the Turkey Point site, its occurrence within adjacent marsh habitats would not be affected by the proposed actions.

Bachman's Warbler (*Vermivora bachmanii*) – Endangered. Little is known about the life history and habitat requirements of Bachman's warbler. However, this species has not been observed in Florida since 1977 and has not been observed within the United States since 1988 (FWS 1999-TN136). No impacts on this species are expected to result from proposed preconstruction or construction activities occurring within the Turkey Point site.

Florida Bonneted Bat (*Eumops floridanus*) – Endangered. The Florida bonneted bat requires specific conditions to roost and has been observed roosting in palms, hollow trees, and within tile building roofs (FNAI 2000-TN139). The nearest location this species is known to occur is near Homestead, Florida (FWS 2011-TN147). These bats forage while flying. It is not known whether Florida bonneted bats occur on the Turkey Point site, but suitable roosting habitat is not known to be present. If present, Florida bonneted bats could be displaced by excessive noise during nighttime foraging by activities related to the building of proposed Units 6 and 7. The Units 6 and 7 plant area does not appear to provide suitable Florida bonneted bat habitat, but suitable habitat may be present along proposed access roads. The FWS would require that surveys be conducted wherever suitable habitat may be present within Florida bonneted bat consultation areas. If found, it is reasonable to expect the FWS to coordinate impact minimization measures if needed, so impacts on this species would be minimal.

Florida Panther (*Puma [= Felis] concolor coryi*) – Endangered. The Florida panther thrives in large, contiguous tracts of undeveloped land and prefers upland forested habitats interspersed with other habitats including wetlands, and to some extent developed lands (FWS 1999-TN136; FWS 2008-TN1580). Upland forested habitats are extremely limited on the Turkey Point site. Critical habitat has not been designated for the Florida panther although the FWS has designated much of Miami-Dade County as a Florida Panther Focus Area (FWS 2008-TN1580). The Turkey Point site is excluded from focus area designation. Panthers are not known to occur often on the Turkey Point site and lands within the site boundary are marginally suitable or unsuitable as habitat for the panther.

The FFWCC is requiring FPL to institute measures that would lower the likelihood of preconstruction or construction impacts on the panther. FPL would install an underpass that provides a wildlife underpass within the temporary construction access road along SW 359th Street between 117th and 137th Avenues. To reduce construction access road collision mortality risk, speed limits would also be limited to 45 mph and fencing, lighted signs, speed bumps, and slow speed zones at dusk and dawn would be used (State of Florida 2014-TN3637). Roads widened for construction of proposed Units 6 and 7 would be returned to their previous widths. Therefore, the impact on the Florida panther, although adverse, would be minimal.

State-Listed Terrestrial Species

Plants

Seventeen State-listed plant species were found within the proposed transmission line corridors (FPL 2009-TN1449), but the full extent of State-listed plant species occurrence within the proposed project areas is undetermined. Individual plants and small populations found within proposed areas of ground disturbance may be eliminated during site preparation and/or deposition of fill. Populations growing adjacent to disturbance areas could also be indirectly degraded by the introduction of invasive plant species. Changes in overland water flow could also make habitats inhospitable to some of these plants.

FPL would be required to conduct surveys for State-listed plant species in all of the proposed work areas using qualified personnel, report findings, and implement practicable protection measures to avoid, minimize, or mitigate impacts before any proposed activities (State of Florida 2014-TN3637). Although these requirements would reduce impacts on State-listed plant species, they likely would not entirely preclude impacts.

Wildlife

An additional 23 State-listed animal species can also be found on or near the Turkey Point site. The list includes 1 amphibian, 3 reptiles, 16 birds, and 3 mammals. Survey information indicates that many of these species have been observed using habitats within the proposed project area, and life history as well as habitat preferences indicate that many of them would be expected to occur there. The FFWCC determined that only the limpkin (*Aramus guarauna*), Florida burrowing owl (*Athene cunicularia floridana*), little blue heron (*Egretta caerulea*), reddish egret (*Egretta rufescens*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), white ibis (*Eudocimus albus*), American oystercatcher (*Haematopus palliatus*), white-crowned pigeon (*Patagioenas leucocephala*), brown pelican (*Pelecanus occidentalis*), roseate spoonbill (*Platalea ajaja*), black skimmer (*Rynchops niger*), least tern (*Sterna antillarum*), and Everglades mink (*Neovison vison evergladensis*) have the potential to be affected by the proposed project activities because only these species are known or suspected to occur in the vicinity of the Turkey Point site (FDEP 2014-TN4371).

Alteration and permanent loss of habitat would affect many of these species that may rely on habitat within the proposed project area for all or part of their life histories. Noise during preconstruction and construction could displace individuals in adjacent habitats into habitats of marginal quality, thereby temporarily increasing mortality rates or decreasing productivity. Increased traffic during preconstruction and construction could also result in direct mortality of individuals. Permits for either a relocation or incidental take may be required from the State of Florida. The presence of individuals of State-listed species must be reported to the FFWCC, and FPL must contact the FFWCC if impacts on these species cannot be avoided before taking actions that could result in an impact (State of Florida 2014-TN3637).

Limpkin. Mangrove habitat would be permanently lost, although most of the affected areas are not high-quality mangrove habitat.

<u>Florida Burrowing Owl</u>. The Florida burrowing owl is found in open habitats and a single bird had been observed once within the IWF. Its habit of nesting underground indicates it requires upland habitats for nesting. The only "upland" habitats on the Turkey Point site are those that have been artificially filled, such as the roads.

<u>Little Blue Heron, Reddish Egret, Snowy Egret, Tricolored Heron, White Ibis, and Roseate Spoonbill</u>. These six species are all primarily piscivorous wading birds resident in South Florida that use shallow wetlands to forage and colonize trees for nesting. The permanent loss of wetlands would affect all of these species by reducing available foraging habitat.

<u>American Oystercatcher</u>. The permanent loss of mudflat habitat would reduce the amount of American oystercatcher foraging habitat. However, shellfish are the primary prey of this species and the distribution and abundance of shellfish within the project area is unknown so the amount of this loss is unknown.

<u>White-Crowned Pigeon</u>. White-crowned pigeons have been observed within the project area, but suitable habitat within the area is limited. Fruit of the poisonwood tree (*Metopium toxiferum*) is a known food source (FNAI 2000-TN139). Fifty-eight poisonwood trees were observed growing within the proposed western laydown yard, ten within the proposed access road, and three within the RCWs footprint (FPL 2011-TN1312). These trees would likely be removed during site preparation. Removal of these trees could slightly reduce the availability of food to white-crowned pigeons, but poisonwood is not a rare species in the region. Poisonwood is not protected under the Miami-Dade tree permitting process. No tree-removal permit would be required (Miami-Dade County 2011-TN601).

<u>Brown Pelican</u>. The brown pelican was observed within the project area. Preconstruction and construction activities could displace individuals that use local roosts or loafing sites within and near the proposed project area (FNAI 2000-TN139).

<u>Black Skimmer</u>. This species has nested on dredge spoil islands and along roads in open habitats. Deposition of dredge spoils within the IWF could displace individuals nesting on dredge spoil islands or other nearby areas. However, most black skimmers nest farther north in Florida, so effects are expected to be limited.

<u>Least Tern</u>. Least terns nest on gravel substrates with little vegetation such as dredge spoil islands and construction sites, and least terns have been observed on or near the proposed Units 6 and 7 plant area. If the deposition of dredge spoils within the IWF takes place from March through October, productivity could be reduced or eliminated due to disturbance if any least terns nest on the dredge spoils. FPL has proposed to conduct activities outside of the April through September nesting season to reduce potential impacts on nesting terns. FPL also proposed to maintain elevated gravel berms within the cooling-canal system to provide suitable tern nesting habitat (FPL 2011-TN1283).

<u>Everglades Mink</u>. The Everglades mink is the only State-listed terrestrial mammal believed to be present within the Turkey Point site. Little is known about this mink subspecies, but mink are known to occur in mostly riparian and aquatic habitats although they will forage in uplands. Loss of wetlands could reduce available habitat. The IWF likely provides the best mink habitat

on the Turkey Point site. Deposition of dredge spoils within the facility may temporarily affect a small amount of the total habitat present. It may also increase the direct mortality risk to mink from vehicle collisions. The FFWCC would require FPL to conduct surveys of suitable mink habitat within the proposed facility locations during the breeding season (FDEP 2014-TN4371). Further management actions including mitigation may be required by the FFWCC and other agencies.

FPL would be required to coordinate with FFWCC when conducting surveys for all listed species that may occur within the proposed Units 6 and 7 plant area, associated non-linear facilities, and associated linear non-transmission rights-of-way before preconstruction activities start (FDEP 2014-TN4371). Specific information that would be recorded and provided to FFWCC includes listed species observations; suitable habitats for listed species; breeding sites, nests, and burrows of listed species; wading bird colony locations; and habitat descriptions including acreage estimates. The FFWCC has required shorebird nesting surveys in all potential habitats before preconstruction and construction and daily during such activities, and disturbance would be restricted within 300 ft of any active shorebird nest (FDEP 2014-TN4371). A species management plan would be required if State-listed species may be affected by the proposed actions. FPL has also committed to enhancement and preservation of an approximately 170 ac mudflat, known as Mitigation Bank Assessment Area 10, immediately adjacent to the IWF, in order to mitigate mudflat habitat lost to shorebirds from the construction of Units 6 and 7 (FPL 2015-TN4630). In exchange for this activity, FPL would receive 5 mitigation credits that can only be used to offset shorebird habitat loss. Further mitigation may be required by other agencies.

Offsite Impacts on Listed Terrestrial Species

<u>Federally Listed Terrestrial Species</u>

Federally listed terrestrial plant and animal species that may occur on or in the vicinity of the offsite facilities associated with the proposed Units 6 and 7 are listed in Table 2-13. Associated offsite facilities include the proposed transmission lines, associated access roads and substations, reclaimed water pipeline, and potable water pipeline.

<u>Plants</u>

FPL had surveys conducted at selected sites to determine the presence, distribution, and abundance of listed plants within the transmission line corridors (FPL 2009-TN657). Similar surveys were not conducted within the reclaimed water pipeline corridors. None of the plants listed as Federally endangered or threatened has been observed within the proposed or existing transmission line corridors that would support proposed Units 6 and 7. However, a single proposed Federally endangered and 3 Federal candidate species along with 33 State-listed plant species were observed during surveys at selected locations within existing and proposed transmission line corridors (FPL 2014-TN4058). The botanical survey of the proposed transmission line corridors does not represent an exhaustive search for listed plants throughout all of the corridor areas (FPL 2009-TN657). Many of the Federal and State-listed plant species grow in pine rockland and/or marl prairie habitats. These two habitats are strongly associated with pine flatwoods and wet prairies, respectively, within the FLUCFCS land classification system. The occurrence of pine flatwood or wet prairie land cover within transmission line corridors may indicate the presence of associated plants. Also, the FLUCFCS land-cover classification was conducted with satellite (LANDSAT) imagery. The use of remotely sensed information does not always allow detection of fine-scale habitat fragments so on-the-ground information was also used to determine potential impacts when and where available. The following discussion describes potential impacts on Federally listed species known to occur in Miami-Dade County

Crenulate Lead-Plant – Endangered. Crenulate lead-plants have not been observed within transmission line corridors that would provide service to proposed Units 6 and 7. However, the crenulate lead-plant occurs in wet pine rocklands and marl prairies. A small amount (0.03 ac) of pine flatwoods, the land-cover classification that represents pine rocklands, occurs within the Clear Sky to Davis segment of the East corridor. Botanical survey information also confirms pine rockland habitat still exists within the Clear Sky to Davis segment of the East corridor as well as within the Clear Sky to Levee segment of the West corridors. Botanical surveys were conducted within selected pine rocklands within the proposed transmission line corridors, and it is not known whether the crenulate lead-plant may exist within the transmission line corridors in rockland habitats that have not been surveyed. Potentially suitable habitat could be affected by the building of transmission lines or other offsite facilities.

Blodgett's Silverbush – Candidate. Blodgett's silverbush has not been found within any of the transmission line corridors, but it is associated with pine rocklands and rockland hammocks. Pine rockland habitat exists within the Clear Sky to Davis segment of the East corridor and within the Clear Sky to Levee portion of the West corridors, and it is unknown whether Blodgett's silverbush exists within the transmission line corridor or other offsite facilities. Potentially suitable habitat could be affected by the building of transmission lines or other offsite facilities.

Florida Brickell-Bush – Proposed Endangered. The Florida brickell-bush was observed in good quality pine rockland habitat within the West corridors (FPL 2009-TN657). Seventeen individual plants were also recorded in the King's Highway Pineland. The estimated total population within this pine rockland was between 100 and 1,000 individuals. Individual plants could be destroyed during ground-clearing, road-building, and pole-installation activities. FPL has committed to conducting pre-clearing surveys during access road and structure pad location activities. FPL has also proposed to relocate individual plants unavoidable during building of the transmission line corridor, if feasible (FPL 2012-TN1618). The King's Highway Pineland has been proposed as critical habitat for the Florida brickell-bush (78 FR 61293) (TN2912), and habitat would likely be permanently altered during clearing and transmission line installation if the line passed through this pineland as proposed. The likelihood of exotic plants introduction and subsequent degradation of critical habitat would also increase due to vehicle traffic on the maintenance road. However, FPL would eradicate or remove exotic, prohibited, controlled, and incompatible plant species within the transmission right-of-way and discourage hardwood hammock to the extent practicable (FPL 2015-TN4442). Impact on this species would likely result, but would be minimized to the extent practicable.

Deltoid Spurge – Endangered. The deltoid spurge is found on exposed limestone and in sand under an open shrub canopy. It has not been recorded within the proposed Units 6 and 7 transmission line corridors (FPL 2009-TN657). It is not known whether the unique habitat requirements of this species are found within the Units 6 and 7 transmission line corridors or whether it occurs within un-surveyed portions of the corridors.

Pineland Sandmat – Candidate. Pineland sandmat occurs in pine rocklands and exposed limestone. A total of 316 individual pineland sandmat plants were observed in pine rockland habitat within the Clear Sky to Levee portion of the West corridors and the total population of sandmat at this location was estimated at 1,000 to 10,000 individual plants. Individual pineland sandmat plants could be destroyed during land clearing and powerline installation. Habitat could also be permanently altered. FPL has committed to conducting pre-clearing surveys during access road and structure pad location activities. FPL has also proposed to relocate individual plants unavoidable during building of the transmission line corridor, if feasible (FPL 2012-TN1618).

Garber's Spurge – Threatened. Garber's spurge has not been observed within the proposed Units 6 and 7 transmission line corridors. It grows on beach dune, coastal rock barren, disturbed upland, and pine rockland habitats. Both disturbed upland and pine rockland habitats exist within the transmission line corridors; it is unknown whether Garber's spurge exists in un-surveyed locations within the transmission line corridors.

Cape Sable Thoroughwort – Candidate. The Cape Sable thoroughwort has not been found growing within any of the proposed Units 6 and 7 transmission line corridors. It typically grows in rockland hammocks, coastal rock barrens, and between buttonwood and coastal hardwood hammocks. The first section of the Clear Sky to Davis portion of the East transmission line corridor lies along the coast, but it is unclear whether any of these habitats are located within the corridor.

Florida Semaphore Cactus – Candidate. The Florida semaphore cactus has not been observed growing within the proposed Units 6 and 7 transmission line corridors. It occurred historically on coastal berms and has been observed with buttonwood between rockland hammocks and coastal swamps within the Biscayne National Park. It is not known whether potentially suitable habitat exists within the transmission line corridors.

Florida Prairie Clover – Candidate. This shrub occurs in a variety of upland habitats including pine rocklands, rockland hammock edges, marl prairie, and coastal uplands. Only five known populations exist, all of which are located within conservation areas. None of the proposed or existing transmission line corridors is known to affect any of the conservation areas that host this plant species, so no impacts are expected.

Florida Pineland Crabgrass – Candidate. Florida pineland crabgrass is found in marl prairie and pine rockland habitats and is only known to occur within the Big Cypress National Preserve and Everglades National Park. This species would not be affected by the proposed actions.

Small's Milkpea – Endangered. Small's milkpea has not been observed within existing or proposed Units 6 and 7 transmission line corridors. It grows in pine rocklands. Pine rockland habitat and its FLUCFCS surrogate pine flatwoods are found within the Clear Sky to Davis transmission line corridor. Other plants that occur in pine rocklands have been observed within the proposed West transmission line corridors and Small's milkpea may also be present because suitable habitat is present.

Beach Jacquemontia – Endangered. Beach jacquemontia has not been observed within the proposed Units 6 and 7 transmission line corridors. This plant is adapted to grow on stabilized coastal dunes in hammocks and coastal scrub. Neither existing nor proposed transmission line corridors contain these types of habitats. No impacts on this plant species are expected to result from building or expanding electrical transmission to support proposed Units 6 and 7.

Sand Flax – Endangered. Pine rockland and marl prairie habitats suitable for sand flax would be affected within the Clear Sky to Levee segment of the West transmission line corridors and the Clear Sky to Davis portion of the East corridor, resulting in loss of actual or potential habitat for the sand flax. Building new transmission line corridors, expanding existing corridors, and installing new lines would create disturbed areas that may eventually be colonized by and benefit this plant species. However, recolonization of newly disturbed areas such as access roads may be temporary because subsequent use of roads or vegetation control efforts may eliminate plants that become established. FPL has committed to conducting pre-clearing surveys during access road and structure pad location activities and has also proposed to relocate individual plants unavoidable during building of the transmission line corridor, if feasible (FPL 2012-TN1618).

Carter's Small-Flowered Flax – Endangered. Carter's small-flowered flax is another plant species endemic to pine rocklands. It has not been recorded within transmission line corridors that would support proposed Units 6 and 7. However, as previously stated, pine rocklands would be affected by the building and expansion of transmission line corridors, which could affect the quality and quantity of available habitat for this plant species. The King's Highway Pineland has been proposed as critical habitat for Carter's small-flowered flax (78 FR 61293) (TN2912). The Clear Sky to Levee portion of the West corridors is proposed to pass through this pineland. If the corridor is developed as proposed, individual plants could be destroyed during ground-clearing activities. Approximately 11.2 ac of proposed critical habitat would also be permanently altered (79 FR 41211) (TN3725) and the likelihood of non-native plant introduction would increase.

Tiny Polygala – Endangered. The tiny polygala is adapted to a coastal environment, thriving in sandy substrates under a slash pine overstory typical of pine rockland habitat in Miami-Dade County. Although pine rockland habitat exists within the proposed Units 6 and 7 transmission line corridors, this plant has not been observed within the existing or proposed corridors. Impacts on pine rockland habitat could affect undetected populations of this plant.

Everglades Bully – Candidate. Everglades bully shrubs are endemic to marl prairie and pine rocklands habitats and are known to occur within pine rockland remnants in Miami-Dade County (FWS 2010-TN833). It has not been reported within the proposed Units 6 and 7 transmission line corridors, but habitat is present within the corridors. Mature Everglades bully plants are large and relatively conspicuous so it is doubtful that individuals of this species exist within surveyed habitats. However, degradation of pine rockland habitat could result in potential habitat loss for this species.

Florida Bristle Fern – Candidate. The Florida bristle fern occurs in rockland hammocks and sinkholes, grows on bare limestone and sometimes on tree trunks, and is always associated with deep shade (FWS 2010-TN834). It has not been recorded within the proposed Units 6 and 7 transmission line corridors and is only known to occur at five locations, three of which are in Miami-Dade County. The West Preferred corridor is located approximately 1.8 mi west of the closest known occurrence of the Florida bristle fern, so no impacts on known Florida bristle fern populations are expected to result from the proposed Units 6 and 7 transmission system.

Wildlife

Known distribution and habitat preferences indicate eight terrestrial species listed by the FWS as threatened, endangered, or candidates for such listing could be affected by the building of offsite facilities associated with proposed Units 6 and 7 (FFWCC 2011-TN554). This list includes the Cape Sable seaside sparrow, Miami tiger beetle, eastern indigo snake, Florida panther, piping plover, Everglade snail kite, wood stork, Bartram's scrub-hairstreak butterfly, and the Florida leafwing butterfly. The following paragraphs describe potential impacts on these species.

Cape Sable Seaside Sparrow – Endangered. Although the preferred habitat of the Cape Sable seaside sparrow is mixed marl prairie, this sparrow is not believed to occur within marl prairie habitat along the proposed Units 6 and 7 transmission line corridors or within any other proposed offsite locations. No Cape Sable seaside sparrows have been observed within the transmission line corridors because the entire population is limited to six subpopulations that are located south and west of the West corridor (FWS 2010-TN256). Impacts on this species are not expected to result from building the proposed transmission system or any other proposed offsite facility or structure.

Miami Tiger Beetle (*Cicendelidia floridana*) – Proposed Endangered. There are only two known occurrences of the Miami tiger beetle. One occurrence is within the Richmond Pine Rockland complex adjacent to the proposed East transmission corridor. FPL has proposed to install a single 230 kV transmission line from a new Clear Sky substation at the Turkey Point site to the existing Davis Substation within the East transmission corridor to support Turkey Point Units 6 and 7. The new transmission line would require concrete monopoles within an existing 330 ft wide corridor with multiple operating 230 kV transmission lines. The Richmond Pine Rocklands complex lies adjacent to a 0.46 mi portion of this proposed corridor. However, no pine rockland habitat would be altered because the existing corridor has space to accommodate the new transmission line. No portion of this pine rockland complex or other habitat suitable for the Miami tiger beetle would be altered or affected.

Eastern Indigo Snake – Threatened. Eastern indigo snakes occur in a wide variety of habitats and thrive in a mosaic of different habitat types. This species has been observed at two locations within the East corridor and suitable habitat is present at many locations within both the eastern and western transmission line corridors. Eastern indigo snakes use burrows and other underground refugia and are vulnerable to mortality while underground during ground-clearing and infrastructure installation activities that require off-road use of vehicles. Critical habitat has not been designated for the eastern indigo snake, but the FWS has required FPL to adhere to standardized protection measures for the eastern indigo snake. These measures include a snake protection plan that would include education of construction personnel to limit impacts and provide a reporting protocol for indigo snake observations and takes (FWS 2004-TN779).

Florida Panther – Endangered. The Florida panther thrives in undeveloped lands and prefers upland forest habitats but will use wetlands, disturbed areas, and agriculture lands. It will also use developed lands to some extent. Florida panthers have been observed historically within the proposed West transmission corridors (FPL 2014-TN4058). More recently, during October 2013 an adult panther and kitten were sighted along the proposed West transmission line corridor in the Model Lands Basin approximately 2 mi west of the Turkey Point boundary (SFWMD 2013-TN2917).

The FWS has designated much of Miami-Dade County as a Florida Panther Focus Area (PFA), and the Clear Sky to Levee corridor would border or pass through portions of the PFA primary and secondary management zones. The building of new corridors, including removal of vegetation to modify existing corridors, and the building of access roads would alter Florida panther habitat within panther management zones.

Florida panthers are believed to use primitive roads and transmission line corridors during travel (FPL 2011-TN1283). FPL states that building roads through lowland habitat into transmission line access roads is converting habitat rather than reducing value or eliminating it altogether, and may actually enhance habitat by the creation of more upland habitats through the addition of fill materials. The review team does not agree with this finding. Fragmentation of wilderness contributed to the current state of peril for the Florida panther (FFWCC 2011-TN1579). Florida panthers require large contiguous blocks of habitat to thrive. Habitat fragmentation is considered one of the greatest threats to this species, and panther mortality from vehicle collisions is an ongoing management issue in South Florida (FWS 2008-TN1580). Although panthers may use linear features as travel corridors, the building of roads would not be considered as a management action to enhance panther habitat. Instead it would only serve to fragment panther habitat if built within areas suitable for panthers and could lead to increased mortality from vehicle collisions. Fragmentation and degradation of habitat as well as increased vehicle collision risk would likely result in reduced Florida panther populations in the affected areas. Human activity related to the proposed actions could temporarily displace panthers from adjacent habitats causing temporary indirect habitat loss. Because panthers have very large home ranges, the close proximity of the West transmission corridors to Everglades National Park would also mean panthers within the park could be affected, thereby reducing the visitor experience within these portions of the park. Increased traffic on offsite roads during construction could increase the likelihood of vehicle collision mortality.

Approximately 5.75 mi of proposed road improvements would occur within the PFA. These road improvements would reduce and fragmented panther habitat resulting in a potential loss of 69 ac of panther habitat worth a habitat value of 412 panther habitat units (PHUs) within the PFA using the FWS standardized methodology for determining habitat value (FPL 2011-TN1283).

After applying the FWS mitigation ratio of 2.5:1 for impacts on panther habitat within the PFA, mitigation required by the FWS could equal 1,030 PHUs for access road improvements. Additional compensatory mitigation of 3,980 PHUs for development of the West transmission corridor may also be required by the FWS. However, the total impact on Florida panther habitat from development of the West transmission route cannot be determined until the corridor and exact route have been finalized. Total compensatory mitigation for habitat impact would be determined through continued consultation between FPL and the FWS.

Piping Plover – Threatened. The piping plover is a migratory shorebird species that occurs in Florida during winter. Individuals from three different piping plover populations winter in South Florida. Piping plovers forage on mudflats and other sparsely vegetated wetlands. Critical habitat has been designated for wintering piping plovers, but none was designated in Miami-Dade County.

Red Knot (*Calidris canutus rufa*) – Threatened. The red knot is a shorebird species that winters but does not breed in Florida. It forages along sandy beaches and tidal mudflats. Red knots also use vegetated habitats such as salt marshes and mangroves (FWS 2012-TN146). Suitable habitat exists on some segments of the proposed offsite transmission line corridors and other corridors. Loss of these areas of habitat would constitute a loss of potentially suitable winter foraging habitat. But none of the affected areas contain the beach habitat that is favored by the red knot, and the extensive mangrove habitat remaining elsewhere in the local landscape would continue to provide suitable foraging habitat. Because non-mobile or weakly mobile nesting young are not expected in South Florida, foraging red knots would likely flee habitats subject to disturbance rather than endure direct mortality. The review team therefore expects that impacts would be minimal.

Everglade Snail Kite – Endangered. The Everglade snail kite would be affected by the building of transmission lines within either West corridor regardless of which corridor is developed. Snail kites have been observed nesting where transmission lines would be installed in the West Preferred corridor. Nesting is also suspected in suitable habitat immediately west of the L-31 levee that borders a portion of both West corridors (FFWCC 2013-TN2339). This area is recognized as an important breeding area for the Everglade snail kite (PNNL 2013-TN2466; Reichert et al. 2011-TN2467). In addition, freshwater marsh habitat is present within much of the West Preferred and West Consensus corridors. Although suitability of habitats for snail kites is unknown except in those areas mentioned above, much of both West transmission line corridors lies within the FWS-designated Everglade snail kite consultation area (FWS 2003-TN227). Temporary disturbance during pole and wire installation could displace snail kites from the L-31 levee and surrounding habitats if this work occurred during the nesting season. If indeed there are nests nearby, productivity of this population could be temporarily affected if nesting pairs are displaced during pole and wire installation activities.

Habitat would be permanently altered during the installation of transmission lines and poles. Snail kites need relatively open marsh habitat that contains apple snails. Freshwater marsh habitat currently being used for nesting and foraging by snail kites would be converted into access roads and upland spoil for pole installation. Siltation and runoff would also degrade wetlands, although BMPs would be used to limit siltation to the extent practicable (FPL 2014-TN4058). Access roads could increase the introduction of non-native plants. This coupled with the alteration of surface-water flow could result in overhead cover becoming more prevalent, thereby decreasing the availability of prey and the suitability of habitat to snail kites. Snail kites are relatively small raptors and are preyed upon by larger hawks and eagles. Transmission poles could also serve as perches for larger hawks and eagles that prey on snail kites, increasing predation and decreasing both habitat suitability and snail kite productivity (PNNL 2013-TN2466).

Much of the western third of Miami-Dade County has been designated as critical habitat for the snail kite, but no critical habitat would be affected by developing either of the West corridors. If the West Preferred corridor is developed, impacts on valuable snail kite habitat would be limited to the 7 mi section that borders suitable habitat near and within Everglades National Park. A reduction in snail kites at this location would also result in a reduction of snail kites in this portion of the park and a degradation of the visitor experience in the vicinity. Approximately 5.4 mi of the West Consensus corridor borders the L-31E Canal, so impacts on snail kites and their habitat would likely be less if this corridor were developed. The West Consensus corridor lies east of the West Preferred corridor and passes through a landscape that has a greater amount of previous disturbance than the West Preferred corridor.

Wood Stork – Threatened. Four wood stork colonies are located near the West Preferred corridor (FPL 2014-TN4058). Installation of transmission lines in this corridor would occur within 1 mi of two active wood stork colonies and within 3 mi of two other colonies. A portion of the West Consensus corridor also occurs within 1 mi of one of these wood stork colonies and within 3 mi of the other three. The three southernmost colonies are located within the Everglades National Park. Although there is no designated critical habitat for the wood stork, the FWS Southeast Florida Ecological Services Office recognizes a 0.47 mi nest colony buffer. The FWS also recommends the establishment of a primary zone around stork nesting colonies. This zone must extend at least 500 ft in every direction and up to 1,500 ft in open cover. No vegetation should be removed from within the primary zone. Wetland vegetation under and surrounding the colony shall be maintained. Power transmission lines, roadways, and other infrastructure should not be built within the primary zone. Also, humans should not get within 300 ft of the colony and human activity patterns should not be changed when storks are present at the colony. FWS also recommends the establishment of a secondary zone that extends 1,000 to 2,000 ft beyond the primary zone. Alteration of hydrology that could affect the primary zone and loss or degradation of wetlands should be minimized within the secondary zone. The proposed transmission line corridors are a sufficient distance from known wood stork colonies to comply with all of these FWS guidelines and impacts on wood storks nesting in nearby colonies during transmission line building activities would not be expected. However, the FWS also recommends that transmission lines not be built within 1 mi of stork nest colonies to lower the probability of low-flying stork strikes. As previously stated, the West Preferred transmission line corridor is proposed approximately 0.5 mi from two wood stork colonies. Wood storks have been injured or killed as a result of collisions with FPL electric utility structures (FPL 2011-TN1283) and could collide with transmission structures while they are being erected. Loss of wood storks from either of these Everglades National Park wood stork colonies would reduce the overall visitor experience of the park in this vicinity.

Wood storks frequent shallow waters to forage where prey items become concentrated and they have been observed foraging on the Turkey Point site. Guidelines drafted to address management of the wood stork foraging habitat recommend an 18.6 mi core foraging area management zone around all known wood stork colonies that have had active nests within the last 10 years in South Florida. Human activity should be restricted within 300 ft of forage sites when storks are present and no closer than 750 ft if there is no vegetation to screen human activities from feeding storks (FWS 2010-TN226). Activities should also not alter water levels of stork forage sites from normal. Chemicals should not be introduced within wetlands that contain stork forage sites. Building of transmission lines within 1 mi of major feeding sites should also be avoided. Specific foraging locations for wood storks within the vicinity of the proposed Units 6 and 7 transmission line corridors are unknown. The majority of all proposed transmission corridors overlap with core foraging areas of at least one wood stork colony, and road-building and pole-installation activities would occur within wetland habitats that could be suitable as wood stork foraging habitat.

FPL is required to conduct preconstruction and post-construction flight surveys of the two known wood stork nesting colonies to determine flight corridors of fledging wood storks. FPL would also have to conduct pre-clearing aerial survey of transmission line corridors if nesting by wading birds is confirmed to occur within one-half mile of proposed transmission line corridors. Ground surveys of active colonies would also be required. FPL would also have to conduct post-construction monitoring during the breeding season after transmission line installation near wood stork colonies. Monitoring would include carcass searches and flight behavior observation. Impacts on suitable habitats, including foraging habitat, within 18.6 mi of a wood stork colony would require mitigation (FWS 2010-TN226). Using the FWS South Florida Wood Stork Effect Determination Key, FPL estimated the loss of wood stork forage within the nine designated wood stork core foraging areas from unavoidable wetland fill and alteration within the West Preferred corridor, including the Levee substation and both access corridors at 643.47 kg (FPL 2012-TN1618). FPL also proposed to compensate for this level of forage loss within wood stork core foraging areas through purchase of credits totaling 308 ac within the Hole-in-the-Donut Mitigation Bank, which would provide an additional 649 kg/yr of forage biomass (FPL 2012-TN1618). Final calculation of wood stork forage loss would depend on final corridor design details, structure locations and heights, and access road locations. Final mitigation requirements would be determined through ongoing discussions between FPL and the FWS, and additional monitoring and mitigation may be required, and could include the installation of flight diverters and perch discouragers on transmission infrastructure.

<u>Bartram's Scrub-Hairstreak – Endangered</u>. Bartram's scrub-hairstreak is not known to currently occur at any of the proposed project areas but has sporadically occurred in suitable habitats near the proposed West transmission line corridors (78 FR 49878) (TN2844). Both the West Preferred and West Consensus transmission line corridors are proposed to pass through the King's Highway Pineland that is designated as critical habitat for this butterfly (78 FR 49832) (TN2845). Designated critical habitat also exists immediately adjacent the proposed East transmission line corridor. Land clearing, road building, and pole installation could destroy individual pineland croton plants that the Bartram's scrub-hairstreak relies on for their continued survival. Transmission line maintenance would increase the likelihood of non-native plant introduction, degrading critical habitat.

<u>Florida Leafwing – Endangered</u>. The Florida leafwing does not occur in any of the proposed project areas (78 FR 49878) (TN2844). However, expansion of an existing transmission line corridor to accommodate the proposed East transmission line would occur immediately adjacent to a remnant pine rockland fragment that is designated critical habitat for this butterfly (78 FR 49832) (TN2845). Land clearing, road building, and pole installation into this critical habitat

could destroy individual pineland croton plants that serve and the sole host plant for Florida leafwing larvae. Transmission line maintenance would increase the likelihood of non-native plant introduction, further degrading proposed critical habitat.

State-Listed Terrestrial Species

Impacts on wetlands resulting from the installation of the proposed Units 6 and 7 transmission system would also affect many State-listed species. Loss and degradation of wetlands would affect many State-listed species because most of them rely on wetlands for all or part of their life histories. Impacts on upland habitats, including pine rocklands and marl prairies, could also affect many State-listed plant and animal species that rely on these habitats. Disturbance created during vegetation clearing, road building, and pole installation could allow the establishment or spread of non-native plant and animal species. FPL is required to conduct surveys for Federal- and State-listed species and their habitats prior to preconstruction. Recorded information would include occurrences of all listed species, breeding sites, nests, burrows, wading bird colony locations, and estimates of acreage and vegetation cover. Guidelines for surveys would be provided by the FWS and the FFWCC. Species management plans would be required for all State-listed species that could not be avoided (FFWCC 2011-TN554).

Other Associated Offsite Impacts

Potable Water Pipeline. The potable water pipeline would be installed within existing roadway medians and below temporary construction access roadway improvements (FPL 2015-TN4442). No wildlife habitat is expected to be lost. Nearby wetlands could be affected by siltation resulting from excavation to install the pipeline. Noise during site clearing and pipe installation activities could result in the displacement of wood storks and State-listed wildlife including the limpkin, little blue heron, reddish egret, snowy egret, tricolored heron, white ibis, roseate spoonbill, and the Everglades mink. Erosion and siltation would however be reduced through the use of environmental BMPs and native plants would be allowed to naturally revegetate disturbed areas (FPL 2014-TN4058).

Reclaimed Water Pipeline. Approximately 1,886 ac of upland, forested, and wetland habitats as well as previously developed or disturbed lands occur within the proposed reclaimed water pipeline corridor. Approximately 134 ac of land within the corridor would be affected for the final pipeline, including 45 ac of undeveloped land that consists almost entirely of wetlands (FPL 2015-TN4442). Approximately 2 ac of uplands and 9 ac of wetlands would be temporarily affected, and 35 ac of forested wetlands would be permanently converted to herbaceous wetlands. Affected habitats include mangrove swamp, mixed wetland hardwoods, freshwater marsh, mangrove swamp/exotic wetland hardwoods, dwarf mangroves, and minor amounts of herbaceous prairie, shrub and brushland, and Brazilian pepper. Vegetation would be cleared prior to digging the pipeline trench. Nearby wetlands could also be affected by siltation resulting from ground-clearing and digging activities. Noise from installation activities could result in the displacement or minor loss of local wildlife. Non-native plant species could also become established as a result of this disturbance and alter habitats. Environmental BMPs would be used to minimize impacts on sensitive habitats, including regrading of disturbed portions to the original elevation. Revegetation would occur either naturally or from plantings if needed

(FPL 2014-TN4058). Impacts from the installation of this pipeline would be temporary in nature, but could displace foraging wood storks and other State-listed wildlife species that use wetland habitats. It is not known whether any of these bird species, including wood storks, use the habitats that would be affected.

No listed plant species are known to occur within this corridor, but some upland marl prairie would also be affected. Marl prairie within this corridor could serve as habitat for and harbor the crenulate lead-plant, Florida prairie clover, Florida pineland crabgrass, sand flax, and Everglades bully. This pipeline would be in the vicinity of Homestead Bayfront Park where sand flax has been found, and habitat for this plant could be affected although it has not been found growing within or near the proposed corridor. No other listed species are expected to be affected by the installation of the reclaimed water pipeline.

Access Roads. Construction access roads would be developed on and along approximately 0.9 mi of SW 117th Avenue, 0.9 mi along SW 137th Avenue, and 3.68 mi along SW 359th Street (Lucille Drive). Lands designated as Environmentally Endangered by Miami-Dade County border portions of these proposed construction access roads west of SW 117th Avenue, north of SW 359th Street. Extensive Environmentally Endangered Lands (EELs) also exist approximated 260 ft (80 m) south of SW 359th Street. EELs were identified and purchased primarily for conservation. Although there are existing unpaved roads present where the proposed construction access roads would be built, clearing, grading, and filling to widen the roadway and paving would increase disturbance, further limit surface sheet water flow, and could disrupt wildlife access among EEL parcels and adjacent lands.

4.3.1.4 Impacts from Fill Acquisition

Another potential impact on terrestrial resources that was considered in the evaluation was mining of fill material needed to build proposed Units 6 and 7. FPL proposes to obtain about 8.9 million cubic yards of fill from commercial sources. Terrestrial resource impacts would take place within land areas already designated for commercial mining operations.

4.3.1.5 Terrestrial Monitoring

To date, FPL has not monitored populations of terrestrial plants or wildlife on the Turkey Point site. Population monitoring of the predominantly aquatic American crocodile (*Crocodylus acutus*) is discussed in the aquatic ecology sections of this EIS. However, before land-clearing activities for proposed Units 6 and 7 can be conducted, FPL would coordinate with the FFWCC and the FWS to conduct targeted surveys for listed species. Specifically, surveys would be conducted for the eastern indigo snake, wood stork, least tern, snail kite, Everglades mink, Florida panther, white-crowned pigeon, little blue heron, reddish egret, white ibis, snowy egret, roseate spoonbill, and the tricolored heron (FFWCC 2011-TN554). Pre-clearing surveys would also be conducted for listed plant species (FFWCC 2011-TN554).

4.3.1.6 Potential Mitigation Measures for Terrestrial Impacts

FPL proposes three broad categories of mitigation for impacts to terrestrial resources: wetland mitigation, an avian protection plan, and a series of mitigation measures addressing impacts to Federally-listed threatened and endangered species.

Wetland Mitigation Plan

FPL proposes wetland mitigation to offset unavoidable wetland losses caused by the project (FPL 2012-TN4629). The USACE has not yet independently reviewed and verified FPL's proposed plan. No approved jurisdictional wetland determination has been conducted for the project; however, FPL signed a preliminary jurisdictional determination on July 10, 2012. The USACE will proceed with processing the application under this preliminary jurisdictional determination. The USACE's CWA Section 404(b)(1) Guidelines analysis, including determination of the sufficiency of compensatory mitigation pursuant to 33 CFR Part 332 (TN1472), will be concluded in the USACE's ROD. The USACE would review the project pursuant to the CWA Section 404(b)(1) Guidelines, which require a sequential process of avoidance, minimization, and compensatory mitigation. Any unavoidable impacts to jurisdictional areas would require compensatory mitigation pursuant to 33 CFR Part 332 (TN1472), which may differ from State of Florida requirements. The USACE would conclude its CWA Section 404(b)(1) Guidelines and public interest analyses in its ROD. The mitigation would have to comply with the USACE's compensatory mitigation rule (33 CFR Part 332) (TN1472), which includes provisions to ensure the long-term success and preservation of completed mitigation activities.

FPL instituted measures early during project planning to avoid and minimize impacts on wetlands to the greatest extent practicable (FPL 2012-TN4629). Avoidance and minimization measures include maximizing the use of previously disturbed areas while minimizing use of areas with high-quality intact wetlands. Corridor selection for the reclaimed water pipeline, potable water pipeline, and transmission facilities maximized collocation with other existing or proposed infrastructure to limit additional disturbance. FPL estimates that situating new reactors and many of the ancillary facilities within the existing footprint of disturbance that previously resulted from building the older units on the Turkey Point site avoids impacts to over 200 ac of intact coastal mangrove swamps and freshwater wetlands on the property. FPL also estimates that movement of proposed parking and laydown areas early in the planning process would avoid impacts to approximately 159 ac of wetlands, including large areas of sawgrass wetlands (FPL 2012-TN4629).

FPL based its proposed compensatory wetland mitigation on compensating for the loss of wetland functions as quantitatively estimated using UMAM. Florida's State regulations (62-345.100 F.A.C) establish UMAM as a standardized process for developing compensatory mitigation for projects requiring state approval. According to those regulations, UMAM "provides a standardized procedure for assessing the functions provided by wetlands and other surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss." The UMAM approach does not merely consider the number of acres of land proposed to offset the impacts to wetlands from the proposed action, but includes consideration of relative location within the landscape, quantity and quality of water available within a wetland, and vegetation community structure to calculate functional value. The procedure can be used to calculate the acres of permittee-responsible wetland mitigation or the number of credits that must be purchased from a wetland mitigation bank or in-lieu fee project to adequately compensate for the loss of hydrological, ecological, and social functions resulting from impacts to wetlands and other surface waters. The calculations used to determine the area or credits of mitigation necessary to offset impacts account for the time lag needed for newly established wetland soils or vegetation to attain full function as well as for the risk that such areas may not become successfully established within the contemplated timeframe.

To meet the wetland mitigation requirements calculated for Units 6 and 7 using UMAM, FPL proposes a combination of wetland mitigation bank credits and permittee-responsible wetland restoration and enhancement in undeveloped portions of its Turkey Point property (FPL 2012-TN4629). FPL estimates that the wetland functions and values gained through the proposed compensatory mitigation, expressed as UMAM units, would offset the functions and values lost (Table 4-10).

Table 4-10. Proposed Mitigation Efforts to Offset Loss of Wetland Function Related to the Preconstruction and Construction of Proposed Units 6 and 7 and the Building and Installation of Related Structures

Site	Affected Area (ac)	UMAM Wetland Functional Change (Mitigation Units)	W.A.T.E.R. Wetland Functional Change (Mitigation Units)
Proposed Units 6 and 7 Site	250.2	-128.3	-148.4
Associated Non-linear Facilities	68.7	-46.1[(a)]	-51.5
Access Roads	81.6	-80.8	
Reclaimed Water Pipelines	43.6	-3.4[(a)]	
Transmission Line Corridors	308.2	-240.9	
Subtotal	**752.3**	**-499.5**	**-199.9**
Everglades Mitigation Bank		+175.8	+201
Hole-in-the-Donut Mitigation Bank		+308.0	
Reclaimed Water Pipeline Restoration	43.6	+3.4	
Northwest Mitigation Site	237.8	+37.6	
SW 320th Street Site	574.0	+60.4	
Sea Dade Canal Crocodile Sanctuary	6.2		+1.5
Subtotal	**864.6**	**+585.3**	**+202.5**
Total (Net Gain)		**+85.8**	**+2.7**

(a) FPL regards pipeline installation impact on wetlands as temporary and functional change accounts for the time lag of in situ remediation.
UMAM = Uniform Mitigation Assessment Method.
W.A.T.E.R. = Wetland Assessment Technique for Environmental Review.

Source: Turkey Point Units 6 & 7 Mitigation Plan – USACE Supplement (FPL 2012-TN4629).

FPL (2012-TN4629) proposes to purchase credits from the EMB to offset unavoidable impacts from development of the proposed Units 6 and 7 plant area, RWTF, nuclear administration building, training and parking area, and the East Preferred transmission line corridor. The EMB has an approved mitigation banking instrument authorized by USACE. The EMB consists of more than 13,000 ac situated directly west of the Turkey Point site that encompasses many of the same habitats occurring on the site in a similar landscape position. To determine the amount of mitigation necessary to compensate for these impacts, FPL had to use the Wetland Assessment Technique for Environmental Review (W.A.T.E.R.), which is an older methodology somewhat similar to UMAM that FPL developed specifically for calculating mitigation credits using EMB (https://www.fpl.com/environment/pdf/wetland-assessment-review-manual.pdf). Like UMAM, W.A.T.E.R. involves quantifying impacts to and compensatory credits toward wetland functions considering specific hydrological, ecological, and social factors. The W.A.T.E.R. approach, like UMAM, does not merely consider the number of acres of land proposed to offset the impacts to wetlands from the proposed action, but includes consideration of relative location within the landscape, quantity and quality of water available within a wetland, and vegetation community structure to calculate functional value. At the time FPL established the EMB, UMAM had not yet been developed. Despite the need to use W.A.T.E.R. to calculate credits needed for purchase from the EMB, Table 4-10 converts mitigation credits calculated using W.A.T.E.R. into credits calculated using UMAM to demonstrate that FPL's overall wetland mitigation adequately compensates for the overall impact following the UMAM process. The EMB has been and would be protected with a conservation easement and a long-term funding mechanism pursuant to its mitigation banking instrument in accordance with 33 CFR Part 332 (TN1472).

FPL (2012-TN4629) also proposes purchasing mitigation credits within the NPS Hole-in-the-Donut Mitigation Bank to offset some of the freshwater wetland acreage and function lost from project activities such as development of the West Preferred transmission line corridor. The Hole-in-the-Donut Mitigation Bank consists of approximately 6,300 ac of previously farmed land within Everglades National Park identified for restoration to natural Everglades' vegetation through a multi-agency effort. FPL used the UMAM methodology to assess wetland impacts that would be mitigated by means other than EMB.

FPL's proposed permittee-responsible wetland mitigation involves two projects, both involving restoration and enhancement of existing but partially degraded freshwater wetlands (FPL 2012-TN4629). The first project, the Northwest Restoration Project, is located approximately 2 mi from where the new reactors would be built. It comprises several contiguous FPL-owned parcels totaling approximately 238 ac within the proposed Biscayne-Everglades Greenway and at the entrance to Biscayne National Park. FPL proposes to remove or control exotic vegetation, backfill ditches, grade the land to resemble a natural state, and plant native wetland vegetation as necessary. FPL also proposes to maintain and monitor vegetation for 3 years after mitigation activities and to preserve the lands under a conservation easement.

The second project, the SW 320th Street Restoration Project, encompasses approximately 574 ac roughly 4 mi northwest of where the new reactors would be built (FPL 2012-TN4629). As for the Northwest Restoration Site, FPL proposes to remove and control exotic plants on these lands with mechanical means and herbicide treatment where appropriate. FPL proposes to grade and backfill to restore natural contours, and plant herbaceous wetlands plants to encourage rapid colonization, and transfer these lands to a public trust to be managed by a qualified government entity after the conclusion of mitigation actions. FPL determined the functional lift provided by the various mitigation activities would exceed the wetland function lost (Table 4-10). The quantitative accounting of losses of wetland functions and values and functional life (credit) provided by the proposed wetland mitigation conservatively accounts for time lags in the establishment of planted vegetation and time needed for that vegetation to mature enough to provide ecological services (FPL 2012-TN4629). The final locations for facilities such as the transmission lines and pads and the RWTF have not been finalized and the final impacts on wetlands are not known. However, FPL applied conservative assumptions with its approach to estimating wetland impacts and provided mitigation to address the maximum impact expected. Further mitigation for impacts on wetlands and listed species may be required by other Federal or State agencies.

FPL also proposes *in-situ* restoration of approximately 46 ac of wetlands that would be disturbed only temporarily to install pipelines to serve the new reactors. Additionally, FPL proposes to perform ecological enhancements to the Sea Dade Canal Crocodile Sanctuary. These mitigation activities are considered by FPL to be voluntary additional mitigation and are not counted for functional life needed to meet wetland mitigation requirements (FPL 2012-TN4629).

The NRC staff carefully examined FPL's entire wetland mitigation strategy and determined that, if fully and successfully implemented, it would likely compensate for the loss of ecological, hydrological, and social functions resulting from unavoidable wetland impacts associated with building Units 6 and 7 (including offsite appurtenances). The NRC staff recognizes that FPL's strategy relies on compensatory wetland mitigation practices calling for restoration and enhancement of wetlands, and that the ultimate success of such efforts to manipulate natural wetlands is less than fully certain, no matter how well designed. FPL has designed its proposed wetland mitigation using practices commonly used in South Florida, designed by qualified experts using state-of-the art methodologies, and approved by applicable state and Federal agencies who would oversee implementation and long-term monitoring. FPL has situated its compensatory mitigation practices in close proximity to the impacts in landscape positions that closely resemble those of the impacts. FPL calls for preserving, restoring, and enhancing wetlands with similar properties and functions as those subject to impacts. The NRC staff determined that FPL correctly reflected the above considerations in FPL's application of the UMAM and W.A.T.E.R methodologies. Accordingly, the NRC staff concludes that the FPL proposal for the use of mitigation bank credits, in-lieu fees projects, and permittee-responsible mitigation, as calculated using UMAM and W.A.T.E.R., is a reasonable estimate of the mitigation these measures can be expected to achieve.

As stated in the opening to this section, the USACE has not yet independently reviewed and verified FPL's proposed compensatory mitigation plan for unavoidable impacts to jurisdictional wetlands because avoidance and minimization have not been demonstrated pursuant to CWA 404(b)(1) Guidelines. Additionally, no approved jurisdictional determination has been conducted for the project; however, a preliminary jurisdictional determination was signed by FPL on July 10, 2012. The USACE will proceed with the processing of the application under this preliminary jurisdictional determination. The USACE's CWA Section 404(b)(1) Guidelines analysis, including determination of the sufficiency of compensatory mitigation pursuant to 33 CFR Part 332 (TN1472), will be concluded in the USACE's ROD.

Avian Protection Plan

FPL provides protection to migratory birds through a corporate avian protection plan (FPL 2011-TN1283). This plan adheres to the Avian Power Line Interaction Committee and FWS guidelines regarding birds and electrical energy production. The avian protection plan provides guidance for reporting bird mortalities, dealing with bird injuries, nest-management procedures, permitting issues, construction design standards to minimize collision and electrocution, staff training, and mortality risk assessment.

Mitigation Specifically Developed for FWS

FPL has proposed a sequence of mitigation actions to the FWS as part of its consultation activities under Section 7 of the ESA (FPL 2016-TN4713). The NRC staff expects that FWS will enforce these mitigation actions under the ESA and thus considers them to be reasonably foreseeable. Some of the mitigation actions are the wetland and avian mitigation actions described above and are not discussed further here. Other mitigation actions involving terrestrial species include the following:

- FPL proposes to conduct updated pre-clearing surveys and assessments of Federally-listed species in potentially affected habitats prior to initiating ground disturbance.
- FPL proposes to conduct updated avian surveys of affected shorebird habitat prior to and during building activities and in wetland mitigation areas designed to provide shorebird habitat.
- FPL proposes to install physical wildlife protection features such as fences and culverted wildlife underpasses on several roads and access roads.
- To compensate for the loss of shorebird habitat, FPL proposes to establish approximately 219 ac of shorebird habitat within the coastal wetland mitigation areas (specifically within the EMB wetland mitigation areas and the Northwest Restoration Site and 320th Street Restoration Site).
- To address the wood stork, FPL proposes to incorporate avian protective measures into the design of associated transmission lines to protect wood storks, and FPL proposes to ensure that its proposed wetland mitigation provides equal or better wood stork habitat near wood stork core foraging areas.
- To address the Florida panther, FPL proposes to purchase 743 panther habitat units from an approved Florida panther mitigation bank to offset the estimated loss of 243 panther habitat units.
- To address possible impacts to Federally-listed plant species where the West Transmission Corridor crosses approximately 0.84 ac of the King’s Highway Pine Rockland, FPL proposes pre-clearing surveys and relocation of affected plants to other suitable areas.

FPL also proposes to perform various compensatory mitigation measures addressing aquatic ecological resources such as American crocodiles and seagrasses; those are discussed in Section 4.3.2.

4.3.1.7 Summary of Impacts on Terrestrial Resources

The review team evaluated the potential impacts on terrestrial ecological resources from construction of the proposed Turkey Point Units 6 and 7 and the associated offsite facilities.

Development of the proposed Units 6 and 7 would proceed according to Federal and State regulations, permit conditions, existing procedures, and established BMPs. Construction and preconstruction activities related to the proposed Turkey Point Units 6 and 7 would result in the permanent loss of approximately 585 ac of habitat on the Turkey Point site. Three land-cover classifications—previously filled areas, non-vegetated mudflat, and mangroves—compose more than 80 percent of the affected lands on the site (Table 4-6). Although wetlands would be avoided to the extent possible, approximately 320 ac of wetlands would be permanently lost within the Turkey Point site (Table 4-8).

Pipelines that would be built extending off of the Turkey Point site, including a 10 mi long potable water pipeline and a 9 mi long reclaimed water pipeline, would affect an additional area of approximately 2,211 ac, including approximately 719 ac of wetlands. Much of the land crossed by the proposed pipeline corridors has been previously developed or disturbed.

Transmission line corridors would be built or upgraded to support proposed Units 6 and 7. Depending on whether the West Preferred or the West Consensus corridor would be developed, these transmission lines would alter as much as 760 ac. All vegetation exceeding 14 ft in height would be removed, and vegetation would be cleared for pad installation and vehicle access. Relatively undisturbed terrestrial cover types that would be altered during these activities include mangrove swamp, freshwater marsh, mixed wetland hardwoods, shrub and brushland, and herbaceous prairie. Pine rocklands serve as a reservoir of endemic species and often contain many Federal and State-listed species. Pine rocklands and pine rockland habitat lies adjacent to the East (Davis to Miami) and within both West (Clear Sky to Levee) corridors. The FFWCC has required surveys to determine the distribution and abundance of listed plants and animals within all transmission line corridors as part of the State of Florida Site Certification permitting process. FPL estimated approximately 308 ac of wetlands would also be affected during transmission line development. Ground disturbance and alteration of surface-water flow could result in the establishment of non-native species.

Compensatory mitigation for unavoidable wetland impacts is required under both the Federal CWA Section 404 (33 U.S.C. § 1344) (TN1019) and the Florida Environmental Resource Permitting processes. FPL has proposed a compensatory mitigation plan that addresses wetland impacts (Table 4-10). The USACE will conclude its CWA Section 404(b)(1) Guidelines and public interest analyses in its ROD. As noted in Section 4.3.1.6, the NRC staff has reviewed the proposed wetland mitigation plan, independently of other reviews necessary for state or Federal permitting, and determined that if fully and successfully implemented, the plan would offset the losses of wetland functions resulting from project impacts. The NRC staff acknowledges that despite FPL's use of state-of-the art assessment and design procedures and qualified mitigation designers, and despite the fact that multiple regulatory agencies can be expected to enforce implementation of the mitigation, the long-term success of mitigation actions such as wetland restoration and enhancement is inherently uncertain. Nonetheless, the use of the UMAM and W.A.T.E.R. methodologies, as described above, results in a reasonable prediction of the likely effectiveness of these mitigation measures.

Site preparation and development for the proposed project area would affect wildlife and important species as defined by the NRC. The review team has determined that habitat loss, hazards posed by site preparation, noise, collisions with elevated structures, and increased traffic may negatively affect wildlife. However, the impacts on wildlife populations are expected to be localized and offset through onsite habitat enhancement and conservation measures.

Federally and State-listed threatened and endangered species, at times, may occur on or in the vicinity the Turkey Point site and the associated offsite facilities. Numerous plants listed as Federally endangered, threatened, or as candidates for listing as threatened or endangered are known to occur in Miami-Dade County. None of these plants has been observed on the Turkey Point site, and habitat does not exist within the Turkey Point site boundary for any of these plants. However, the sand flax (endangered), Florida brickell-bush (proposed endangered), and the pineland sandmat (candidate) have been observed growing within proposed transmission line corridors that would support proposed Units 6 and 7. One of the plant species listed by the FWS as endangered—sand flax—has been observed within the Clear Sky to Levee corridor. Two candidate species, the Florida brickell-bush and pineland sandmat, were also recorded to be growing within the Clear Sky to Levee corridor. This portion of the corridor is part of both the West Preferred and West Consensus corridors. The botanical survey of the proposed transmission line corridors does not represent an exhaustive search for listed plants throughout all of the corridor areas and further investigations may reveal additional listed species (FPL 2009-TN657). Most of the listed plant species occur in pine rockland habitats. Pine rockland habitat has been highly fragmented in Miami-Dade County and is now found in small, widely scattered remnants. Pine rocklands were historically maintained by periodic disturbance in the form of wildfire and are dependent upon such disturbance for continued existence (FWS 1999-TN136). The presence of pine rockland plant species within existing transmission line corridors may indicate periodic vegetation-management practices that have been used within the corridors may simulate the natural fire disturbance regime and serve to maintain pine rockland habitat (FPL 2009-TN657). Additional patches of pine rockland and marl prairie habitat, within which most of the other Federally listed plants are associated, have not yet been surveyed for plants.

Numerous terrestrial animal species that are Federally listed or proposed as either endangered, threatened, or as candidates for such listing are known to occur in Miami-Dade County. Suitable habitat does not exist at or near locations proposed to be affected by proposed Units 6 and 7 and all of their associated facilities. Those that could be affected are the eastern indigo snake (threatened), Florida panther (endangered), piping plover (threatened), Everglade snail kite (endangered), and the wood stork (threatened). No designated critical habitat for any of these species would be affected by the proposed actions. Measures to protect and minimize impacts on indigo snakes have been required by the FWS. Florida panther are not known to occur on the Turkey Point site but have historically occurred within habitats that would be affected by proposed Clear Sky to Levee (West) transmission line development. The FWS has established panther management zones within the State of Florida. The PFA includes much of Miami-Dade County west of the Turkey Point site but excludes the site itself. Proposed activities would result in loss of panther habitat. FPL has proposed mitigation for lost panther habitat as well as management controls to limit impacts of preconstruction and construction on panthers. Piping plovers would be minimally affected by both preconstruction and construction activities. Everglade snail kites are known to occur within the EMB adjacent to the Turkey Point site and a single kite was observed along the West Preferred corridor. Activities on the Turkey Point site are not expected to affect snail kites, but development of sections of the West Preferred or West Consensus corridors that lie adjacent to Everglades National Park could affect habitat and snail kites foraging nearby including within the park boundary. Development of the Clear West Consensus corridor could have relatively less impact on the snail kite because this corridor is located further east than the West Preferred corridor and would pass through habitats that have been previously degraded and provide less ecological value to snail kites (FPL 2013-TN2941). Wood storks have been observed foraging on the Turkey Point site and two active nest colonies exist near the Clear Sky to Levee segment of the West Preferred corridor. The nearest colony is slightly less than 1 mi of the corridor and the other is within 3 mi. The FWS established management buffers around wood stork nest colonies and forage sites. FWS recommends building overhead transmission lines more than 1 mi from nesting colonies. The FFWCC requires FPL to conduct extensive pre- and post-installation monitoring, and further mitigation may be required, such as use of flight diverters and perch discouragers on transmission wires and poles.

Plant species listed by the State of Florida as threatened or endangered are numerous and occur in a variety of habitats; most species are associated with either pine rocklands or marl prairie. Some are also associated with disturbance. Individual plants and populations have been observed within proposed project areas, and other areas have not yet been surveyed, so distribution and abundance of State-listed plants within all proposed project area are unknown. In addition, numerous animal species listed by the State of Florida as threatened or endangered may occur at or in the vicinity of proposed facility locations. Miami-Dade County and the FFWCC have required FPL to conduct pre-clearing surveys for all State-listed species in coordination with the FFWCC. FPL would follow FFWCC-approved survey protocols, conduct regular reporting of results, and implement management actions for specific species or resources as required. Provided that adequate surveys are conducted prior to commencement of development, consultation with the FWS and FFWCC is initiated as needed, and other identified mitigation is implemented, impacts on threatened and endangered species from the proposed Turkey Point project likely would be reduced to the extent practicable. However, without proper surveys, consultation, and appropriate mitigation, the impact could be greater.

Based on the review team's independent evaluation of the Turkey Point project described above, including the ER, the SCA, FPL's responses to NRC's RAIs, the identified mitigation measures and BMPs, and consultation with other Federal, State, and County regulatory agencies, the review team concludes that the impacts of preconstruction and construction activities on terrestrial ecological resources (including wetlands and threatened and endangered species) would be MODERATE. This conclusion reflects the impacts on wetlands, wildlife, and Federally and State-listed plant and animal species at the Turkey Point site, in the vicinity of the site, and at or in the vicinity of all associated offsite facilities. It also reflects the proximity of many of these impacts to Biscayne and Everglades National Parks. The review team does not consider the terrestrial impacts from building the proposed facilities to be potentially destabilizing, considering the abundance of similar habitat in the vicinity and region; the history of prior disturbance of the proposed Units 6 and 7 plant area and adjoining areas; the extent that offsite pipeline and transmission line corridors have been collocated within or along existing corridors or routed to cross mostly disturbed lands; and the extent of the proposed wetland mitigation, which would be required under Federal and State regulations. However, the review team considers the impacts to be noticeable despite the proposed mitigation, considering the complexity and extent of the impacts, potential time lag and uncertainties associated with the mitigation, and the unavoidable presence of workers and equipment in sensitive terrestrial habitats, including pine rocklands, even if only temporary.

The USACE is concurrently reviewing the project but will not have enough information to support this impact level determination until after the public notice has been published, comments have been received from the public, and LEDPA has been identified.

The LWA rule (72 FR 57416) (TN260) specifically states that transmission lines, pipelines, heavy-haul roads, and other offsite actions that support building the proposed Units 6 and 7 are not included in the definition of construction. NRC-authorized construction activities would be limited to activities necessary to develop safety-related structures on the Turkey Point site, a subset of the total development activities on the site analyzed above for impacts on terrestrial resources. The NRC-authorized construction activities with the potential to affect terrestrial species and habitats include the use of cranes and the erection of safety-related structures; movement of construction vehicles and heavy equipment around the site; the noise associated with construction, machinery, and testing of diesel and combustion turbine generators; and minor changes in surface-water drainage. These NRC-authorized construction activities are not expected to increase mortality rates enough to destabilize affected wildlife populations, and detectable changes in abundance would not be expected at a regional population level. Based on these analyses, the NRC staff concludes that impacts on terrestrial ecological resources from NRC-authorized construction activities would be SMALL, and no mitigation beyond the actions stated would be warranted.

4.3.2 Aquatic Impacts

Based on the independent review of FPL's ER, SCA submission, other relevant information, and Federal and State regulatory agency comments, building-related effects on onsite and offsite aquatic resources could include the following:

- temporary or permanent loss of onsite surface water and other habitat from clearing and grading operations, and building of roads, permanent structures, laydown areas, pipelines, transmission lines and substations, and stormwater-drainage structures needed to support these activities
- effects of building site runoff and dewatering releases on aquatic species inhabiting the IWF
- deep-well injection installation
- RCW installation
- effects of stormwater or dewatering constituents and of excavated "muck" disposal on aquatic species inhabiting the IWF
- effects of light, sound, and vibration related to building activities on American crocodiles (*Crocodylus acutus*) occurring on the Turkey Point site
- increased vehicular traffic that could result in fatal or non-fatal collisions with American crocodiles present on the site
- habitat loss or alteration related to the building of the RCW system, or effects related to noise and building activity on nearshore aquatic resources

- habitat loss or alteration associated with the expansion of the existing equipment barge-unloading area and excavation and dredging in the vicinity of the existing barge-turning basin
- barge and tug traffic that could result in fatal or non-fatal collisions with the Florida manatee (*Trichechus manatus latirostris*), sea turtles, Smalltooth Sawfish (*Pristis pectinata*), or other species present near the barge-unloading area and turning basin during construction equipment deliveries.

Specific information about anticipated property disturbance by FLUCFCS land-use category is provided in Table 4-1. In general, activities resulting in the largest disturbance or loss of aquatic habitat (streams, waterways, ditches, reservoirs) are associated with building proposed Units 6 and 7 and the western equipment laydown areas and creation of designated spoils areas along some of the IWF berms to permanently store the muck excavated from the proposed Units 6 and 7 plant area.

In the following sections, the expected building-related effects likely to occur at onsite and offsite locations are described, including, when possible, the extent and duration of the expected effect. The narrative first focuses on likely effects within the site boundaries, and provides an overview of potential effects on aquatic habitats adjacent to FPL (e.g., Biscayne Bay, Everglades National Park, EMB, Florida Keys National Marine Sanctuary). The remainder of this section evaluates the potential building-related effects on the aquatic resources described in Section 2.4.2, including species considered to be ecologically, commercially, or recreationally important; those listed as threatened, endangered, proposed threatened, proposed endangered, or candidates for listing by State and Federal resource agencies; Federal or State Species of Concern, and species with designated or proposed critical habitat or designated essential fish habitat within or adjacent to the Turkey Point site. The aquatic monitoring studies proposed by FPL during building activities are summarized as are those requested by Federal or State resources agencies in their comment responses to FPL's ER or SCA submissions. A final determination of likely onsite and offsite impacts on aquatic resources is provided at the end of this section along with a summary of potential mitigation options, if any, that could lessen or eliminate the identified impacts on aquatic resources.

4.3.2.1 Aquatic Resources − Site and Vicinity

Onsite Surface-Water Habitats

This section provides a general summary of the likely impacts of building-related activities on aquatic resources at or near the Turkey Point site. A detailed assessment of building impacts is provided in Section 4.3.2.2 for transmission line and pipeline installation and Section 4.3.2.3 for building impacts on aquatic species and habitats at or near the site.

As described in Section 2.4.2, onsite aquatic habitats that could be affected by building activities include hypersaline mud flats, mangrove heads associated with historical tidal channels, remnant canals, and the cooling canals of the IWF. Potential impacts on onsite surface waters associated with the building of proposed Units 6 and 7 include the following:

- temporary or permanent loss of onsite surface-water and other habitat from clearing and grading operations, and building of roads, permanent structures, laydown areas, pipelines, transmission lines and substations, and stormwater-drainage structures needed to support building activities
- effects of building site runoff and dewatering releases on aquatic species inhabiting the IWF
- deep-well injection installation
- RCW installation
- effects of stormwater or dewatering constituents and of excavated “muck” disposal on aquatic species inhabiting the IWF.

For each of the above activities, temporary or permanent loss of aquatic habitats is expected to occur. Building activities also create the potential for the degradation of water quality caused by site runoff, leading to siltation or sedimentation, water turbidity, or release of chemicals or other constituents related to building activities into surface waters.

<u>Proposed Units 6 and 7 Plant Area</u>

The power blocks, makeup-water reservoir, switchyard, and related infrastructure associated with proposed Units 6 and 7 would occupy approximately 218 ac at the northeastern edge of the existing IWF (FPL 2014-TN4058). FPL characterizes this area as a sparsely vegetated hypersaline mudflat that is partially buffered from tidal influence by the IWF.

As described in ER Revision 6 (FPL 2014-TN4058), wetland and aquatic habitats within the proposed Units 6 and 7 plant area and adjacent laydown areas include the following:

- 187.5 ac of mudflats
- 25 ac of remnant and active canals
- 17 ac of dwarf mangroves
- 16 ac of open-water habitat
- 12 ac of mangrove heads
- 10 ac of wetland spoil areas.

In June 2009 as part of pre-application monitoring, Tetra Tech NUS (FPL 2009-TN201) conducted a survey of fish species in areas that would be affected by building the new units. All fish collected during the survey represented hardy species common to South Florida. No rare, unusual, sensitive, or protected species were observed. Building-related impacts on aquatic resources at this location would include the permanent loss of aquatic habitat and potential disturbance of American crocodiles nesting in the northeastern corner of the IWF. Heavy equipment operation in this area could also result in fatal or non-fatal collisions with crocodiles. Additional impacts related to the building of the power block and related structures include releases of stormwater or dewatering constituents into the IWF and relocation of the “muck” excavated from the Units 6 and 7 power block area to dredge spoil sites located within the IWF.

Pipelines and Reclaimed Wastewater-Treatment Facility

As described in ER Revision 6, (FPL 2014-TN4058), a 72 in. diameter water pipeline would be buried to bring reclaimed water from Miami-Dade County to the Turkey Point site. This pipeline would extend approximately 9 mi north from the site generally following existing roadways or corridors including the existing Clear Sky to Davis transmission line right-of-way for 6.5 mi. A second pipeline would be constructed to bring potable water to the site from MDWASD. This pipeline would be 10 mi long, and approximately 2.5 mi of the pipeline corridor would require new land disturbance (FPL 2014-TN4058). The review team assumes the reclaimed water pipeline and the entire potable water pipeline rights-of-way would likely affect aquatic resources in ways similar to those ascribed to the transmission line corridors. The pipelines would be installed in trenches within or alongside existing corridors, or alongside roadways in conjunction with planned roadway enhancements. Areas disturbed during construction would be graded and landscaped after pipeline installation. Standard industry practices would include the use of silt fences, mulching, slope texturing, and other techniques that are protective of both terrestrial and aquatic resources occurring along the pipeline route. The reclaimed water pipeline supplies water to the onsite RWTF. The RWTF would be built on approximately 44 ac of land immediately north and west of the IWF near SW 360th Streets (Figure 3-1). This land currently contains sawgrass marsh, dwarf mangroves, upland Australian pine (*Casuarina* spp.), an excavated canal system (the Moat), and exotic wetland hardwoods (FPL 2014-TN4058).

Roads, Bridges, Parking Areas, and Laydown Space

As described in the ER (FPL 2014-TN4058), approximately 52 ac of space west of the proposed Units 6 and 7 plant area would be used for building laydown, including fill areas for roads and highways. This area contains streams, waterways, land adjacent to the existing IWF, and wetland and dwarf mangroves. To support building activities, existing roads on the Turkey Point site would be improved to provide heavy-haul capabilities to transport large components and equipment from the equipment barge-unloading area. This building is expected to result in the permanent loss of 5.17 ac of water courses, and non-vegetated, disturbed land, including fill areas and land with existing highways and power facilities. In addition, to accommodate heavy loads, two new bridges would be installed over existing canals (FPL 2014-TN4058). As described in Section 2.4.2, the predominant fish species found in onsite surface-water habitats are the Sheepshead Minnow (*Cyprinodon variegatus*), followed by the Sailfin Molly (*Poecilia latipinna*) and the Goldspotted Killifish (*Floridichthys carpio*). All of the species collected represent hardy species common to South Florida; no rare, unusual, or protected species were observed during the collections (FPL 2009-TN201). Additional information about road and bridge building is available in the Conceptual Design Report by HDR Engineering, Inc. (HDR) (HDR 2009-TN1040). Because these road improvements would occur in areas adjacent to established crocodile populations, there is a potential for increased fatal or non-fatal collisions with building equipment. Additional discussion of this potential building impact and proposed mitigation measures follows.

Building-Related Erosion, Runoff, and Spills

In its ER (FPL 2014-TN4058), FPL describes the general building-related impacts related to sedimentation, changes to water turbidity, spills, and habitat disturbance that are likely to affect aquatic species on or near the Turkey Point site. Building-related activities such as excavation, road building, grading, storage of soil piles, and use of heavy machinery can result in soil erosion that can lead to sedimentation and changes in water clarity or quality in onsite waterbodies or those near the building site. Building activities can also increase the likelihood of chemical spills into aquatic environments. To reduce erosion and turbidity effects, FPL has indicated environmental BMPs would be used during building; these techniques would include the use of stormwater-retention basins, silt screens, mulching, slope texturing, buffer strips, and soil reseeding to minimize erosion and runoff. In addition, a Spill-Prevention, Control, and Countermeasure (SPCC) plan would be implemented in accordance with EPA regulations described in 40 CFR Part 112 (TN1041). This plan would require immediate cleanup of spills occurring on the building site (FPL 2014-TN4058). Activities used to minimize erosion, runoff, and spills at the proposed Units 6 and 7 plant area would likely also apply to other areas within or adjacent to the Turkey Point site.

Industrial Wastewater Facility

The IWF encompasses 5,900 ac on the existing Turkey Point site (Figure 2-4). The IWF is used as a closed-loop system to provide reactor cooling for Turkey Point Units 1 through 4, and receives blowdown water from Unit 5. As described in Section 2.4.2, the IWF is hypersaline, consists of an extensive system of unlined canals and berms, and supports a variety of aquatic species that are tolerant of subtropical, hypersaline environments. Gamefish species observed in the IWF include Tarpon (*Megalops atlanticus*) and Common Snook (*Centropomus undecimalis*), and a variety of forage fish species are present, including Sheepshead Minnow, killifish, Mosquitofish (*Gambusia holbrooki*), Sailfin Molly, and Needlefish (*Strongylura* sp.) (FPL 2014-TN4058). A robust American crocodile population lives within this system, and nests have been observed in the northeast portion of the canal system adjacent to the site of proposed Units 6 and 7. Potential activities that could affect species within the IWF from building of proposed Units 6 and 7 include the following:

- excavation and disposal of “muck” excavated from the proposed Units 6 and 7 plant area at three spoils sites on IWF berms, resulting in dewatering constituents entering the IWF
- discharge of construction-related effluents and stormwater from the Units 6 and 7 site into the IWF, as described in Section 3.3.1.1
- other building-related impacts, including increased risk of fatal or non-fatal encounters between aquatic species and building equipment, and the effects of noise and vibration on sensitive aquatic resources within or adjacent to the IWF, including crocodiles.

<u>Muck Excavation and Disposal</u>

As described in the ER (FPL 2014-TN4058), approximately 5 ft of muck would be excavated and removed from the proposed Units 6 and 7 plant area and disposed of in the IWF at three locations designated as Spoils Areas A, B, and C (Figure 4-3). Engineered fill material would then be used to raise the grade to the appropriate level for building. The total volume of muck to be removed is estimated to be 1.8 million cubic yards (FPL 2010-TN272). Potential effects on aquatic communities residing in the IWF include disturbance from heavy equipment and truck traffic and related noise and vibration, increased risk of collision of American crocodile with

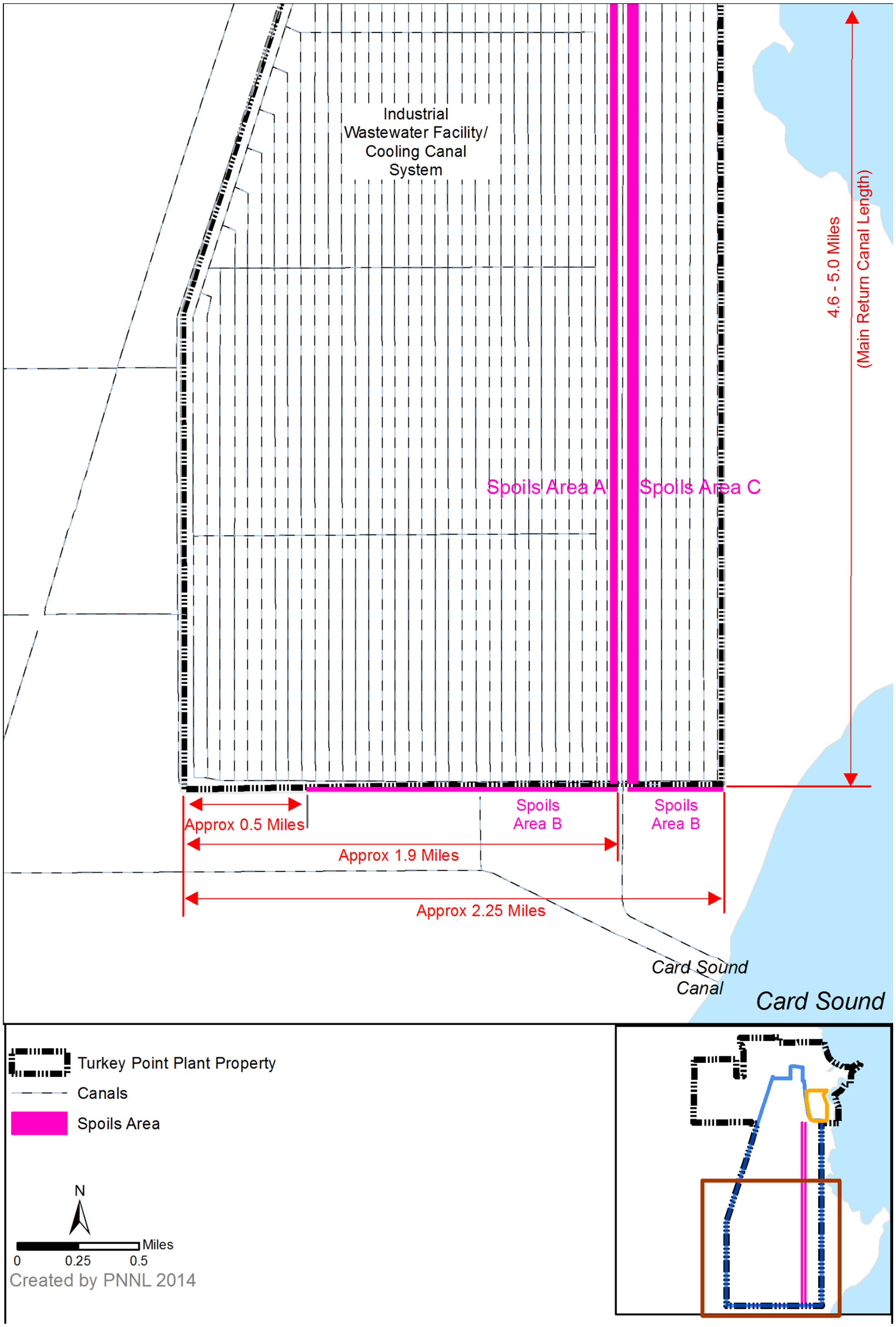

Figure 4-3. Location of Muck Spoils Area within the IWF (Source FPL 2014-TN4058)

vehicles, alterations to IWF water quality from dewatering constituents or fine particles associated with muck, and habitat loss in areas of designated spoils disposal. FPL has addressed many of these concerns in its Threatened and Endangered Species Evaluation and Management Plan (FPL 2010-TN170) and has also stated that BMPs would be used to lessen building-related impacts on the IWF. These practices would include controlling runoff through structural or operational measures such as berms, riprap, and sedimentation filters to intercept water before it flows into the IWF, and to provide runoff control. To further evaluate the potential for leachate from muck to affect IWF water quality, the review team used a mass-balance model to calculate the concentrations of nitrogen and phosphorus that would be discharged into the IWF as pore water. A detailed description of the mass-balance modeling used to assess potential changes in water quality is provided in Section 4.2.1.4. Specific impacts associated with muck disposal on species residing within the IWF are described below for species known to occur in the IWF.

Building-Related Effluent Discharge

As discussed in Section 3.3.1.1, stormwater runoff from the plant area and the laydown area during building activities would be directed to the cooling canals of the IWF. Table 2-10, in the Local Site Drainage subsection of Section 2.3.1.1, provides annual discharge volumes from the building areas within the site as computed by the review team. As discussed in FPL's Stormwater Management Plan (FPL 2011-TN303), except for equipment area runoff all stormwater runoff from the RWTF area would be routed to stormwater-management basins before being released to its surrounding wetland area. The review team determined that building within the plant area and laydown area would not detectably alter the amount of runoff entering the cooling canals (which the review team currently estimates to have an average annual runoff of 1,163 ac-ft [Table 2-10]), because the area to be disturbed for the proposed units already drains into the cooling canals.

Potential impacts on aquatic biota from discharges into the IWF are primarily related to increased exposure to contaminants or constituents in the water, the potential for turbidity, and sedimentation near the effluent release. It is also possible that construction-related activities occurring near the IWF could affect adjacent nearshore areas of Biscayne Bay, though the hydrological connection between these two waterbodies is not well understood it is unlikely that there would be detectable changes in the water quality of the bay attributed to construction-related activities. Potential impacts on species within the IWF are discussed below, with an emphasis on the American crocodile and its prey species.

Other Building-Related Impacts

As described above, during the building of proposed Units 6 and 7 and related facilities, there would be increased vehicle and heavy equipment traffic throughout the site. Of particular concern is the potential for vehicle collisions with the endangered American crocodile, especially during excavation and subsequent placement of fill to bring the Units 6 and 7 site up to planned grade as well as transport of the muck to the spoils areas within the IWF.

The effects of building noise and vibration are also a concern for crocodiles residing in or near the IWF. In its ER (FPL 2014-TN4058), FPL acknowledges that the impact of building noise and risk of collision would be moderate for crocodiles, and that mitigation would be required. To mitigate the hazards associated with the increased traffic between the northern end of the IWF and the test cooling canals, FPL is proposing to install a system of wildlife underpasses to allow crocodiles to move safely under the primary access road to the plant when traveling between the IWF, the test cooling canals, and associated freshwater ponds on the berms to the north. Additional details about potential mitigation actions proposed to FFWCC and FWS are provided below, and by FPL (2012-TN1618). Potential effects related to noise and vibration from construction and building activities are discussed below for crocodiles and other species that could be affected. A detailed discussion of noise and vibration effects on listed species is provided in Appendix F-2 and F-3.

Turkey Point Nearshore Waters

The Turkey Point peninsula is located at the northeastern portion of the FPL property adjacent to Biscayne Bay, the Biscayne Bay Aquatic Preserve, and Biscayne National Park. On the Turkey Point peninsula, FPL would install four RCWs to provide one source of cooling water for proposed Units 6 and 7. The other source would be reclaimed wastewater from Miami-Dade County. For the RCW water source, associated delivery pipelines would require excavation on the Turkey Point peninsula and the existing berm east of the plant area. Potential building-related impacts on aquatic resources on or adjacent to the Turkey Point peninsula result from the following activities:

- building of RCWs
- installation of water delivery lines.

<u>Building of the Radial Collector Wells and Water-Supply Line</u>

As described in the ER (FPL 2014-TN4058) and SCA Chapter 5 (FPL 2010-TN272), the RCWs would be constructed on previously disturbed land at the northern edge of the Turkey Point site. Approximately 3 ac of land would be required for the RCWs and associated facilities; an additional 3 ac of industrial/fill habitat would be needed for a building area; and approximately 13 ac of land would be disturbed during the building of the water-supply pipelines to the new units (FPL 2014-TN4058). Each radial well would consist of a central reinforced caisson extending below ground level and lateral pipes extending approximately 900 ft from the caisson into and underneath Biscayne Bay at a maximum depth of approximately 25 to 40 ft. During installation and lateral drilling (see Section 4.2.1.2), BMPs would be used to reduce the potential for surface-water or sediment disturbance. No in-water work is needed for the installation of the RCWs. The SFWMD Conditions of Certification outline RCW installation conditions for the applicant to follow, including submission of a drilling plan and techniques for approval, and development of contingency plans in the event of a natural or man-made uncontrolled release of excavated material (State of Florida 2014-TN3637). Pre-installation baseline monitoring and characterization of aquatic resources in Biscayne Bay near the RCW area is required by FDEP, FFWCC, and SFWMD for a period of at least two (2) years prior to the start of installation activities (State of Florida 2014-TN3637). This baseline monitoring would be included in an RCW monitoring plan that FPL is required to submit to FDEP two (2) years prior to RCW installation for approval. Other conditions of the RCW monitoring plan are discussed further in Section 4.3.2.4.

During operation, water from the well laterals (horizontal collector lines) would flow to collection caissons and be pumped via pipelines to proposed Units 6 and 7. These water-supply lines would require excavation on the Turkey Point peninsula and the existing berm east of the plant, and would cross streams, waterways, mangrove swamps, and fill areas (FPL 2014-TN4058). FPL's general concern related to building activities on the Turkey Point peninsula is the potential for disturbance or loss of mangrove habitat that supports important aquatic species. Table 4-2 lists the potential impact of RCW pipeline installation as affecting 4 ac of mangrove swamp and 0.15 ac of streams and waterways. The FWS National Wetlands Inventory maps code the mangrove swamps in this area as intertidal and irregularly flooded (tidal waters flood the land surface less often than daily), and not as subtidal or open water (FWS 2016-TN4583). FPL has stated that RCW caissons would be installed primarily on areas of existing upland fill and roadways to minimize effects on adjacent mangrove wetlands (FPL 2014-TN4058). Specific impacts on aquatic resources during the building of the RCWs and associated infrastructure are discussed below.

Biscayne Bay, Biscayne National Park, Biscayne Bay Aquatic Preserve

Potential building-related impacts on Biscayne Bay, Biscayne National Park, and Biscayne Bay Aquatic Preserve include the following:

- noise, vibration, and turbidity related to dredging and building-related activities to support enlargement of the barge slip
- increased collision risk for sea turtles and manatees related to barge and vessel traffic to support building activities
- noise, vibration, and potential water-quality effects related to RCW building activities
- potential changes in the water quality of nearshore areas of Biscayne Bay related to the discharge of dewatering effluent and stormwater to the IWF.

<u>Dredging and Building Activities Related to the Equipment Barge-Unloading Area</u>

To support building activities, the equipment barge-unloading area located at the northeastern portion of the Turkey Point site would need to be expanded. As described in the ER (FPL 2014-TN4058), this area would be expanded to a total area of approximately 0.75 ac, which would require the dredging of approximately 780 yd^3 in a 0.1 ac area in the turning basin and the installation of sheet piling to support building activities. As reported in the ER (FPL 2014-TN4058), a survey of the area showed sparse growth of seagrasses and algae within the turning basin. FPL has committed to surveying the turning basin again for benthic resources, including seagrass, prior to dredging and barge area expansion (FPL 2015-TN4417), which is required by the SFWMD as described in the Conditions of Certification (State of Florida 2014-TN3637). FPL expects dredging to result in temporary impacts on water quality because of increased turbidity, and would use sheet-pile walls, turbidity curtains, silt screens, or similar technology to minimize impacts (FPL 2010-TN272). Material dredged from the turning basin would be placed in designated spoils areas located on existing berms within the IWF. FPL would submit an application to USACE for a permit to dredge pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768), as described in the ER (FPL 2014-TN4058). FPL did not indicate in ER Revision 6 (FPL 2014-TN4058) that dredging of the entrance channel or intercoastal waterway would be required to support the proposed building activities. If dredging in these areas is required, the review team assumes a dredging permit would be obtained from USACE.

Barge and Vessel Traffic

In ER Revision 6 (FPL 2014-TN4058, Section 4.3.2.2.1) FPL indicates there were historically five to seven barge deliveries of fuel oil per week, or 269 to 364 deliveries per year for Turkey Point Units 1 and 2. These deliveries have decreased since Unit 2 was converted to synchronous condenser mode in January 2013, and that further reductions in deliveries would occur when Unit 1 is converted to a similar purpose in October 2016 (FPL 2013-TN2630).

During the 6-year building period, approximately 80 deliveries of building equipment and modules would occur for each unit (FPL 2014-TN4058). This represents an average annual number of deliveries for both units of fewer than 30. Potential effects on aquatic resources from barge and tug traffic include short-term changes in water turbidity vessel movements, lethal or non-lethal encounters between tug/barge tandems and manatees and sea turtles, and potential for vessel groundings along the entrance channel leading to Turkey Point that result in damage to benthic habitat, corals, and seagrass resources as well as the release of petroleum or other products into the bay.

Given the 7 ft depth of the entrance channel, water turbidity during tug/barge transit would likely increase during shipments, but the effects are expected to be short-term, and similar to existing turbidity levels that occur during wind-induced wave events in shallow-water areas of Biscayne Bay. To reduce the potential for fatal or non-fatal encounters between tug/barge operations and manatees and sea turtles, FPL developed a Barge Delivery Plan (FPL 2009-TN169). This plan provides detailed procedures for the delivery of major equipment to the Turkey Point site during the building of the proposed Units 6 and 7 that would be protective of listed species in particular and marine resources in general.

In response to a Freedom of Information Act request from NRC staff, the U.S. Coast Guard (USCG) provided documentation of vessel-grounding incidents near the Turkey Point site for the past 20 years, during which barge deliveries ranged from 269 to 364 per year (USCG 2012-TN1063). The USCG records reveal three incidences of vessel groundings, as follows:

- On October 4, 1996, the fishing vessel *St. Lazaro* was intentionally run aground in Biscayne Bay to avoid sinking, resulting in the release of approximately 50 gal of diesel fuel. USCG records indicate approximately 30 gal of fuel was recovered.
- On February 28, 2001, the tugboat *Coastal St. Marks* towing the barge *T/B Coastal 202* grounded in the right (north) side of the entrance channel to the Turkey Point site. The tug and barge system was refloated approximately 5 hours later and completed its passage to the Turkey Point site.
- On November 17, 2007, the tug *Coastal St. Marks* towing the barge 501 ran aground on the “east shoal of the cut” (USCG 2012-TN1063) during a low-tide event. The tug/barge was refloated approximately 5 hours later and completed its transit to the Turkey Point site.

Given the historical number of weekly barge/tug deliveries that occur at Turkey Point site, groundings are exceedingly rare, but the accident investigations conducted by USCG have relevance with respect to the increased barge/tug traffic expected to occur during the building phase of the proposed Turkey Point Units 6 and 7. USCG findings for the February 28, 2001 event indicate the grounding was apparently caused by a missing channel buoy that had been removed for maintenance by FPL but not replaced with an equivalent marker. Because a replacement buoy was not installed, the Master of the *Coastal St. Marks* was uncertain of the channel location, resulting in the grounding event. Weather and tide conditions during the grounding included a northwest wind of 15 kt, and an ebb tide followed by a slack water event. According to the USCG report, the influence of the wind on the barge resulted in a “crabbing” motion that placed the bow of the barge near the northern edge of the channel, effectively increasing the width of the barge/tug system from 54 ft to approximately 100 ft (USCG 2012-TN1063). In the closeout documentation for the February 28, 2001 grounding, the USCG indicated the FPL Turkey Point Facilities Maintenance Supervision had stated the FPL “…currently has a stock pile of four additional buoys” and that “…this incident was isolated and should not happen again” (USCG 2012-TN1063). The USCG documentation also noted FPL had changed its operation to replace each buoy one-at-a-time and would not have a missing buoy while the original is under repair.

The USCG investigation of the November 17, 2007 grounding event concluded “…one of the contributing factors was the discrepant/missing private aids to navigation in the Turkey Point Channel.” The report specifically mentioned that one aid was missing, aids were faded or covered in bird guano, and reflective tape was missing or damaged. The USCG investigation summary also noted that because the entrance channel to the Turkey Point site is marked by private navigational aids maintained by FPL, it is FPL’s responsibility to ensure the aids are in proper operating condition at all times. USCG considers a discrepancy to exist whenever an aid is not displaying the characteristic as set forth in the approved application. As a result of the November 17, 2007 accident investigation, FPL was required to correct discrepant aids within 30 days or face a fine or revocation of its private aid application (USCG 2012-TN1063).

The two tug/barge-grounding incidents described above illustrate the importance of maintaining navigational aids, and the potential for groundings that can occur during transits of the entrance channel during low-tide events or windy conditions. The groundings also suggest that maneuverability generally decreases with increased barge length, and wind-induced “crabbing” can increase the effective width of the barge under tow to dimensions exceeding channel width. The NRC staff notes that in both tug/barge-grounding incidents, the lengths of the barges (295 ft for *Tug/Barge Coastal 202* and 297.5 ft for *Barge 501*) were significantly greater than the 230 ft maximum length of barges currently being used for fuel deliveries, as reported by FPL in its Barge Delivery Plan (FPL 2009-TN169).

During the building of proposed Turkey Point Units 6 and 7, the review team assumes FPL would maintain navigational aids in the private entrance channel in compliance with USCG regulations and follow the terms and conditions set forth in the Barge Delivery Plan (FPL 2009-TN169). Because the plan specifies that the maximum barge length for building equipment delivery would be 210 ft (FPL 2011-TN43), it is expected that tug/barge maneuverability would increase, and the potential for “crabbing” would not result in the kind of vessel grounding that occurred on February 28, 2001 when a 295 ft long barge was used for fuel oil delivery. As noted in the USCG investigations of recent groundings, Coastal Tug and Barge has a written policy governing when its vessels may or may not enter the Turkey Point entrance channel; for instance, wind conditions must be less than 20 kt in general and less than 15 kt when wind is blowing out of the east. The investigation also notes that vessel masters are granted wide latitude in using their own discretion upon entry into the channel, and may delay entry if they are not comfortable with the existing conditions or associated marine traffic. Based on the information supplied by the USCG, tug/barge groundings in the vicinity of Turkey Point are rare. If the conditions in the Barge Delivery Plan are met, compliance with USCG regulations continue, and adherence to existing policies and procedures occur, the impacts of additional barge deliveries on aquatic resources in Biscayne Bay during building of proposed Turkey Point Units 6 and 7 are expected to be minimal. The National Marine Fisheries Service (NMFS 2009-TN1475) reached a similar conclusion with respect to the risk of increased vessel collisions resulting from new dock and marina building in Florida waters. Using conservative (e.g., environmentally protective) assumptions, NMFS estimated that a new marina project designed to accommodate 500 vessels would likely result in a single sea turtle strike (defined as a “take” by ESA) every 2.9 to 8.8 years (NMFS 2009-TN1475).

Offshore Impacts of Radial Well Building

Because much of the building of the RCWs would occur on land adjacent to Biscayne Bay and involve lateral drilling, impacts on water quality at offshore locations would be unlikely. However, drilling noise and vibration could affect sensitive species, as discussed in Section 4.3.2.

Other Protected Areas

Building of the proposed Units 6 and 7 is not expected to adversely affect aquatic resources west, south, and southeast of the site (Everglades National Park, EMB, Model Lands Basin, Card Sound, Card Sound Canal, Florida Keys National Marine Sanctuary) because no building-related activities are planned within those areas. Construction of the Clear Sky to Levee transmission line will occur east of the Everglades National Park boundary, and is not expected to adversely affect nearby aquatic resources. A complete description of the proposed corridor routes and associated land-use classifications is provided in Section 2.2.

4.3.2.2 Aquatic Resources – Transmission Line and Pipeline Corridors

As described in Section 2.2.2 and Chapter 3, proposed Turkey Point Units 6 and 7 would require new transmission facilities to integrate the new power sources into the FPL transmission system. New pipelines would also be required to supply reclaimed water from MDWASD for reactor cooling and potable water for plant use. What follows is a description of the aquatic species likely to be present in existing or planned transmission line and pipeline corridors and the potential for building activities to result in adverse impacts.

Transmission Line and Pipeline Corridors

As described in Section 2.4.2, fish known to occur in the wetland and open-water habitats along the transmission line and pipeline corridors include native fish (e.g., Mosquitofish, Sailfin Molly, killifish, sunfish [*Lepomis* spp.], gar [*Lepisosteus* spp.]), and non-indigenous species (Peacock Bass [*Cichla ocellaris*], tilapia, Mayan Cichlid [*Cichlasoma urophthalmus*], Jaguar Guapote

[*Cichlasoma managuense*], and Oscar [*Astronotus ocellatus*]). All of these species are common to South Florida. With the exception of the Mangrove Rivulus (*Rivulus marmoratus*), no rare or protected fish or aquatic species are expected to occur within the proposed transmission line and pipeline corridors (FPL 2014-TN4058), although American alligators may occasionally be present. FPL also indicates encounters with manatees and American crocodiles are unlikely because manatees are generally found in coastal areas away from the routes, and crocodile populations are centered in the IWF. FFWCC (2011-TN554) describes the requirements for monitoring of listed species prior to clearing and building following standard methodologies and the appropriate mitigation strategies if unavoidable impacts are likely. FPL would also be required to follow standard manatee protection procedures for in-water work (FPL 2012-TN2768). As described in the SCA (FPL 2010-TN272), the applicant would avoid major lakes, rivers, and streams. While transmission line and pipeline installation may require installation of culverts or placement of fill resulting in temporary localized increases in turbidity and siltation, these impacts are expected to be temporary. FPL also states that no withdrawals or discharges to surface waters (not including the IWF) are planned during the building of new transmission and pipeline facilities or modifications to existing facilities, and BMPs would be used to reduce effects on aquatic biota (FPL 2014-TN4058). Based on the above information, the review team believes the building-related impacts on aquatic resources within the corridors would likely be minimal. Aquatic resource monitoring of the corridors is described in Section 4.3.2.4.

4.3.2.3 Aquatic Species and Habitats

This section evaluates the potential effects of building-related activities on important aquatic species described in Section 2.4.2, including ecologically, commercially, or recreationally important species; Federally or State-listed species; those with designated critical habitat; and species with designated essential fish habitat.

Ecologically, Commercially, or Recreationally Important Species

<u>Marine Mammals</u>

Although a variety of marine mammals has been reported in Biscayne Bay, many are transitory and are unlikely to be affected by constructed activities. Those commonly present in Biscayne Bay include the common bottlenose dolphin (*Tursiops truncatus*) and the Florida manatee. Potential effects on manatee are discussed in the Federally or State-Listed Species section below. Common bottlenose dolphins are generally found throughout Biscayne Bay and may transit close to shore. Potential impacts on this species and others located near Turkey Point from building activities are expected to be related to noise associated with construction activities at the Units 6 and 7 plant site, and the noise and vibrations associated with the lateral drilling beneath Biscayne Bay during installation of RCWs on the Turkey Point peninsula.

Noise related to construction activities could also adversely affect marine mammals near the area. As described by FPL (FPL 2014-TN4058), the highest levels of construction noise on land would be from impact wrenches, cranes, backhoes, front-end loaders, trucks, bulldozers, and the concrete batch plant. FPL estimates aerial noise levels to be 85 dBA 3 ft from the source, 75 dBA 200 ft from the source, and 65 dBA 400 ft from the source, which is within the range of current ambient noise levels measured by FPL (2014-TN4058). Thus, marine mammals transiting near the Turkey Point peninsula would likely receive minimal exposure to aerial building noise.

The potential for noise and vibrations from in-water or nearshore construction activities to affect marine mammals is discussed in FPL (2014-TN3717). Noise or vibration-producing activities evaluated in the report included (1) pulsed sound associated with sheet-pile installation in the equipment barge-unloading area, (2) continuous sound and vibrations related to construction of the RCW laterals using microtunneling technology, (3) pulsed sound associated with sheet-pile installation in the Units 6 and 7 plant area, and (4) site preparation and construction of plant infrastructure and RCW caissons. Numerical models and other sources of information were then used to calculate impact radii corresponding to the threshold for auditory injury (180 dB RMS) and behavioral response changes (160 dB RMS). Given predicted noise levels at the sheet-pile installation location of 220 dB peak pressure and 194 dB cumulative sound exposure, auditory injury to marine mammals is possible at a distance of 130 ft from the sheet-pile installation site and behavioral responses could occur up to about 600 ft from the site (FPL 2014-TN3717).

While FPL acknowledges these exposure levels could result in adverse impacts on marine mammals (likely bottlenose dolphin and manatee) the assumption is risk is low because both species would likely avoid areas of injurious noise levels and are rarely seen in the equipment barge-unloading area and entrance channel, and sheet-pile installation would occur for only 2 weeks. Although dredging activities would not cause harmful levels of noise, temporary and localized increases in suspended sediment and turbidity are likely but would not adversely affect either species. As described in FPL (2014-TN3717), construction activities would occur during daylight hours and the current manatee protection plan discussed in Appendix F-2 would be used to ensure protection during construction. As noted in FPL (2014-TN3717), site-preparation activities associated with RCW installation on the Turkey Point peninsula would generate aerial noise, but are not expected to produce sounds in water that would adversely affect marine mammals.

Based on an analysis conducted by FPL contractors and presented in FPL (2014-TN3717), installation of RCW laterals using microtunneling technology would generate a maximum of 120 dB re 1μPa at 1 m from the drill head, and drilling would occur 25 to 40 ft below the bottom of Biscayne Bay. Sound and vibration would dissipate as it moved upward through the limestone and bottom sediments to the sediment-water interface at the bottom of Biscayne Bay. These sound emissions are below thresholds expected to cause auditory injury or behavioral responses in marine mammals (FPL 2014-TN3717).

While FPL notes that sound and vibrations associated with sheet-pile installation at the Units 6 and 7 plant site and site preparation and construction on the Turkey Point peninsula would create aerial noise, these emissions are not expected to affect marine mammals in nearshore locations (FPL 2014-TN3717). A complete discussion of the potential construction-related effects on listed marine mammals is provided in Appendix F-2 (FWS Biological Assessment) and Appendix F-3 (NMFS Biological Assessment).

<u>Game Fish</u>

As described in Section 2.4.2, a variety of game fish are present in waterbodies on or near the Turkey Point site. Representative game fish species occurring in Biscayne Bay include Common Snook, Tarpon, Spotted Seatrout (*Cynoscion nebulosus*), Red Drum (*Sciaenops* *ocellatus*), and Red Grouper (*Epinephelus morio*). Most of these species are found in a variety of water depths and salinity regimes and are widely dispersed within Biscayne Bay. For example, the NPS used the Spotted Seatrout as an indicator species during the development of salinity targets for Biscayne Bay. This species prefers brackish to marine waters and is found in shallow coastal and estuarine waters, on sandy bottoms, or in eelgrass to depths of 33 ft. During warm summer months, Spotted Seatrout are found in seagrass beds; they move to deeper waters in estuaries during the cooler months. Spawning occurs in late spring and summer, and juveniles move to seagrass beds, muddy bottoms, and shell reefs as they grow into adults (FMNH 2012-TN167). Adverse impacts on Spotted Seatrout and similar species related to building activities would be unlikely at or near the Turkey Point site. Thus, building-related impacts are expected to be minor for game fish near the Turkey Point site.

As described above, Common Snook and Tarpon have been observed in the IWF but are not managed by FPL or harvested by members of the public. These species have adapted to the harsh conditions of the IWF and may also be tolerant of building-related impacts. The review team believes building-related impacts on these species would be minor.

<u>Forage Fish</u>

Forage fish represent an important component of freshwater, estuarine, and marine food webs, providing food for larger fish, reptiles, birds, and mammals. Over a dozen species were identified in Section 2.4.2 as ecologically, commercially, or recreationally important. This list includes Mosquitofish, Sheepshead Minnow, snappers, grunts, Pinfish (*Lagodon rhomboides*), and various species of perch. Many of these species are found in aquatic habitats within Turkey Point site boundaries, in the IWF, or in aquatic habitats associated with the proposed transmission line and pipeline corridors, as described in Section 2.4.2. For instance, the Mosquitofish has been reported in surface-water habitats on the Turkey Point site, in the IWF, and in aquatic habitats associated with transmission line and pipeline corridors. The Sheepshead Minnow has been found onsite and in the IWF. In general, these species are hardy forage fish that are tolerant to changes in water quality and temperature and would likely not be adversely affected by building runoff or dewatering effluent introduced into the IWF, surface-water sites within or near the Turkey Point site, or during transmission line and pipeline building.

Bluestriped and White grunts (*Halemulon sciurus*, *H. plumierii*), Fringed Pipefish (*Anarchopterus criniger*), and Pinfish were numerically abundant during the 2008-2009 sampling by Ecological Associates, Inc. in Card Sound; Pinfish were the most abundant (EAI 2009-TN154). These species are generally found along shorelines and in mangroves to depths exceeding 100 ft; juveniles occur in shallow-water seagrass beds (FMNH 2012-TN167). Silver Perch (*Bairdiella chrysoura*) are found in seagrass beds, tidal creeks, rivers, and marshes, and are similar in appearance to Sand Seatrout (*Cynoscion arenarius*) (FFWCC 2011-TN159), and the NPS included them as an indicator species (NPS 2006-TN183) for establishing ecological targets for western Biscayne National Park. Given their proximity to the Turkey Point peninsula, these kinds of forage fish could be susceptible to building-related effects, but the impacts would likely be minimal because the affected area is small and suitable habitat is available elsewhere in Biscayne Bay.

Crustaceans and Mollusks

As described in Section 2.4.2, Biscayne Bay contains a diverse assemblage of fish and invertebrate species and a complex, dynamic food web. Crustacean and mollusk species identified in Section 2.4.2 that have ecological, recreational, or commercial importance include the pink shrimp (*Farfantepenaeus duorarum*), the spiny lobster (*Panulirus argus*), and the blue crab (*Callinectes sapidus*). Nelson et al. (1991-TN174) indicated pink shrimp larvae and juveniles are highly abundant in Biscayne Bay, and the NPS included this species as an indicator with regard to establishing salinity targets for the bay (NPS 2006-TN183). Spiny lobsters are also common in Biscayne Bay, and juveniles are found in nursery areas that include seagrass meadows and algal beds. Blue crabs are common to the south-central portion of Biscayne Bay, and optimum hatching takes place in salinities ranging from 23 to 28 ppt (Browder et al. 2005-TN151). Because these species could occur in areas adjacent to the Turkey Point site, there is a potential for building-related effects associated with installation of RCWs and dredging activities in the area of the barge slip. Because lateral drilling would be used when building radial wells, effects are expected to be small for crustaceans and mollusks. Dredging operations may cause short-term changes in water quality, but these effects are expected to be confined to a small area of Biscayne Bay, and suitable refuge areas are available for mobile species. Although dredging may result in mortality to non-mobile species, the impacts are not expected to be detectable at the population level. Thus, building-related effects on crustaceans and mollusks are expected to be minor. Impacts on crustaceans and mollusks present in the IWF that may occur during muck-disposal operations are expected to be localized and temporary.

Corals

As noted in Section 2.4.2, on August 27, 2014, the National Oceanographic and Atmospheric Administration (NOAA) listed 20 new coral species as threatened (NOAA Fisheries 2014-TN4022; 79 FR 53851 [TN4097]). Of these, the following are known to occur in the Florida Atlantic region:

- *Acropora cervicornis* (Staghorn coral)
- *Acropora palmata* (Elkhorn coral)
- *Mycetophyllia ferox* (Cactus coral)
- *Dendrogyra cylindrus* (Pillar coral)
- *Montastraea (Orbicella) annularis* (Boulder star coral)
- *Montastraea (Orbicella) faveolata* (Mountainous star coral)
- *Montastraea (Orbicella) franksi* (Star coral).

Hard-bottom areas near Turkey Point are generally considered marginal habitat for coral because of large temperature and salinity fluctuations, and species richness and abundance generally increase west-to-east in response to the increasing influence from the Atlantic Ocean (Lirman et al. 2003-TN1519). Although some corals present near Turkey Point may be affected by dredging and associated in-water activities, effects would be localized. Species present in central or eastern portions of Biscayne Bay or offshore locations would also likely be unaffected by building-related activities. Therefore, effects on offshore corals are not likely to be detectable.

Submerged Aquatic Vegetation

Potential effects on submerged aquatic vegetation (SAV) during building include those from the installation of the RCW system and dredging and excavation activities at the equipment barge-unloading area at the northeast end of the Turkey Point site. Because the installation activities associated with the RCW system occur on land, they are unlikely to affect SAV. Dredging and excavation activities at the equipment barge-unloading area may have minor effects on SAV. Such effects would likely consist of short-term, localized water-quality changes related to increased turbidity and deposition of suspended sediments. As described in the ER (FPL 2014-TN4058), expansion of the barge-unloading area would require dredging and removal of sediment in an area encompassing approximately 0.1 ac. FPL would use BMPs, including the use of curtain wall technology, to minimize effects of dredging. As required under the Conditions of Certification (State of Florida 2014-TN3637), a new baseline survey for seagrass and SAV is required prior to dredging and expansion of the barge area. Increased barge traffic may also create temporary increases in suspended sediment, thereby reducing water clarity, but the increases are expected to be minor. SAV effects in the IWF related to muck disposal would likely be localized and temporary.

Non-Indigenous Species

Based on the above discussion, building activities are not expected to affect the abundance or distribution of non-indigenous species in the vicinity of the Turkey Point site. As reported by Ogden et al. (2005-TN197), South Florida has one of the largest non-indigenous faunal communities in the world; more than 25 percent of the resident mammal, bird, reptile, amphibian, and fish species are classified as non-native. Because the expected building-related activities are not likely to substantially affect water quality, temperature, or salinity in Biscayne Bay, or result in additional vectors for non-indigenous species, building-related impacts are expected to be minimal.

Federally or State-Listed Species and Designated Critical Habitat

As described in Section 2.4.2, Federally or State-listed species known or expected to occur on or near the Turkey Point site include one marine mammal (Florida manatee), five species of sea turtle (Hawksbill, Leatherback, Green, Loggerhead, Kemp's ridley), American alligators and crocodiles, the Smalltooth Sawfish (*Pristis pectinata*), and Johnson's seagrass (*Halophila johnsonii*) (Table 2-28). Designated critical habitat for the American crocodile is present on and near the site, designated critical habitat for the Florida manatee is near the southern end of the site, and other designated critical habitats are outside the affected area. A summary of likely building-related effects on these species and habitats is also provided below, and the biological assessments for these species are presented in Appendix F-2 and F-3, and additional consultation information is referenced in correspondence listed in Appendix F (NRC 2016-TN4801; NRC 2016-TN4802).

Marine Mammals

Although a variety of large whales listed as threatened or endangered by NOAA has been observed in Biscayne Bay, most are considered infrequent visitors and are not expected to occur near the Turkey Point site and therefore are not considered further in this assessment of building-related impacts. Florida manatees are common in Biscayne Bay near the Turkey Point site and are the most likely Federally listed marine mammal to potentially be affected by building activities in the vicinity of the equipment barge-unloading area. Changes in water quality and turbidity during dredging, noise and vibration associated with sheet-pile installation and dredging, and general building noise and activity could affect marine mammals in the vicinity of the equipment barge-unloading area. Risk of collision between marine mammals and tugs and barges may also increase during building. During the proposed 6-year building period, FPL estimates 80 barge trips would be required per unit to support building activities, resulting in a risk of manatee collision with barge and tug operations. To reduce collision risk for this species, FPL has developed a Barge Delivery Plan (FPL 2009-TN169) that describes how operations would be monitored to ensure the risks of collisions are reduced. Specific activities to be used include the following:

- coordination of building equipment delivery with potential ongoing fuel oil deliveries to minimize the need for simultaneous barge movements within the turning basin and barge entrance channel
- maintenance of a ship's log documenting manatee sightings, collisions, or injuries during the project
- movement of work barges and associated vessels and in-water work only during daylight hours
- presence of a dedicated observer during in-water work, including dredging or barge movement, to identify the presence of manatees
- operation of vessels in the building area at no-wake or idle speeds
- restriction or cessation of work if a manatee is detected within 100 ft or 50 ft, respectively, of building or barge activities.

As described above, noise associated with installation of sheet-pile at the equipment barge-unloading area has the potential to adversely affect marine mammals, but these effects would be localized and temporary. Sheet-pile installation and dredging at the equipment barge-unloading area would occur over a 2-week period and effects would likely be confined to the nearshore areas and entrance channel. RCW lateral installation would occur over a 2–4 year period, but laterals would be drilled sequentially and noise and vibration effects would be attenuated, given the proposed location of the RCW laterals is 25 to 40 ft below the bottom of Biscayne Bay (FPL 2014-TN3717). Manatees may temporarily leave an area where building noise, vibration, and vessel traffic are present. The FFWCC (2011-TN554) has also provided specific guidance for protection of manatees during in-water work that is consistent with the SCA (FPL 2009-TN169). Given the above precautions, building-related activities are not expected to result in adverse impacts on the manatee. No adverse modifications of manatee critical habitat are expected because no detectable changes in water quality in Card Sound are anticipated.

Sea Turtles

Potential impacts on sea turtles from building activities at the Turkey Point site include the effects of noise, vibration, and area lighting associated with the building of the RCW system; short-term impacts on water quality, turbidity, noise, and vibration from dredging and excavation; percussive noise associated with sheet-pile installation; aerial noise from building activities; and an increased risk of collision or disturbance related to barge or vessel traffic in the equipment barge-unloading area or adjacent entrance channel. Of the five sea turtles identified as threatened or endangered by Federal and State resource agencies, the green sea turtle (*Chelonia mydas*) is the most common to Biscayne Bay and Card Sound based on stranding data. Green sea turtles visit these areas at various times of the year to feed (FPL 2014-TN4058). With regard to noise generated from sheet-pile installation at the equipment barge-unloading area and installation of RCW laterals under Biscayne Bay, contour lines corresponding to levels of sound that could elicit physical or auditory injury or behavioral changes were produced using computer models as described in FPL (2014-TN3717). These analyses suggest below ambient noise levels for RCW lateral installation and that given the predicted noise levels at the sheet-pile installation location of 220 dB peak pressure and 194 dB cumulative sound exposure, physical/auditory injury to sea turtles is possible within 30 ft of the sheet-pile installation location, behavioral response changes are possible within about 600 ft of the site, and auditory injury is possible within 2,815 ft of the site. Auditory injury estimates are based on installation of 10 piles per day and a conservative (protective) assumption related to how noise would propagate along the walls of the entrance channel (FPL 2014-TN3717).

Although these analyses suggest a potential for harm to sea turtles during sheet-pile installation, FPL considers the risk to be minimal, because sea turtles are not commonly found in the entrance channel or equipment barge-unloading area, and construction duration is expected to be only 2 weeks. It is likely, however, that sea turtles in the vicinity would avoid this area during active sheet-pile installation and dredging because of noise and increased turbidity. Impacts on sea turtles are expected to be further reduced if the conditions for in-water building required by NMFS are followed (NMFS 2006-TN3451). NMFS requirements for in-water work includes working only during daylight hours, worker training on safe practices and implications of harming a sea turtle, the use of siltation barriers that will not entangle turtles, “no-wake/idle” speeds in construction areas, and cessation of operations if sea turtles are observed within 50 yards of active construction/dredging operations or vessel movement. NMFS also requires immediate reporting of a collision with a sea turtle.

As discussed above for marine mammals, noise and vibration associated with microtunnel drilling during RCW installation, sheet-pile installation at the Units 6 and 7 site, and building and construction activities on the Turkey Point peninsula to support RCW installation and operation are not expected to generate noise or vibration levels that would adversely affect sea turtles.

Alligators and Crocodiles

The American crocodile is currently listed as Federally and State-threatened; the American alligator is listed as Federally threatened due to its similarity in appearance to the crocodile and is a Species of Concern in the State of Florida. As described in Section 2.4.2, there is a robust population of American crocodiles in the IWF on the Turkey Point site, and American alligators are common in aquatic environments bordering the site. Designated critical habitat for the American crocodile that would be lost through adverse modification due to the building of Units 6 and 7 include the power block area and areas designated for muck disposal. Building-related impacts include additional risk of collision with construction vehicles and equipment, disturbance of crocodile nesting activity at the northeastern end of the IWF during the excavation of the power block for proposed Units 6 and 7, discharge of dewatering effluent and stormwater into the IWF during building activities, and the placement of approximately 1.8 million cubic yards of muck excavated from the site along spoils areas within the IWF, which could result in the migration of fine-grained sediment, nutrients, contaminants, and other constituents to IWF waters.

In Section 4.3.1.1.2 of ER Revision 6 (FPL 2014-TN4058), FPL acknowledges that increased vehicle traffic could pose a risk to crocodiles, especially along 359th Street, an area scheduled for roadway improvements to support building activities. In November 2011, FPL reported the death of a young crocodile in the vicinity of exploratory UIC work (NRC 2011-TN4121). As described in its 2009 Threatened and Endangered Species Evaluation and Management Plan, FPL has proposed to install three wildlife underpasses on the road between the northern end of the IWF and test canals to the west of the IWF to mitigate collision hazards (FPL 2010-TN170).

Building of the power block for proposed Units 6 and 7 would require excavation and building in areas adjacent to the northeastern portion of the IWF. As discussed in Section 2.4.2 and shown in Figures 2-30 and 2-31, nests have been documented close to the Units 6 and 7 plant area and along the IWF Grand Canal where muck disposal would occur. FPL has concluded (FPL 2014-TN4058) that impacts on the local population of American crocodiles as a result of increased traffic and building noise, vibration, and disturbance would be moderate and would require mitigation. The review team agrees with this assessment. Additional information about potential effects of construction noise on crocodiles is provided in (FPL 2014-TN3717) and in Appendix F-2.

As described in Section 4.2.1, dewatering of the site during building would result in a maximum discharge flow to the cooling canals of 1,200 gpm (1.7 Mgd) for 1 year. Based on a recirculating flow rate of 2,747 Mgd, this discharge would represent an increase of less than 0.1 percent. Stormwater runoff from the plant and laydown areas would not increase compared to the runoff levels that currently drain to the cooling canals from same area. Consequently, building-related discharge would have an undetectable effect on IWF water quality, and adverse impacts from stormwater runoff on the American crocodile or its prey would be unlikely. Stormwater runoff from the Units 6 and 7 site would be to the IWF, as described in Section 4.2.2. The volume of the discharge of stormwater runoff would be approximately the same, but there might be a slight change in water quality.

Excavation at the Units 6 and 7 site would result in removal of approximately 1.8 million cubic yards of muck, and FPL proposes to store the material in designated spoils areas encompassing approximately 211 ac within the IWF, an area identified as critical habitat for American crocodile (Figure 4-3). As described in the *Turkey Point Units 6 & 7 Project – Conceptual Earthwork and Materials Disposal Plan* (FPL 2011-TN1042), spoils would be put in an existing trench with a berm to prevent sediment runoff into the IWF. This is expected to reduce or eliminate the sediment loading from the spoils mound into the IWF. Increases in nutrient levels (nitrogen and phosphorus) in the waters of the IWF were estimated by the review team to be 8.6 µg/L and 0.29 µg/L, respectively, as noted in Section 4.2. A complete discussion of the potential for water-quality impacts on the IWF or nearshore waters of Biscayne Bay, including recent changes in IWF water quality, can be found in Section 4.2.

With regard to direct impacts on crocodiles from muck disposal, the spoils areas were specifically selected due to their lack of suitable nesting substrate for American crocodile (FPL 2012-TN1618). As shown in Figures 2-31 and 2-32, surveys conducted by FPL from 1978 to 2013 have shown that only a few nests have been observed in areas where muck disposal would occur. Because crocodiles have been observed in these areas, FPL considers the locations to be potential habitats and would continue habitat enhancement activities to improve crocodile habitat onsite and offsite by creating juvenile freshwater refugia and enhancing substrates on berms that have not traditionally supported high numbers of crocodile nests due to poor substrate (FPL 2012-TN1618). In addition to relocating hatchlings to low-salinity environments located in depressions on top of the IWF berms, FPL has indicated it would create a new sanctuary area (Sea Dade Crocodile Sanctuary) located south and west of the IWF (FPL 2012-TN1618) to provide additional habitat for crocodiles away from the main construction area.

Based on the above discussion, and the results of the biological assessment, the review team concluded that minor building-related impacts on the American crocodile would occur from unit construction, noise, light, muck disposal, dewatering effluent, and stormwater discharge into the IWF, which may adversely affect designated critical habitat. Major building-related effects on this species would likely occur with respect to disturbance of individuals that have nested near the Units 6 and 7 plant area and from increased risk of collision with construction traffic. Reduction of impacts would be dependent on the success of the worker training programs and the effectiveness of proposed wildlife overpasses and barriers designed to decrease collision risk. Therefore, some adverse effects on crocodiles and critical habitat may occur during construction. Additional information about potential impacts on crocodiles from building activities is found in the FWS biological assessment (Appendix F-2). The FWS provided comments and asked for clarification concerning muck disposal and containment on the IWF berms, which is included above and referenced in Appendix F. After further review of the biological assessment and commitments by FPL to minimize vehicular mortalities and the potential for mortalities from construction and building activities, the FWS and NRC staff concurred with a may affect, not likely to adversely affect determination for the American crocodile (FWS 2016-TN4728; NRC 2016-TN4801).

<u>Smalltooth Sawfish (*Pristis pectinata*)</u>

The Smalltooth Sawfish is a tropical species that has been observed in Biscayne Bay and Card Sound. This species is currently listed as Federally endangered but does not have designated critical habitat near Turkey Point (NOAA 2010-TN179). As described in ER Revision 6 (FPL 2014-TN4058), given one of the primary threats to this species is loss of protective mangrove habitat for juvenile fish, nearshore building activities that disturb or eliminate nearshore habitat could contribute to population declines. FPL has indicated that the building of RCWs would be designed to preserve nearshore mangrove resources, would not occur in water, and BMPs would be used to protect Biscayne Bay from the impacts of stormwater, effluent, or accidental spills (FPL 2014-TN4058). A recent assessment of likely effects on

Smalltooth Sawfish from noise related to sheet-pile installation at the equipment barge-unloading area and construction and building activities on the Turkey Point peninsula concludes that there is a potential for physical and auditory injury and behavioral changes to sawfish from these activities. FPL does not expect adverse effects to occur, given the short duration of the construction activities and the likelihood that sawfish would avoid the area during active construction. Based on an analysis conducted by FPL contractors and presented in FPL (2014-TN3717), installation of RCW laterals using microtunneling technology would generate a maximum of 120 dB re 1μPa at 1 m from the drill head which would be located 25 to 40 ft below the bottom of Biscayne Bay, and the emitted sound would dissipate as it moved upward through the limestone and bottom sediments. These sound emissions are below thresholds expected to cause auditory injury or behavioral responses in fish. Thus, the review team concludes impacts on Smalltooth Sawfish would likely be minor because building-related disturbance would be temporary and localized and because individuals can avoid the area. The review team also assumes in-water building guidance for the sawfish developed by NMFS (2006-TN3451) would be followed. Additional information regarding the potential construction-related effects on this species are provided in Appendix F-3 (NMFS Biological Assessment).

Johnson's Seagrass (*Halophila johnsonii*)

Johnson's seagrass is a Federally threatened species that may occur in Card Sound and Biscayne Bay (FPL 2014-TN4058). Critical habitat for this species includes the central portion of Biscayne Bay extending from Virginia Key 23 mi north-northeast of the site to Miami (65 FR 17786 [TN273]; NOAA 2010-TN180). This species was not reported in the survey conducted around the Turkey Point peninsula by Ecological Associates, Inc. in 2009 (EAI 2009-TN153). Because the documented occurrence of this species is well north of the Turkey Point site, it is unlikely to be affected by in-water building activities or installation of the RCW system on the Turkey Point site.

Federal or State Species of Concern

Federal or State-listed Species of Concern that could occur on or near the Turkey Point site include the Mangrove Rivulus, Dusky Shark (*Carcharhinus obscurus*), Nassau Grouper (*Epinephelus striatus*), Opossum Pipefish (*Microphis brachyurus lineatus*), Sand Tiger Shark (*Carcharias taurus*), and Speckled Hind (*Epinephelus drummondhayi*). Of these, only the Mangrove Rivulus and the Nassau Grouper could potentially be affected by building activities at the Turkey Point site because they are known to occur in the vicinity where suitable habitat exists, including the C-1 Canal (FPL 2014-TN4058). The potential effects of noise and vibration from construction activities on this species are similar to those described above for Smalltooth Sawfish. Given the Mangrove Rivulus habitat preferences, this fish species could also be affected by the building of pipelines, transmission lines, and the RCWs. The FFWCC requires surveys for the Mangrove Rivulus to be done in the affected areas of the pipelines, transmission lines, and RCWs. If the presence of Mangrove Rivulus is determined in any of these areas, FPL and FFWCC would prepare a mitigation plan to address specific effects and mitigation measures, and monitoring to document the effectiveness of mitigation (State of Florida 2014-TN3637). Adult Nassau Grouper are often found near coral reef systems and rocky bottoms in depths to 100 m; juveniles are found in shallower water depths in and around coral, macroalgae, and in seagrass beds (Sadovy and Eklund 1999-TN200). FPL intends to follow existing corridors and rights-of-way, and use BMPs to reduce impacts on these species during the building of the reclaimed wastewater pipeline (FPL 2014-TN4058). FPL has also indicated that building activities for the RCWs would be controlled to minimize impacts on red mangroves. No presently undisturbed mangrove habitat is expected to be affected by building activities (FPL 2014-TN4058). With regard to the remaining Federal or State Species of Concern, most are found throughout Biscayne Bay, and would be less likely to be affected by in-water dredging and building or installation of the RCW system because suitable habitat is available elsewhere.

Species with Designated Essential Fish Habitat

As described in Section 2.4.2, designated essential fish habitat exists near the Turkey Point site for the snapper-grouper complex, spiny lobster, pink shrimp, and coral. In addition, habitat areas of particular concern (HAPCs) identified by NOAA (2010-TN835) near the Turkey Point site include mangrove and seagrass habitats described above for the snapper-grouper complex, and Biscayne Bay for spiny lobster. Biscayne Bay and Biscayne National Park are also HAPCs for coral, coral reefs, and hard-bottom communities. In general, building-related impacts on these species and habitat areas are expected to be minor and localized and would consist primarily of in-water dredging and building at the barge-unloading area and potential short-term changes in nearshore water quality at the RCW installation site at the Turkey Point site. A complete analysis of building-related effects on essential fish habitat and HAPCs is provided in the essential fish habitat assessment and NRC's response to NMFS conservation recommendations (NRC 2016-TN4802) are referenced in Appendix F-4.

4.3.2.4 Aquatic Monitoring

Section 2.4.2 provides a summary of past monitoring studies conducted by FPL to assess existing baseline conditions at and near the Turkey Point site. FPL has developed a Threatened and Endangered Species Evaluation and Management Plan (FPL 2010-TN170) and a detailed Barge Delivery Plan describing monitoring and assessment practices that would be used during in-water work to protect manatees from harm (FPL 2009-TN169). The review team assumes FPL would follow the protocol to protect Smalltooth Sawfish developed by the NMFS (2006-TN3451). In addition, FPL would continue its ongoing monitoring program to assess and protect American crocodiles inhabiting the IWF (FPL 2014-TN4058). The State of Florida Conditions of Certification describe biological monitoring and surveys that are required during installation and post-installation activities (State of Florida 2014-TN3637). Monitoring required during installation activities is described for the RCW installation and pipeline installation activities. For the RCW installation, FPL's RCW system monitoring plan should include construction monitoring during all construction activities. The monitoring should include seagrass cover and benthic fauna within the area surrounding the peninsula and the extent of the RCW laterals, as well as two control sites with seagrass beds within 5 mi of the peninsula.

Measures and Controls to Limit Adverse Impacts during Building

In Table 4.6-1 of the ER (FPL 2014-TN4058), FPL describes a series of measures and controls to limit adverse impacts during building. Those pertaining to aquatic resources include the following:

- Use restrictive land-clearing processes and BMPs to limit spills, turbidity, runoff, or other discharges to aquatic systems from the building of nuclear power plant buildings, related structures, transmission lines, and pipelines.
- Use technologies that physically isolate building activities from nearby water sources (e.g., use of sheet piles to protect nearshore resources during building of the RCWs and expansion of the barge-unloading area).
- Limit, when possible, building activities to locations that have already been disturbed. For example, this action would be used to limit adverse impacts on red mangroves when building RCWs, and thus reduce potential impacts on Mangrove Rivulus and Nassau Grouper.
- Follow project-specific management plans to protect listed species during building, including a Threatened and Endangered Species Evaluation and Management Plan to limit disturbance or risk of vehicle collision for the American crocodiles (FPL 2010-TN170), a Barge Delivery Plan to reduce risk of collision or injury of manatees from tug and barge operations or dredging (FPL 2010-TN272), and Sea Turtle and Smalltooth Sawfish Construction Conditions document that describes established procedures to protect sea turtles and Smalltooth Sawfish during nearshore construction activities (NMFS 2006-TN3077).

4.3.2.5 Summary of Impacts on Aquatic Resources

Based on a review of FPL's ER (FPL 2014-TN4058), the SCA (FPL 2010-TN272), agency comments, and the review team's independent evaluation, the review team concludes that the impacts of preconstruction and construction activities on aquatic resources would be MODERATE for American crocodiles and SMALL for other species. Based on the expectation that NRC-authorized construction activities would also affect American crocodiles due to proximity and activity, the NRC staff concludes that the impacts on aquatic resources due to NRC-authorized construction activities would be MODERATE for American crocodiles and SMALL for other species. Because American crocodiles are known to occur and nest in the IWF near the building site for proposed Units 6 and 7, they may be disturbed by NRC-authorized construction and other building activities, including the disposal of muck from the power block site. Nests have also been documented along the IWF Grand Canal where muck disposal is planned. Further, this species is susceptible to injury or death from collisions with vehicle or building equipment, and fatal encounters have been documented on the site. As described in the ER (FPL 2014-TN4058), disturbances of crocodile populations in the IWF related to building activities or muck disposal would be mitigated through creation of additional freshwater refugia areas for juveniles and ongoing vegetation restoration efforts to improve existing nesting habitat. Building activity restrictions would also be used during the nesting season. To mitigate hazards related to vehicle collision, FPL will continue its worker awareness program and implement its proposed series of wildlife underpasses on the road between the northern end of the IWF and test canals to the west of the IWF (FPL 2014-TN4058; FPL 2010-TN170). As noted in the FWS Biological Assessment (Appendix F-2), construction of the proposed units would result in the adverse modification of approximately 218 ac of designated American crocodile critical habitat at the plant area, as well as approximately 211 ac of critical habitat along IWF berm walls to support muck disposal. Collectively, these actions would affect less than 1 percent of the designated critical habitat in South Florida. Additional discussion is provided in Appendix F-2.

With regard to noise and vibration related to building and construction activities adjacent to nearshore areas, the review team concludes that sheet-pile installation at the equipment barge-unloading facility has the potential to harm marine mammals, sea turtles, and fish, but adverse effects are unlikely because these species are not commonly found near the sheet-pile installation site and adjacent entrance channel, and the duration of the installation is expected to be only 2 weeks (FPL 2014-TN3717). Species sensitive to in-water sound would likely leave the area during construction activities. Noise and vibration related to building and construction on the Turkey Point peninsula and microtunneling activities for RCW lateral installation are unlikely to affect aquatic resources because sound levels are below thresholds of concern established by Federal resources agencies.

4.4 Socioeconomic Impacts

Building activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of building activities and of the construction workforce on the region.

Although the review team considered the entire region within a 50 mi radius of the Turkey Point site when assessing socioeconomic impacts, the primary area for physical impacts is the area closer to the plant. As described in Section 2.5, with regard to social and economic impacts, the entire 50 mi radius is considered, but the focus is primarily on the economic impact area of Miami-Dade County. Based on commuter patterns, populations, and the distribution of residential communities in the area, the review team expects minimal impacts on other counties within the 50 mi radius in Florida.

The following sections describe the physical impacts on the site (Section 4.4.1), demographic impacts (Section 4.4.2), economic impacts on the community (Section 4.4.3), and the impacts on infrastructure and community services (Section 4.4.4). The impacts on minority and low-income populations are covered in Section 4.5.

4.4.1 Physical Impacts

Building activities can cause temporary and localized physical impacts such as noise, odors, vehicle exhaust, dust, and visual aesthetic disturbances. Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section addresses potential building impacts that may affect people, buildings, and roads.

4.4.1.1 Noise Impacts on Workers and the Local Public

Building activities would generate noise. FPL assessed the potential noise from building Turkey Point Units 6 and 7 based on noise levels from equipment similar to that expected to be used for the building of Turkey Point Units 6 and 7 (FPL 2014-TN4058). The highest levels of onsite noise would be generated by impact wrenches, cranes, backhoes, front-end loaders, trucks, bulldozers, and operation of the concrete batch plant. Noise levels could reach as high as 102 dBA during short periods.

To limit onsite noise impacts, workers would use noise protection as required by the Occupational Safety and Health Administration (OSHA) when engaging in work subject to noise hazards. Offsite, the nearest residence is located 3.9 mi away from the proposed units and peak noise conditions at that residence would be below 65 dBA (FPL 2014-TN4058), a level at which noise impacts would be of small significance.

Vehicular traffic from construction workforce commuting and heavy material and equipment deliveries is another source of noise. Traffic noise levels are not expected to be high because of the varying nature of traffic noise, the dispersion of traffic as it moves away from the construction site, and the distance of residential areas from the vicinity of the site. Traffic-related noise can be reduced by lowering the speed limit, shuttling workers, staggering shifts, and using the railroad spur for large deliveries.

All project activities would also be subject to regulations from the Noise Control Act of 1972, Federal regulations for noise from construction equipment (40 CFR Part 204) (TN653), OSHA regulations (29 CFR 1910.95) (TN654), and State regulations. The review team expects that noise impacts on the general public would be minimal with the use of the mitigation actions included in the above regulations (as applicable) and because noise attenuates rapidly with distance, intervening vegetation, and variations in topography. Consequently, the review team concludes that noise impacts on surrounding communities would be minimal and mitigation would not be warranted.

4.4.1.2 Air-Quality Impacts on Workers and the Local Public

The review team discusses impacts on local air quality in Section 4.7. Construction and preconstruction activities, such as land clearing and filling and exhaust emissions from vehicles used to transport workers and construction materials, could emit particulate matter, carbon monoxide, oxides of nitrogen, sulfur dioxide, and volatile organic compounds. Based on FPL's commitment to developing and implementing a dust-control plan, strategies to minimize daily emissions, the roadway improvement plan, and generally favorable meteorological conditions for dispersal of air pollutants, in Section 4.7 the review team concluded that impacts on local air quality would be minimal and would not warrant mitigation measures beyond those already proposed by FPL. Therefore, the review team determined the air-quality impacts on workers and the local public would also be minimal.

4.4.1.3 Buildings

Construction and preconstruction activities would not affect any onsite buildings. Onsite safety-related buildings have been constructed to safely withstand any possible impact, including shock and vibration, from activities associated with building new reactors at the Turkey Point site (10 CFR Part 50, Appendix A) (TN249).

The transmission line construction and expansion within the West corridor (whether West Preferred or West Consensus corridor) would be primarily on wetlands, agricultural, or undeveloped land. The transmission line construction and expansion within the East corridor would be primarily on urban land. Where practicable, new transmission lines would be routed in existing corridors owned by FPL and routed adjacent to existing transmission lines or other existing linear facilities (e.g., access roads, transportation routes) to minimize impacts

(FPL 2014-TN4058). New construction, upgrades, and/or expansions of the Turkey Point, Clear Sky, Levee, Pennsuco, Davis, and Miami substations would be needed. Because none of these is expected to affect existing buildings, the review team expects impacts to be negligible.

4.4.1.4 Roads

FPL proposes a number of road improvements in the vicinity of the proposed site to accommodate the increased traffic expected during construction and operations. These road improvements would noticeably alter roads in the area because they would expand existing thoroughfares and/or convert dirt roads into improved surfaces. Socioeconomic impacts of building activities on traffic are analyzed in Section 4.4.4.1. The physical impacts from road improvements are described below (FPL 2014-TN4058).

Figure 4-4 shows FPL's assessment of which intersections would need improvements to facilitate building-related traffic. A new access road would be constructed along SW 359th Street, which would be connected to SW 344th Street/Palm Drive by improving SW 137th Avenue/Tallahassee Road and SW 117th Avenue. In addition, existing road segments of SW 328th Street/North Canal Drive, SW 117th Avenue, and SW 344th Street/Palm Drive would be widened. Specific improvements would be made as follows:

- SW 137th Avenue/Tallahassee Road (SW 344th Street/Palm Drive to SW 359th Street: improved to three lanes (two southbound and one northbound).
- SW 359th Street (SW 137th Avenue/Tallahassee Road to SW 117th Avenue): improved to three lanes (two eastbound and one westbound).
- SW 137th Avenue/Tallahassee Road at SW 359th Street: new curve linking SW 137th Avenue/Tallahassee Road with SW 359th Street. This curve would be designed so that it integrates appropriately with the existing FPL transmission lines.
- SW 117th Avenue (SW 344th Street/Palm Drive to SW 359th Street): improved to four lanes (two northbound and two southbound).
- SW 359th Street (SW 117th Avenue to the Turkey Point site): improved to four lanes (two eastbound and two westbound).
- SW 359th Street and SW 117th Avenue: new intersections with signalization or police control; two eastbound approach lanes (prohibit eastbound left turns); one westbound through lane; one westbound right-turn lane; two southbound approach lanes (one striped as an exclusive left-turn lane and the other as a shared left-turn/right-turn lane).
- SW 328th Street/North Canal Drive (SW 137th Avenue/Tallahassee Road to SW 117th Avenue): widened from two to four lanes.
- SW 328th Street/North Canal Drive and SW 137th Avenue/Tallahassee Road: signalization or police control; one additional southbound left-turn lane; one additional westbound through lane; two westbound right-turn lanes.
- SW 328th Street/North Canal Drive and SW 117th Avenue: signalization or police control; two northbound left-turn lanes; one eastbound right-turn lane; restripe the eastbound through lane to a shared through/right-turn lane.

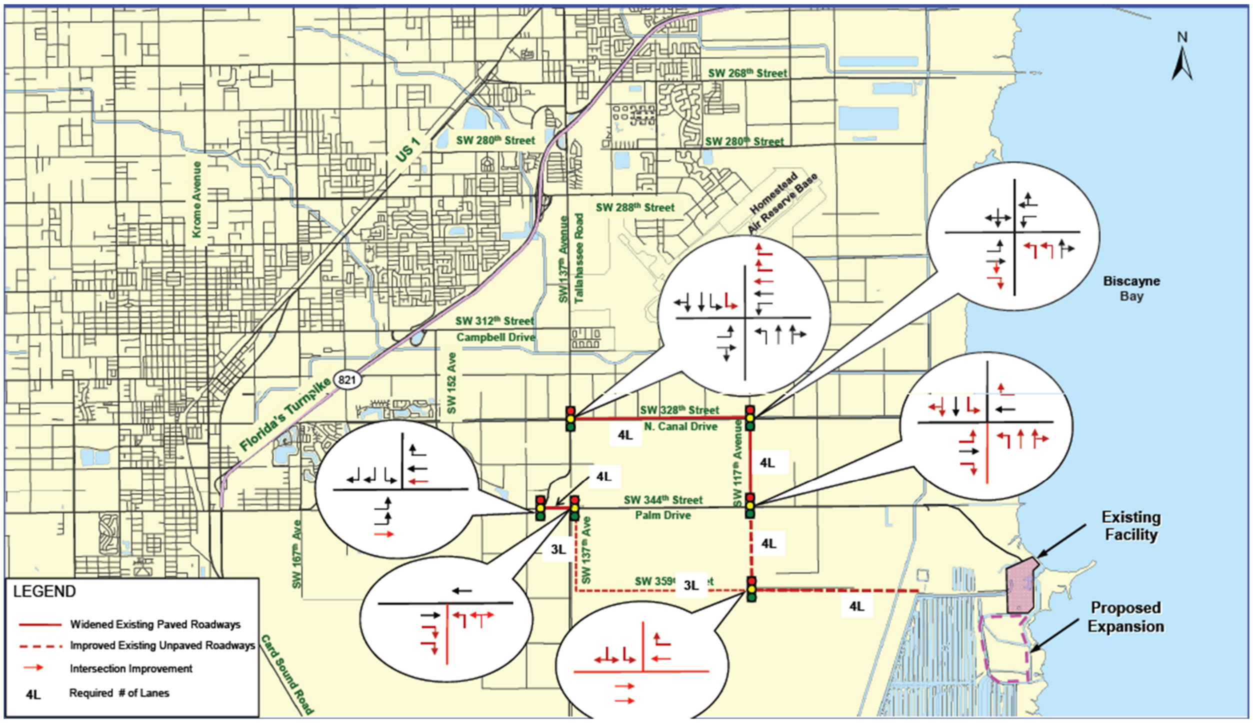

Figure 4-4. Road Improvements to Maintain an Acceptable Level of Service (Traf Tech 2009-TN1266)

- SW 117th Avenue (SW 328th Street/North Canal Drive to SW 344th Street/Palm Drive): widened from two to four lanes.
- SW 344th Street/Palm Drive (SW 137th Avenue/Tallahassee Road West to SW 137th Avenue/Tallahassee Road [East]): widened from two to four lanes.
- SW 344th Street/Palm Drive and SW 137th Avenue/Tallahassee Road (West): signalization or police control (p.m. peak hours only); one separate eastbound through lane; one additional westbound left-turn lane.
- SW 344th Street/Palm Drive and SW 137th Avenue/Tallahassee Road (East): new Intersection; signalization or police control (p.m. peak hours only); two eastbound right-turn lanes; two northbound approach lanes (one striped as an exclusive left-turn lane and the other as a shared left-turn/right-turn lane).
- SW 344th Street/Palm Drive and SW 117th Avenue: signalization or police control; one eastbound left-turn lane; one eastbound right-turn lane; one westbound right-turn lane; one northbound left-turn lane; two northbound through lanes (outside lane would function as a shared through/right-turn lane); one southbound left-turn lane; one southbound through lane (outside lane would function as a shared through/right-turn lane).

In its ER (FPL 2014-TN4058), FPL stated that "…after completion of construction, FPL would remove a portion of the roadway improvements on SW 359th Street and return to a transmission patrol road." All other updates to the transportation system would be used and maintained throughout construction and operation. Operational impacts on the roads are discussed in Section 5.5.1.

From a socioeconomic perspective, the review team considers the road improvements derived from increasing lanes, signalization, and police control to represent noticeable and beneficial changes. However, such changes have the potential to impose impacts on land use and terrestrial ecology. For an analysis of these impacts see Sections 4.4.1, 4.4.3, and Chapter 7.

4.4.1.5 Waterways

Large components and modules for Units 6 and 7 would arrive by barge. Approximately 80 barge trips for large components and modules are estimated for each unit. Materials arriving by barge would be trucked over an onsite heavy-haul road to the Units 6 and 7 plant area. The review team expects only minor impacts on waterways from these activities.

4.4.1.6 Aesthetics

The building impacts of proposed Units 6 and 7 would involve the use of 460 ft-high cranes, which would be slightly higher than the tallest structures currently at the Turkey Point site (the 400-ft-high emission stacks). Commercial and recreational boating traffic on the eastern side of the property would have a broad view of the entire Units 6 and 7 plant area, and would have an open view of Units 6 and 7 building activities. This viewscape would be temporarily affected by the presence of construction equipment and the new reactor modules being installed.

Light pollution and light trespass would be addressed during construction of Units 6 and 7 when working in low-light hours. Guidelines specifically addressing potential lighting issues, from the Illuminating Engineering Society of North America (IES 2012-TN1044), would be incorporated into the outdoor lighting design to the extent practicable while meeting NRC and OSHA (29 CFR Part 1910) (TN654) requirements for security and worker and plant safety (FPL 2014-TN4058). Typical features to be incorporated would include minimizing upward light from luminaries, minimizing upward light in general so that light reaches its intended target, turning off lighting not needed for safety and security between 11:00 p.m. and sunrise, containing light within its intended target area by suitable choice of luminaries for light distribution, carefully selecting mounting height and physical location, and minimizing glare in the horizontal or vertical directions (FPL 2014-TN4058). Because light from current Turkey Point units is visible from several locations surrounding the site, sky glow from these units is visible from urban areas as far away as Miami (Section 2.5.2.4), and because of the mitigating factors listed above, the review team concluded that the visual impact of the building of proposed Units 6 and 7 would be noticeable but temporary.

The building of transmission lines in established transmission line corridors would have a temporary visual impact that would have little contrast with the existing use of these areas. The line from Clear Sky to Turkey Point lies within Turkey Point site and when completed would not alter the view of the existing lines between the McGregor switchyard and the Turkey Point switchyard (FPL 2014-TN4058). Because the Davis to Miami transmission line would be collocated with the MetroRail and a major transportation highway in an urbanized area, visual impacts would also not contrast with the existing environment. The segments of the western transmission line corridor between Everglades National Park and the Levee substation would be adjacent to the Everglades National Park (both the Western Consensus corridor and the Western Preferred corridor) until its northern-most leg, just south and north of US 41, when it would turn east to connect to the Levee substation. Building activities would be visible to recreational users of the park up to a distance of 20 mi (FPL 2014-TN4058). Construction of the transmission line along the borders of the Everglades National Park would follow SW 187th Avenue and the presence of the road would attenuate any visual contrast with the natural environment. Based on the information provided by FPL and the review team's independent assessment, the review team determined the physical impacts of construction and preconstruction from site-related viewscape intrusion, light pollution, and transmission line visibility would be minimal and would not warrant mitigation.

4.4.1.7 Summary of Physical Impacts

Based on the information provided by FPL (FPL 2014-TN4058) and the review team's independent analysis, the review team concludes that the overall physical impacts of construction and preconstruction on workers and the local public, buildings, and aesthetics near the Turkey Point site would be SMALL and adverse, although there would be MODERATE and beneficial socioeconomic impacts on roads near the existing Turkey Point site.

4.4.2 Demography

The following assessment of population impacts is based on FPL's estimated peak project workforce analysis (FPL 2014-TN4058). The proposed project schedule assumes 10 years—39 months for preconstruction activities and 84 months for NRC-authorized construction—to build both units. The greatest number of onsite NRC-authorized construction and operation workers for the project would occur during month 81 of the building schedule (month 42 of the construction schedule) and would include the following:

- 3,950 construction workers
- 33 operations workers for Unit 6.

The review team believes that the above assumptions are plausible. The workforce estimates and the assumption of the family size of in-migrating workers are based on existing studies (FPL 2014-TN4058). FPL determined the best estimate for the in-migrating workforce for building proposed Units 6 and 7 was 50 percent of the construction and operation workers present during peak employment, or 1,992 workers (1,975 construction workers and 17 operations workers). Also, FPL assumed that approximately 70 percent of in-migrating construction workers (1,383) would bring family members, as would 100 percent of in-migrating operations workers (17). Using an average family size for the workforce of 3.25 people (Malhotra and Manninen 1981-TN1430), this would bring the total in-migrating project-related population to 5,142 (5,087 construction workers and their families and 55 operations workers and their families). Upon construction completion, FPL estimates that 50 percent of the in-migrating construction workforce would leave the 50 mi region (2,543 workers and family members). This would outweigh the increase in in-migrating operations workers for fully staffing Units 6 and 7 (773 workers and family members after the month of peak employment). Therefore, the project-related in-migrating population (building and operations) would reach, at its peak, 5,142 workers and family members.

The review team believes that the assumption that 50 percent of the workforce would migrate into the 50 mi region may be an upper-bound estimate based on the number of construction workers and the local unemployment rate in Miami-Dade County. Furthermore, the review team believes the assumption that the average family size of the in-migrating workforce would be 3.25 people is also an upper-bound estimate because the average family size in Florida in 2012 was 3.19 people (USCB 2012-TN4080). Projections for overall population growth in Miami-Dade County were presented in Section 2.5, but no forecasts are available for the unemployment rate. At peak employment, 3,983 workers would represent about 7 percent of the currently available construction workforce in Miami-Dade County, and 50 percent (the locally supplied workers) would represent about 3.5 percent of the currently available construction workforce in Miami-Dade County (57,345, Section 2.5). Therefore, the review team believes it is not unreasonable to expect that at least 50 percent of the construction workforce would be available locally and that the following analysis is an upper-bound estimate of the impacts that may occur.

The review team assumes based on the FPL analysis that the in-migrating population will follow the same geographic distribution as the existing workforce. Therefore, at peak construction employment, 42.8 percent (2,201 people) of the in-migrating population would live in Homestead and Florida City, and 83.3 percent (4,283) in Miami-Dade County. Based upon these assumptions, there would be a net population increase of less than two-tenths of 1 percent in the projected population of Miami-Dade County and approximately a 3.1 percent increase in population in the Homestead and Florida City area, based on 2012 population estimates.(1) If the in-migration rate for construction workers were larger than assumed or if more workers brought families, then it is possible that impacts could be greater than shown in the remainder of this section. However, given the propensity of construction workers to either commute long distances or relocate temporarily to a job site without families, and given the number of communities, in addition to Homestead and Florida City, in the Miami urbanized area and within the 50 mi region, the review team believes that the impact of in-migration would not be larger than that assumed.

For each direct local job created by building Turkey Point Units 6 and 7, additional local jobs and earnings would be created in two ways. To the extent that the increased demand for materials and services is satisfied by local suppliers, this increased demand would result in indirect jobs and earnings in those sectors supplying the building of Units 6 and 7. In addition, in-migrating workers would generate additional local jobs and earnings through their local purchases. Because a portion of the dollars spent in the area is re-spent in the area by those earning the dollars, a multiplier effect is generated, resulting in the creation of jobs and earnings beyond those of the workers directly employed in the building of Units 6 and 7. The U.S. Department of Commerce's Bureau of Economic Analysis (BEA) provides estimates for regional multipliers for industry jobs and earnings. For each new job created in the construction industry in Miami-Dade County, an estimated 0.9535 indirect jobs in all industries would be created in Miami-Dade County, and for each new job created in the power-generation and supply industry in Miami-Dade County an estimated 2.1696 indirect jobs would be created in Miami-Dade County (FPL 2011-TN56).(2) The in-migration of workers also will stimulate new employment in Homestead and Florida City (see Section 4.4.3.1 for a detailed discussion), but

(1) 59,866 population estimate for Homestead and 11,313 population estimate for Florida City.
(2) RIMS II (Regional Input-Output Modeling System) direct effect employment multipliers for Miami-Dade County are 1.9535 for the construction industry and 3.1696 for the power generation and supply industry.

the review team expects these indirect jobs would be filled by current residents and not by new in-migrating people.

Figure 4-5 characterizes the size of the workforce for the entire project. FPL estimates NRC-regulated construction activities to be 84 months long, peaking in year four. Also shown is the 39 months of preconstruction activities. The figure shows the construction workforce and the operations workforce for proposed Turkey Point Units 6 and 7 (FPL 2014-TN4058). A corresponding table showing total estimated numerical values by month for the Turkey Point workforce is in the supporting documentation in Appendix G.

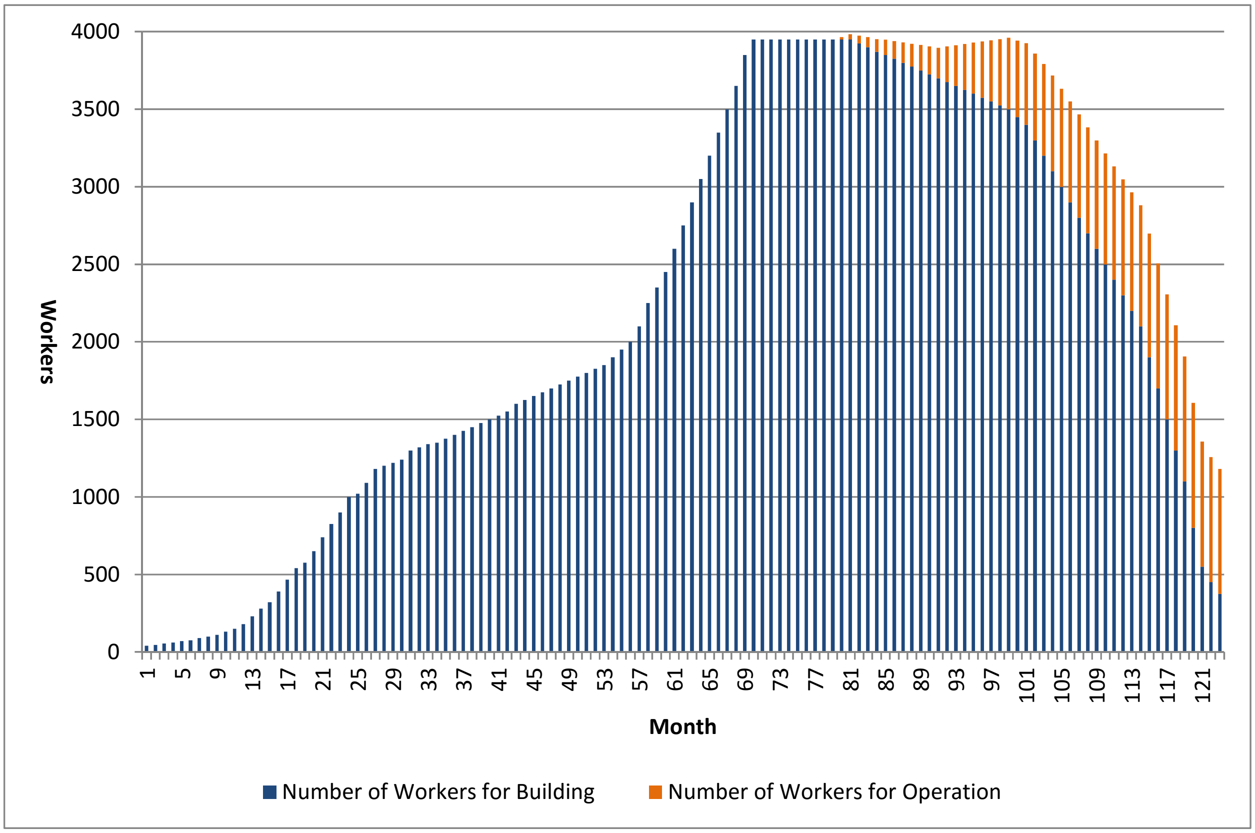

Figure 4-5. Total Workforce at Turkey Point Plant Units 6 and 7

Based on its independent analysis, the review team concludes that the demographic impacts of building in Miami-Dade County would be SMALL. Although the impacts may be larger in the Homestead and Florida City area than in the county as a whole, the review team determined the impacts would still not noticeably alter the demographics of the Homestead and Florida City area. Therefore, the demographic impacts on Homestead and Florida City would also be SMALL.

4.4.3 Economic Impacts on the Community

This section evaluates the social and economic impacts on the area within 50 mi of the Turkey Point site as a result of building proposed Units 6 and 7. The evaluation assesses the impacts of building Units 6 and 7 and the demands placed by the larger workforce on the surrounding region. Because the review team expects the economic impact area will receive the majority of the impacts associated with building Turkey Point Units 6 and 7, the review team determined the economic impacts outside the economic impact area but within the 50 mi region would be minimal but beneficial. The remainder of this discussion focuses on the economic impacts within the economic impact area.

4.4.3.1 Economy

The impacts of building the proposed units on the local and regional economy depend on the region's current and projected economy and population. For this analysis, FPL assumed site-preparation activities would begin in 2016 and commercial operation dates would be 2025[(3)] for Unit 6 and 2026 for Unit 7.

The generation of 3,950 new construction jobs would create new indirect jobs in the area through a process called the "multiplier effect" (described in Section 4.4.2). Assuming the construction workforce residential patterns would be similar to those of the current Turkey Point workforce, and assuming one worker per job,[(4)] 83.3 percent (3,290) of the new construction job workers would reside in Miami-Dade County. Although the impacts calculated below are for Miami-Dade County, the impact would be larger if the impacts on surrounding counties were included.

For every new construction job, the BEA multiplier estimates an additional 0.9535 jobs would be created in Miami-Dade County (FPL 2011-TN56). Therefore, the 3,290 construction workers residing in Miami-Dade County would support 3,137 indirect jobs. Because most indirect jobs would be service or retail related and not highly specialized and because this represents approximately 2.9 percent of the number of unemployed in the county in 2013 (Table 2-40), the review team assumed these jobs would be filled by local residents and would result in no additional in-migration.

The review team used BEA multipliers for Miami-Dade County. Because these multipliers capture indirect impacts in the area where workers spend their incomes, and because workers typically spend most of their incomes close to their areas of residence, the review team used only the portion of workers expected to reside in Miami-Dade County (83.3 percent) to estimate indirect employment generation. In addition, the review team considered that all workers that would be employed in the building and operation of Turkey Point Units 6 and 7 would constitute "new employment," and applied the multiplier to all direct employment residing in Miami-Dade County, not just in-migrating employment. The reason for doing so is that workers already residing and working in Miami-Dade County who left their jobs to work at Turkey Point Units 6 and 7 would leave a vacant position that would need to be filled by others.[(5)]

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(3) From the time of this analysis, commercial operation dates have been moved to 2027 and 2028, respectively (FPL 2015-TN4502). The review team does not expect this change to affect the results of the current analysis.
(4) Throughout this section, the review team assumed one worker per job.
(5) The review team assumes these replacement workers would be recruited from the local unemployed workforce. For more information about BEA RIMS II regional economic multipliers see BEA 2012 (TN1569). RIMS II is an essential tool for regional developers and planners.

Using the BEA multipliers, the review team estimated that the 3,950 new construction jobs created during peak project workforce use would generate 3,137 (3,950 × 0.9535 × 0.833) indirect jobs in Miami-Dade County and the 33 new operation jobs created during peak project workforce use would generate 60 (33 × 2.1696 × 0.833) indirect jobs in Miami-Dade County. Because most indirect jobs would be service or retail related and not highly specialized, and because the total of 3,197 indirect jobs represents approximately 3.0 percent of the number of currently unemployed in the county (3,197 ÷ 108,230, see Table 2-40), the review team considers that these jobs would likely be filled by local residents and any additional in-migration would be negligible.

The employment of a large construction workforce over an approximately 10-year building period would have positive economic impacts in the region. BEA estimates that for each dollar paid in the construction industry in Miami-Dade County, an additional 80.22 cents of earnings are generated in the region (FPL 2011-TN56). If each construction worker earned $56,145[(6)] a year, $1,015,663,050 ($56,145 × 10 years × 1,809 average annual construction employees residing in Miami-Dade County during building period) in salaries would be generated during the building phase of the project (see Appendix G for the number of workers employed per month). These earnings would generate an additional $814,764,899 in earnings during the building phase, or an average indirect earnings to the region of about $81 million per year, over the 10-year period

In the peak construction employment months, $15,393,088 (3,290 construction employees residing in Miami-Dade County × $4679) in direct earnings would generate an additional $12.3 million per month ($15,393,088 × 0.8022) of indirect earnings for a total of $27.7 million in total earnings in the region.

After reaching peak project employment, the construction workforce would start to decline and produce a decline in related payrolls. There would be a corresponding decline in economic impacts. The loss of project-related jobs would mean a decrease in indirect jobs through the “multiplier effect.” However, this decline would lag the loss in project-related jobs and would be partially offset by the economic impact of the arriving operations workforce.

The review team concludes that beneficial economic impacts could be experienced throughout the 50 mi region surrounding the site as a result of building activities at the Turkey Point site. Because peak construction earnings would be less than eight-tenths of 1 percent of total wage earnings in Miami-Dade County,[(7)] these beneficial impacts would not noticeably alter local earnings. Peak workforce construction jobs and the jobs indirectly created by the in-migrating workforce would total 3,290 + 3,137 = 6,427 new jobs in Miami-Dade County. Because these new jobs would be less than 1 percent of employment in the Miami-Dade County (see Table 2-40), these beneficial impacts would likely not noticeably alter local employment. The review team concluded that the impacts would be minor and beneficial.

(6) Source: BLS 2012-TN4084. Average Annual Pay in Heavy and Civil Engineering, Miami-Dade County, 2012.
(7) Source: BLS 2012-TN4084. $46,667 million annual estimate in 2012, divided by 12 months, equals an average of $3,889 million.

4.4.3.2 Taxes

Several tax revenue categories would be affected by building proposed Units 6 and 7. These include corporate income taxes, sales and use tax and other taxes on sales and services, and property taxes.

Personal and Corporate Income Taxes

As stated in Section 2.5.2.2, the State of Florida does not levy a personal income tax on individuals. Florida does levy a corporate income tax but FPL would pay none on Units 6 and 7 until they become operational. Local construction expenditures would increase revenues from local businesses resulting in an increase in the corporate income taxes they pay. Similarly, purchases by the construction workforce would also increase revenues of local businesses and the corporate income taxes they pay.

FPL estimates it would spend between $12.8 billion and $18.7 billion over a 12-year period from initiation of licensing activities to completion of Unit 7 (FPL 2014-TN4058). This corresponds to average annual expenses between $1.07 billion and $1.56 billion. The review team's experience is that applicants purchase approximately 10 percent of their construction materials locally. Assuming the same percentage for Turkey Point Units 6 and 7, the average annual local expenses would be between $107 million and $156 million. If all corporate revenues were corporate profits (costs = 0), corporate profits taxes paid by local business would increase by no more than $8.58 million per year during the construction period, due to Turkey Point Units 6 and 7 construction expenditures ($156 million x 5.5 percent). Because corporate income is actually only a fraction of corporate revenues (costs >0), the actual corporate income taxes in the month of peak employment would be much lower.

The corporate income tax generated by direct local expenditures would total no more than $8.58 million per year. The State of Florida received $1.87 billion (6.3 percent of its total tax revenue of $29.7 billion) from corporate income and excise taxes in fiscal year (FY) 2010-2011 (Table 2-42). The impact would be minor and not noticeably alter corporate income tax revenues in the State.

Sales and Use Taxes

The region would experience an increase in the sales and use taxes collected from building purchases made for the project. The area around the proposed site would also experience an increase in sales and use taxes generated by retail expenditures (e.g., restaurants, hotels, merchant sales, food) by the construction workforce.

FPL estimates it would spend between $12.8 billion and $18.7 billion over a 12-year period from initiation of licensing activities to completion of Unit 7 (FPL 2014-TN4058). This corresponds to average annual expenses between $1.07 billion and $1.56 billion. Because Florida provides 100 percent tax exemption for equipment and materials associated with the building of power plant equipment and for pollution-control equipment, the only taxable expenses are purchases of services. Based on FPL's Petition to Determine Need for Turkey Point Nuclear Units 6 and 7 Electrical Power Plant (FPL 2007-TN445), the review team estimates that services would make up less than 20 percent of construction costs. Purchases made out of state receive a tax credit for sales taxes paid in those states. FPL estimates that 67 percent of labor and services expenses would be purchased from Miami-Dade County providers with the remaining being purchased out of state (FPL 2014-TN4058). With a Florida State 6 percent sales tax, the estimated sales tax paid to the State would be up to $12.5 million a year ($1.56 billion × 0.20 × 0.67 × 0.06). An additional 1 percent surtax imposed by Miami-Dade County would generate another $2.1 million a year for the County. As noted in Section 2.5.2.2, the State of Florida received $1,935 billion from sales and use taxes in FY 2011. State sales tax revenues from the building of the proposed project would therefore correspond to less than approximately seven-hundredths of 1 percent of the annual sales tax revenues from the State. Because of the large tax base of the State, the impact would be minor and beneficial. Miami-Dade County adopted budget shows $282.7 million in sales and use taxes in FY 2011-2012 (Table 2-41). The 1 percent surtax imposed by Miami-Dade County on construction expenses of Units 6 and 7 would correspond to approximately seven-tenths of 1 percent of sales and use tax revenues.

The area around the Turkey Point site would also experience an increase in sales and use taxes generated by retail expenditures by the construction workforce. The total earnings generated by Units 6 and 7 during the month of peak employment was estimated in Section 4.4.3.1 to be $29 million. If all these earnings were spent in taxable expenses, sales and use taxes for both the State and the County would add up to about $2 million during the month of peak employment. The impact on State and County revenues would be minor and beneficial.

Property Taxes

According to Florida Statute Title XIV, Chapter 192, “improved or portions not substantially completed of real property” are not attributed value for the purposes of property taxation. Substantially completed means that the “the improvement or some self-sufficient unit within it can be used for the purpose for which it was constructed” (Fla. Stat. Title 14 2012-TN1585). Because Turkey Point Units 6 and 7 cannot be used for the purpose for which they were constructed until start of operations, the review team concludes there should be no new property taxes paid due to Turkey Point Units 6 and 7 during the construction period.

One possible source of revenue from property taxes during the construction period would be housing purchased by some construction workers. In-migrating workers could purchase houses. Because there is such a large housing stock available in Miami-Dade County, the review team does not expect upward pressure on housing prices (see Section 4.4.4.3). If incoming worker families were to reside in Miami-Dade County, they would represent an increase of less than two-tenths of 1 percent over Miami-Dade County’s projected population in 2020 population. If 43 percent of in-migrants would choose to reside in the Homestead and Florida City area, in accordance with the residence patterns of current Turkey Point workers, incoming workers and families would represent a 3.1 percent increase in population in the Homestead and Florida City area (based on 2012 population estimates) (see Section 2.5.1.1). These in-migrating worker families would contribute property taxes to the counties and special districts in which they reside. It is unlikely that the property tax revenues in Homestead or Florida City would increase with the construction of Units 6 and 7. Therefore, the property tax impacts from new residents would cause a minor and beneficial change in property tax revenues.

Summary of Tax Impacts

The review team expects tax revenue increases in the form of sales, corporate, and property taxes because of the building of the proposed Units 6 and 7 and the influx of construction workforce into the region. Because of the large tax bases of Florida State and Miami-Dade County, the impact on their tax revenues would likely be minimal and beneficial. The impact on Homestead and Florida City would also be minimal and beneficial for property tax revenues.

4.4.3.3 Summary of Economic Impacts on the Community

Based on its independent analysis, the review team concludes that all of the economic impacts of building activities would be SMALL and beneficial in the 50 mi region, Miami-Dade County, Homestead, and Florida City.

4.4.4 Infrastructure and Community Service Impacts

Infrastructure and community services include transportation, recreation, housing, public services, and education.

4.4.4.1 Traffic

FPL proposes a number of road improvements in the vicinity of the proposed site to accommodate the increased traffic expected during construction and operations. Among them, the new access road along SW 359th Street would open traffic to an area with limited accessibility to the public. Because this new access road would lead mostly, if not exclusively, to the Turkey Point power plant, the review team expects traffic along this new access road to be mostly used by plant-related traffic.

Building impacts on traffic would be greatest during the period of peak building workforce use—month 81 of the building schedule and month 45 of the construction schedule. By then, a new entrance on SW 359th Street and access road would provide access to the Turkey Point site and all construction traffic would be routed to the new construction entrance.

As explained in Section 4.4.2, the peak workforce would consist of an estimated 3,983 construction and operation workers. In addition to this workforce, existing traffic and vehicles transporting construction and fill material also would be using roads in the vicinity of the site. To assess the impact of the proposed Turkey Point Units 6 and 7, a traffic study was conducted in 2009. Because project-related traffic during peak workforce would exceed the capacity of local roads, the study identified improvements that would need to be made at key intersections so that all affected intersections would maintain a “level of service” of at least D. The Transportation Research Board “level of service” (LOS) designations define the flow of traffic on a designated highway. LOS designations can range from traffic freely flowing (LOS A) to a point where traffic flow exceeds the design capacity of the highway resulting in severe congestion (LOS F). Miami-Dade County adopts LOS D (flow at 90 percent capacity) (Miami-Dade County 2012-TN1495) as a standard for planning and operational analysis (Traf Tech 2009-TN1266).

The traffic study assumed the project-related workforce would commute to the Turkey Point site by the same routes used by current Turkey Point plant employees. The workforce would be divided into two shifts; 70 percent would be assigned to shift 1 (6:00 a.m. to 4:30 p.m.) and 30 percent to shift 2 (5:00 p.m. to 3:00 a.m.). The time of the day of peak commute would be between 4:30 p.m. and 5:00 p.m. The traffic study assumed that a maximum of 36 trucks per hour would enter and leave the site for a total of 72 trips per hour. Half of the trucks were assumed to come from a quarry north of the site using SW 117th Avenue and the other half were assumed to come via US-1 and SW 344th Street to SW 137th Street. Figure 4-4 shows the improvements that would need to be made to roads and intersections to maintain an acceptable LOS. These improvements are listed in Section 4.4.1.3. The resulting LOS designations for the key intersections are shown in Table 4-11.

The 2009 traffic study assumed a peak workforce of 3,650, considerably less than the current peak workforce estimate of 3,983. However, additional sensitivity analyses were conducted and the conclusions remained valid, even with this increment in the peak workforce (FPL 2012-TN1463).

Table 4-11. Level-of-Service Designations for Key Intersections during Peak Workforce after Road and Intersection Improvements

Intersection	A.M. Peak Hour	P.M. Peak Hour
SW 328th St & SW 137th Ave	C	D
SW 328th St & SW 117th Ave	C	D
SW 344th St & SW 137th Ave (W)	C	B
SW 344th St & SW 137th Ave (E)	B	B
SW 344th St & SW 117th Ave	C	C
SW 359th St & SW 117th Ave	C	D

Source: Traf Tech 2009-TN1266

Traffic in the vicinity of the site would likely exceed the levels discussed above for short periods. Events at the Homestead Miami Speedway on SW 344th Street/Palm Drive would bring additional traffic to the area two to four times a year. In addition, refueling outages for the existing units would occur during construction, bringing in an additional 600 to 1000 workers. FPL stated that mitigation measures could include staggering the outage shifts to not coincide with construction shifts, encouraging workers to carpool, providing van services to remote parking facilities, and adjusting the construction schedule to ensure that the construction workforce is not commuting when the most traffic would be arriving at the speedway. The review team concludes that given the mitigation strategies proposed by FPL, the increase in traffic from building activities for Units 6 and 7 would be noticeable, but not destabilizing. The impacts would also be temporary and intermittent. However, if the mitigation strategies were not put in place, the review team expects that impacts from traffic would be significant and destabilizing.

FPL estimates truck traffic could reach 36 trucks an hour over a period of 5 years (FPL 2013-TN3546). Some of this traffic may occur before the proposed road improvements. Because there is currently considerable available peak hour capacity at traffic count stations in the vicinity of the proposed site (see Section 2.5.2.3), and because field visits confirmed the current low level of road use in the vicinity of the site, the review team considers that this increased truck traffic would be noticeable but would not destabilize traffic in the vicinity of the site.

To assess potential impacts of truck traffic on roads beyond the vicinity of the site, the review team estimated the current LOS at Florida Department of Transportation (FDOT) traffic-monitoring sites along potential truck routes. This was done based on the peak hour directional traffic and FDOT LOS thresholds. Peak hour directional traffic information was obtained from FDOT Florida Traffic Online (FDOT 2013-TN3558) and consists of the Annual Average Daily Traffic (AADT) at each traffic-monitoring site, a Standard Peak Hour Factor (K) and a Directional Distribution Factor (D). The multiplication of these three elements (AADT x K x D) provides an estimate of the current peak hour directional traffic volume. The LOS was determined comparing this peak hour directional traffic volume with the maximum thresholds for each LOS in Table 7 (urban areas) of FDOT's Generalized Service Volume Tables (FDOT 2013-TN3297). The review team used FDOT's 2013 Quality/Level of Service Handbook (FDOT 2013-TN3297) to determine how to classify roads (e.g., highway, freeway, or arterial). The review team assumed trucks would be coming from one of two potential places, typically carrying fill material:

- Rail lines west of Homestead. After transloading cargo from trains to trucks, the trucks would head west on West Mowry Drive, south on SW 187th Avenue and east on SW 8th Street/ SW 328th Street. For a traffic-monitoring site on SW 8th Street, west of US-1 the review team estimated a peak hour directional traffic of 413 vehicles corresponding to a LOS of D. An increase of 36 trucks an hour would keep the estimated LOS unchanged (Table 4-12).
- The Cemex FEC Quarry next to the Florida Turnpike/SR-821, south of North Okeechobee Road. Trucks would head south on SR-821 to SW 328th Street. The review team estimated a LOS at three different traffic-monitoring sites along SR-821. An increase of 36 trucks an hour would not alter these levels of service (Table 4-12).

A third potential source of fill material would be the Atlantic Civil rock mine located about 10 mi west of the FPL site, but the use of this site would only require the use of roads in the vicinity of the FPL site.

Table 4-12. Peak Workforce Traffic LOS Analysis for Truck Traffic beyond the Vicinity of the Site

Traffic-Monitoring Site	Baseline Peak Hour Directional Traffic	Baseline LOS	Added Peak Hour Directional Traffic	Peak Hour Directional Traffic with Project	LOS with Project
SW 8th west of US-1	413	D	36	449	D
SR-821 north of 8 St.	7,242	E	36	7,278	E
SR-821 north of US-1	5,745	E	36	5,781	E
SR-821 north of SW 137th St.	3,476	C	36	3,512	C

Source: Review team calculations based on FDOT 2013-TN3558 and FDOT 2013-TN3297.

In addition to congestion impacts, construction-related traffic would also result in traffic accidents, injuries, and fatalities. The costs associated with these incidents include workers' compensation premiums, lost productivity, environmental remediation, property damage, fines and penalties, insurance premiums, and medical costs. Section 4.8.3 presents an estimate of construction-related vehicular impacts on accidents, injuries, and fatalities. Because the review team expects the impacts on accidents, injuries and fatalities to be low, the associated socioeconomic impacts would be minor.

Based on the information provided by FPL (2014-TN4058) and the review team's independent analysis, the review team concludes that the construction impacts on traffic would be noticeable. Traffic on the roads surrounding the proposed site would noticeably increase during construction but, with the proposed mitigation measures described above, would not destabilize traffic in the affected area.

4.4.4.2 Recreation

Several recreational facilities exist in the vicinity of the proposed site: Biscayne National Park, Homestead Bayfront Park, Homestead Miami Speedway, and Mangrove Preserve. In addition, the segments of the western transmission line corridor between the Everglades National Park and the Levee substation would be adjacent to the Everglades National Park. To the extent that traffic, noise, air emissions, and the visual landscape are affected by the building of Units 6 and 7, recreational activities in these facilities also could be affected. Traffic impacts of building activities are analyzed in Section 4.4.4.1. Traffic impacts would be unevenly distributed during the day and would be greatest during peak commuting hours (4:30 p.m. to 5:00 p.m.). Visitors to recreational facilities in the vicinity of the park would face increased traffic on some of the local roads. Noise and air emissions impacts of building activities are analyzed in Section 4.4.1.1. Visual impacts of building activities are analyzed in Section 4.4.1.4. Building activities at the proposed site would be fully visible to recreational users of Biscayne National Park.

The influx of building-related population to Miami-Dade County, and to the Homestead and Florida City areas in particular, would increase the number of local users of recreational facilities. Because the in-migrating population would be less than two-tenths of 1 percent of the projected population of Miami-Dade County in 2020 and approximately 3.1 percent of the population in the Homestead and Florida City area, the review team expects the impact on current recreational infrastructure to be negligible.

4.4.4.3 Housing

Section 4.4.2 of this chapter presents the assumptions behind the review team's estimate of the number of in-migrating workers. The review team assumed that 1,660 ((1,975 in-migrating construction workers + 17 in-migrating operations workers) × 0.833 relocating to Miami-Dade County) workers would migrate to Miami-Dade County. Approximately 1,166 (1,400 × 0.833) of these workers would bring families and 494 (592 × 0.833) workers would relocate without families. All 1,660 in-migrating workers would need housing. Some of the workers would need permanent housing, generally owner-occupied, and others would elect to rent housing. Still others would elect to reside in transitional housing such as residential hotels, motels, rooms in private homes, or to bring their own housing in the form of campers and mobile homes.

As shown in Section 2.5.2.5, the U.S. Census Bureau estimated Miami-Dade County to have 163,185 vacant housing units in 2012, 35,884 of which were for rent. Because the demand from in-migrating workers would be 1.0 percent of the available housing, the review team expects the housing market in the county would be able to absorb the influx of workers, and rental rates and housing prices would not suffer a perceptible increase because of this influx.

In Homestead and Florida City there were 26,215 housing units in the area in 2012, 4,928 of which were vacant. If the distribution of the residences of Units 6 and 7 workers were the same as that of present Turkey Point plant employees, 853 workers (42.8 percent) would reside in the area. The demand from in-migrating workers would be for 17.3 percent of the available housing.

Because houses vary in characteristics, there may or may not be enough to absorb the estimated influx of workers to the Homestead and Florida City area. During a field visit, the review team verified that commuting from south Miami-Dade County to the Miami urban area is common and that commuting from north Miami-Dade County to the Homestead and Florida City area would be acceptable to workers migrating into the area and would occur against the direction of most traffic during rush hours. The review team concluded that if vacant housing in the Homestead and Florida City area were insufficient to accommodate 853 workers during peak building employment, these workers would be able to find housing in other areas of Miami-Dade County within a convenient driving distance to the Turkey Point site. The review team confirmed this in discussions with local community leaders (NRC 2010-TN1457). Impacts on rental rates and housing prices in the Homestead and Florida City area could occur but would be minor and temporary.

Because of the temporary nature of construction, workers often choose not to live in permanent housing. There are eight recreational vehicle parks or campgrounds in Miami-Dade County with 1,277 spaces with full hookups (water, sewer, and electricity) for private recreational vehicles. Approximately 62 percent (792) of these spaces are in the Homestead and Florida City area (FPL 2014-TN4058). In the South Dade region, which includes the Homestead and Florida City area, 25 hotels/motels with approximately 1,683 rooms were available in 2007 and the average occupancy percentage for the area was 63.9 percent (FPL 2014-TN4058). Due to the numerous housing opportunities available, the review team expects impacts on recreation vehicle (RV) parks, campgrounds, and hotels/motels would be minor.

Construction of Units 6 and 7 and their associated transmission lines could affect property values, if proximity to nuclear reactors or to transmission lines affects the attractiveness of properties to prospective buyers or renters. Various studies have reviewed the recent evidence and found the body of studies to be inconclusive. For example, Bezdek and Wendling (2006-TN2748) found that various studies report no statistical effect of proximity to nuclear plants, while other studies have found positive or negative effects. The authors' own analysis of impacts around seven nuclear facilities finds a potential positive impact that they explain by the jobs and tax contributions of the plants. They caution, though, that results may vary from case to case, depending on the various factors that influence housing market prices and suggest further research is needed. In the case of proposed Units 6 and 7, other nuclear reactors are already at the site, suggesting that results from the literature examining new power plants in locations with no power plant may be less informative about the potential impacts at Turkey

Point. In the case of transmission lines, studies have often also reached different conclusions. For example, Chalmers and Voorvaart (2009-TN4395), noting that the literature on the effects of transmission lines on property values is extensive but of uneven quality, argue that of what they consider to be the 16 studies that "form the core of the professional literature and are widely quoted and cross-referenced on to the other," half find a negative effect and half find none. When effects were found they tended to be small, decay with distance, and dissipate over time. Because the current evidence is inconclusive, it is not possible to state whether construction of Units 6 and 7 and their associated transmission lines would or would not affect property values.

Based on its independent analysis, the review team concludes that the impacts on housing in Miami-Dade County of building the proposed Turkey Point Units 6 and 7 would be minor. The impacts may be larger in the Homestead and Florida City area than in the county as a whole. However, the impacts would not likely alter the housing market of the Homestead and Florida City area other than for short periods of time. Therefore, the impacts on housing in Homestead and Florida City would also be minor.

4.4.4.4 Public Services

This section describes the public services available and discusses the impacts of building at the Turkey Point site on water supply and waste treatment; police, fire, and medical services; education; and social services in the region.

Water Supply and Wastewater-Treatment Facilities

A detailed description of building-related water requirements and their impacts is presented in Section 4.2 of this EIS.

FPL estimates the maximum potable onsite water use to be 0.8 Mgd during the peak construction period. This would include personal uses (potable) and uses related to concrete batch plant operation, concrete curing, cleanup activities, dust suppression, placement of engineered backfill, and piping hydrotests and flushing operations. Miami-Dade County would provide the necessary water for potable onsite use during construction (FPL 2014-TN4058). A consumption of 0.8 Mgd would represent less than two-tenths of 1 percent of the current Miami-Dade County water and sewer capacity (Table 2-47).

The in-migrating population would also increase offsite demand for potable water. The review team estimated the in-migrating population (including families) at peak employment for the 50 mi region to be 5,142, 83.3 percent (4,283) of whom would be expected to move into Miami-Dade County. According to the EPA, U.S. residents use about 100 gpd of water (EPA 2012-TN1267). If each in-migrating person used approximately 100 gpd, demand would increase by approximately 0.43 Mgd. A total of less than a 1.3 Mgd increase in water demands could be reached during the building of proposed Units 6 and 7 before the MDWASD system reached capacity. This would represent a three-tenths of 1 percent increase beyond current demands on the MDWASD supply capacity of 483.61 Mgd and would be less than 1 percent of current available capacity (Section 2.5.2.6). The MDWASD is currently operating at 71.92 percent of its capacity. If 42.8 percent of workers establish themselves in the Homestead and Florida City area, the 2,201 additional people would generate an increase in potable water demands of 0.22 Mgd, increasing current use from 70.8 percent to 71.9 percent of available capacity.

Onsite sanitary/wastewater treatment during the initial phases of Units 6 and 7 construction would be provided via portable facilities and/or a separate, packaged wastewater-treatment facility. All wastewater treatment in the economic impact area is handled by MDWASD except for Homestead. Assuming all new project-related water consumption results in wastewater, then the increase in water demand of 0.43 Mgd would increase wastewater treatment from 87.6 percent to 88.0 percent. Assuming 2,201 people migrate into Homestead (and none to Florida City, which is a part of the MDWASD), the increase in wastewater for Homestead of 0.22 Mgd would increase treatment from 102.2 percent of current capacity to 105.8 percent of current capacity.

As explained in Section 2.5.2.6, Homestead's proposed 10-Year Water Supply Facilities Work Plan identifies and details the construction of a 3.45 Mgd high-level disinfectant wastewater-treatment plant upgrade, which would accommodate this increase in demand. In addition, Homestead uses the MDWASD system as a backup.

Based on the information provided by FPL (2014-TN4058) and the review team's independent analysis, the review team concludes that the overall impacts of building the proposed Turkey Point Units 6 and 7 on the water-supply and wastewater-treatment facilities would be minor, with implementation of Homestead's 10-Year Water Supply Facilities Work Plan or current use of MDWASD's system as a backup for Homestead.

Police, Fire Protection, and Medical Facilities

The temporary increase in population from the workforce for building the proposed Turkey Point Units 6 and 7 can increase the burdens on local fire and police departments. The transitory nature of this increase can require management of both the increased burden when construction workers migrate to the area, and the decreased demand (and possible excess capacity) when construction workers leave the area, if personnel or assets were previously obtained to meet the influx of construction workers.

For onsite security, FPL would use its own security force. The offsite, residents-to-law enforcement officer ratios for Miami-Dade County are presented in Table 4-13. The ratio of residents-to-law enforcement officers in Miami-Dade County was 575.8 to 1. If 4,283 (0.833 × 5,142) workers and their families migrate into the county during peak construction periods, the population in-migration would increase that ratio to 576.8, a two-tenths of 1 percent increase. In the Homestead and Florida City area, the increase in residents-to-law enforcement ratio would be 3.1 percent. These increases would be minor to the police protection services in Miami-Dade County or Homestead and Florida City.

To the extent that these areas want to maintain their current residents-to-law enforcement ratios, an additional five law enforcement officers would be needed in Miami-Dade County and an additional five in the area of Homestead and Florida City.

Residents-to-firefighter ratios for Miami-Dade County are presented in Table 4-14. In 2012, the ratio of residents to firefighters in Miami-Dade County was 717.8 to 1. If 4,283 (0.833 × 5,142) workers and their families migrate into the county during peak construction periods, the population in-migration would increase that ratio to 719.0, a two-tenths of 1 percent increase. In the Homestead and Florida City area, the increase in residents-to-firefighter ratio would be 3.1 percent. These increases would be minor to the fire protection in Miami-Dade County or the Homestead and Florida City.

Table 4-13. Construction Impact on Police Protection in Miami-Dade County and the Homestead and Florida City Area

	Miami-Dade County	Homestead and Florida City
Population (2012)[a]	2,512,219	71,179
Sworn law enforcement officers (2010)[b]	4363	135
Ratio of residents per law enforcement officer	575.8	527.3
Population with building-related in-migration	2,516,502	73,380
Ratio of residents per law enforcement officer with building-related in-migration	576.8	543.6
Percent increase in residents-to-law enforcement ratio	0.2%	3.1%
Additional sworn law enforcement officers needed	9	5

(a) USCB 2012-TN4098.
(b) FPL 2014-TN4058.
Source: Review team calculations.

Table 4-14. Construction Impact on Fire Protection in Miami-Dade County and the Homestead and Florida City Area

	Miami-Dade County	Homestead and Florida City
Population (2012)[a]	2,512,219	71,179
Active firefighters (2010)[b]	3500	69
Ratio of residents per active firefighter	717.8	1,031.6
Population with building-related in-migration	2,516,502	73,380
Ratio of residents per active firefighter with building-related in-migration	719.0	1,063.5
Percent increase in residents-to-firefighter ratio	0.2%	3.1%
Additional active firefighters needed*	7	3

(a) USCB 2012-TN4098.
(b) FPL 2014-TN4058.
Source: Review team calculations.

To the extent that these areas want to maintain their current residents-to-firefighter ratios, an additional seven firefighters would be needed in Miami-Dade County and an additional three in the area of Homestead and Florida City.

The population increase in Miami-Dade County from building-related in-migration would be approximately two-tenths of 1 percent of the population. A two-tenths of 1 percent increase in the average daily census in Miami-Dade hospitals would be negligible if compared to the current occupancy rate of 77.5 percent (for those hospitals for which a census is available). In addition, the review team determined the two-tenths of 1 percent increase in the annual admissions and the annual outpatient visits would not be noticeable relative to the existing medical service capacity.

The review team concludes that the impacts of building the proposed Turkey Point Units 6 and 7 on police, fire services, and medical facilities would be minor and temporary.

4.4.4.5 Education

Based on a 1981 study of the migration of workers at nuclear power plant construction sites (Malhotra and Manninen 1981-TN1430), the review team assumed that each in-migrating worker with a family would have eight-tenths of one school-age child, so the in-migrating peak building workforce with families of 1,166 (1,400 × 0.833) people would bring approximately 933 (1,166 × 0.8) school-aged children. If all of these children attended public schools, the additional 933 students would represent three-tenths of 1 percent of the 2011-2012 enrollment in Miami-Dade County Public School District. Because three-tenths of 1 percent is considerably less than the 1 percent average annual variation in public school enrollment in Miami-Dade County in the past years and because Miami-Dade County public schools generally meet current mandated class sizes (see Section 2.5), the review team expects the education system in the county to be able to accommodate students that would accompany the construction workers.

As discussed in Section 4.4.2, the peak building-related workforce with families of 499 (1,400 × 0.833 × 0.428) people would bring approximately 399 (499 × 0.8) school-aged children into the Homestead and Florida City area. These students would represent an increase of 1.6 percent relative to the 23,923 students enrolled in either a traditional public school or a charter school in 2011-2012 in the Homestead and Florida City area. Although this is 60 percent more than the typical annual variation in school enrollment in Miami-Dade County, the increase in student enrollment due to building-related in-migrating families would be short term. The workforce would steadily increase over about 6 years, and only remain near the peak level for about three years, then rapidly decline as building activities cease. For this reason, and because Homestead and Florida City area public schools generally meet current mandated class sizes (see Section 2.5), the review team expects the education system in the Homestead and Florida City area to be able to accommodate students that would accompany the construction workers.

Approximately 15 percent of students in Miami-Dade County currently attend private schools (FPL 2014-TN4058). If the same share of in-migrating school-aged children were enrolled in private schools, this would further reduce the use of the expected public school capacity. Fifteen percent of in-migrating students would correspond to approximately 143 students, or two-tenths of 1 percent of the students enrolled in private pre-K through 12th grade schools in Miami-Dade County as of 2007-2008 (Section 2.5). The review team expects the private school system in the county to be able to accommodate this increase in demand.

Based on FPL's ER, the review team's independent assessment, and meetings with local officials, the review team determined that the building-related impacts on schools would be minor. However, if Miami-Dade School District decided to maintain the status quo with respect to student-teacher ratios and class size during the building phase of the proposed project, the new students moving into Homestead and Florida City would impose additional costs from hiring temporary teachers, expanding the fleet of trailers used for classrooms, and additional administrative costs. However, even with such new costs, the review team expects the overall impact of building-related impacts on education would remain minor.

4.4.4.6 Summary of Infrastructure and Community Service Impacts

Based on the information provided by FPL, interviews with local planners and officials, and the review team's independent review, the review team concludes that building-related impacts on the regional infrastructure and community services would be SMALL for the 50 mi region and the economic impact area, with the exception of impacts on traffic, which would be MODERATE for Homestead and Florida City, and SMALL elsewhere in the economic impact area and the 50 mi region.

4.4.5 Summary of Socioeconomic Impacts

The review team has assessed the activities related to building proposed Units 6 and 7 and their potential socioeconomic impacts in the vicinity and region. Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Based on information provided by FPL and the review team's independent evaluation, the review team concludes that the physical impacts of building activities would be SMALL for the 50 mi region and the economic impact area, with the exception of MODERATE and beneficial impacts on roads near the plant.

Social impacts span issues of demographics, economy, taxes, infrastructure, and community services. Based on the information provided by FPL and review team interviews with city and county planners, social service providers, and school district officials, the review team concludes that the overall impacts of building activities on the economy in the socioeconomic impact area would be SMALL for the 50 mi region and the economic impact area, with the exception of a MODERATE, adverse impact on traffic in the Homestead and Florida City area, based upon FPL's identified mitigation strategies. The review team determined there would be a LARGE, adverse impact on traffic if the identified mitigation strategies were not implemented.

4.5 Environmental Justice Impacts

The review team evaluated whether the health or welfare of environmental justice (EJ) populations of interest (as defined in Section 2.6.1) in the communities identified in Section 2.6 of this EIS could experience disproportionately high and adverse impacts from building Turkey Point Units 6 and 7 at the proposed site. The review team (1) identified all potentially significant pathways for human health and welfare effects, (2) determined the impact of each pathway for individuals, and (3) determined whether the characteristics of the pathway or special circumstances of the EJ populations of interest would result in a disproportionately high and adverse impact. To perform this assessment, in the context of building-related activities at the Turkey Point site, the review team studied populations of interest identified through census data and examined potential pathways that could lead to a disproportionately high and adverse impact on EJ populations of interest.

The review team determined that, for physical impacts, the high proportion of minority and low-income people living in the vicinity of the Turkey Point site creates a potential for a disproportionate impact. Furthermore, through phone and field consultations with local organizations and review of FPL's ER, the review team concluded that subsistence activities such as subsistence fishing are typically not conducted by any identified minority or low-income groups. However, the review team identified migrant agricultural workers as a mostly minority (Hispanic) and low-income group with potentially unique pathways for exposure to environmental effects. Migrant agricultural workers spend most of the day outdoors, making them potentially more exposed to air and noise pollution. EJ impacts are described in the following sections, including the impacts on health and environment (Section 4.5.1), socioeconomics (Section 4.5.2), subsistence and special conditions (Section 4.5.2), and high-density communities (Section 4.5.4). EJ impacts are summarized in Section 4.5.5.

4.5.1 Physical and Socioeconomics Impacts

4.5.1.1 Physical Impacts

Except for the final phases of building activities, when fuel is loaded into the reactor, construction of a nuclear power plant is very similar in its environmental effects to the construction of any other large-scale industrial project. The three primary physical pathways in the environment for impacts to occur are via soil, water, and air. The potential impacts on each of these pathways, along with noise are discussed below.

Soil-Related Impacts

Building activities for the proposed Units 6 and 7 would involve moving large quantities of soil. This would occur mainly at the proposed site, but also along the proposed transmission line and pipeline corridors. FPL would follow standard industry practice to minimize dust, erosion, and sedimentation. Methods would include limiting the time disturbed soil is exposed to weather, covering disturbed areas, and appropriate design of grading and drainage (FPL 2014-TN4058). Because standard industry practice would minimize dust, erosion, and sedimentation, the review team expects no soil-related high and adverse environmental and human health effects from building activities. No soil-related high and adverse environmental and human health effects would, therefore, disproportionately affect any EJ populations of interest.

Water-Related Impacts

As discussed in Section 4.2, the review team determined the impacts of building activities on surface-water use and quality and groundwater use and quality would be minor and not require mitigation beyond Florida regulations and BMPs. Because impacts on surface water and groundwater would be minor and because no special pathways for water-related impacts on EJ populations of interest were identified, the review team determined no disproportionately high and adverse impacts on any EJ populations of interest would exist.

Air-Quality Impacts

Section 4.7 discusses impacts of building activities on air quality and concludes that impacts would be minimal and not warrant mitigation beyond FPL's commitments. The review team identified migrant agricultural workers as being particularly vulnerable to air-quality impacts because of their outdoor presence. However, the closest agricultural areas to the site would be approximately 3 mi away, and most agricultural areas within the 50 mi region are more than 10 mi away, to the west of US-1. Because of the distance from the site and the minimal impacts on air quality, the review team determined no air-quality–related disproportionately high and adverse impacts on any EJ populations of interest would exist.

Noise Impacts

Noise levels from building activities may exceed 100 dB within the site, but would be lessened by distance and obstacles such as buildings, vegetation, and topography (Section 4.8). Noise from traffic along the access routes to the sites may intermittently exceed levels acceptable for residential areas. However, these impacts would be highly concentrated in the area immediately proximate to the site or the site-access roads where few individuals live. Sensitive noise receptors closest to the site are likely to experience intermittent, but temporary, noise pollution during building activities. The review team identified migrant agricultural workers as being particularly vulnerable to noise impacts because of their outdoor presence. However, as discussed above, their distance from the site and the fact that noise impacts are lessened by distance mean they would not be particularly affected by noise during building activities. The review team determined there would be no noise-related disproportionately high and adverse impacts on any EJ populations of interest.

4.5.1.2 Socioeconomics

Socioeconomic impacts are discussed in Section 4.4. The review team concluded that all socioeconomic impacts identified were small with the exception of moderate impacts on traffic near the plant. The review team did not identify any special pathways through which socioeconomic impacts would affect EJ populations of interest. Therefore, the review team concluded there would be no disproportionately high and adverse impacts on any EJ populations of interest.

4.5.2 Health Impacts

Section 4.9 assesses the potential radiological health impacts of building activities. Section 4.9 concludes that radiation exposure of construction workers during building of Units 6 and 7 would be within the NRC annual exposure limits and that impacts would be small and not warrant further mitigation. Section 4.8 evaluates potential nonradiological health impacts from building Turkey Point Units 6 and 7. The section discusses potential impacts on public and occupational health, the potential impacts from noise, and transportation of workers and construction materials. Section 4.8 concludes that, given the mitigation measures identified by FPL, and State and local permits and authorizations, the impacts would be minimal and not require further mitigation. The review team did not identify special pathways through which EJ populations of interest would be more exposed to these minimal impacts. Therefore, there would be no disproportionately high and adverse human health and environmental impacts on any EJ populations of interest.

4.5.3 Subsistence and Special Conditions

The NRC's EJ methodology includes an assessment of affected populations of particular interest or with unusual circumstances, such as minority communities that are exceptionally dependent on subsistence resources or identifiable in compact locations (e.g., American Indian settlements) and those that have a high density of minority or low-income groups.

4.5.3.1 Subsistence and Unique Pathways of Exposure to Environmental Effects

As discussed in Section 2.6.2, the review team concluded that subsistence activities such as subsistence fishing are typically not conducted by any identified minority or low-income group in the vicinity of the Turkey Point site. This conclusion was based on phone and field consultations with local organizations and review of FPL's ER. Therefore, the review concludes that there will be no disproportionately high and adverse impacts on any EJ populations of interest.

4.5.3.2 High-Density Communities

Based on the analysis in Section 2.6, most of the census block groups in the 50 mi radius around the proposed site are populations of interest under the NRC's identification criteria. Because of its proximity to the proposed site, the area surrounding the Homestead airbase, a low-income and African-American population is of particular interest. The review team does not believe any pathways exist to disproportionately affect this population. Another area of particular importance is the Miccosukee area on the corner of Krome Avenue and Tamiami Trail, which is bordered by FPL's potential location for the western transmission line corridor (Western Preferred corridor). Areas crossed by the eastern transmission line corridor in the proximity of Miami area are also often inhabited by low-income and African-American groups. Because there are no identified pathways through which health, physical, or socioeconomic impacts would disproportionately affect high-density communities, the review team concluded there would be no disproportionately high and adverse impacts on any EJ populations of interest in high-density communities.

4.5.4 Summary of Environmental Justice Impacts

The review team evaluated the extent to which potential environmental and socioeconomic impacts would disproportionately affect EJ populations of interest. After reviewing the evidence presented in the various sections of this chapter, and after considering any special pathways through which EJ populations of interest could be more affected than other population groups, the review team did not identify any high and adverse human health or environmental impacts and concluded that no disproportionately high and adverse impacts on any EJ populations of interest would exist.

4.6 Historic and Cultural Resources Impacts

The National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4321 et seq.) (TN661) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and culturally traditional places. The National Historic Preservation Act of 1966 (NHPA) (54 U.S.C. § 300101 et seq.) (TN4157) also requires Federal agencies to consider the impacts on those resources if they are eligible, or considered potentially eligible for listing in the National Register of Historic Places (NRHP or National Register (54 U.S.C. § 300101 et seq.) (TN4157) (such resources are referred to as "Historic Properties" in the NHPA). The USACE is the lead

Federal agency for compliance with Section 106 of the NHPA. The USACE's NHPA Section 106 consultation for this project has been completed with the exception of the transmission line consultation with the SHPO and the THPOs for STOF and the Miccosukee Tribe which is ongoing.

Construction and preconstruction of new nuclear power plants may affect either known or undiscovered cultural resources. In accordance with the USACE Regulatory Program's Procedures for Protection of Historic Properties at 33 CFR Part 325, Appendix C, the USACE is required to make a reasonable and good faith effort to identify historic properties in the Area of Potential Effect (APE) and, if such properties are present, determine whether significant impacts are likely to occur. Identification of historic properties by the USACE is to occur in consultation with the State Historic Preservation Office (SHPO), Federally recognized Native American tribes, and other interested parties. If significant adverse impacts on historic properties eligible for the NRHP are possible, efforts shall be made to mitigate them. If it is determined that potential eligible or eligible historic properties are present, the USACE is required to assess and resolve any adverse effects of the undertaking.

For a description of the historic and cultural resources at the Turkey Point site, see Section 2.7. In 2009, FPL conducted an archaeological and architectural resources survey of the direct- and indirect-effects APEs on the Units 6 and 7 project site (FPL 2011-TN95). FPL concluded that there are no NRHP-eligible archaeological sites, above-ground resources, or traditional cultural properties located within the direct-effects APE and the indirect-effects APE. As a result of cultural resources studies conducted for the Turkey Point Units 6 and 7 project area, FPL concluded that no known cultural resources exist within the direct or indirect APEs. The Florida SHPO concurred with FPL's informal determination of "no historic properties affected" (Appendix 2.5A in FPL 2014-TN4058). During the site visit in June 2010 (NRC 2010-TN1457), the NRC staff reviewed the documentation used by FPL to prepare the cultural resources section of the ER. The NRC staff did not identify any important onsite cultural resources that would be affected directly or indirectly by construction and preconstruction of proposed Turkey Point Units 6 and 7.

For transmission lines and other offsite facilities, FPL has completed desktop cultural resources investigations, including a search of the Florida Master Site file (Janus Research 2009) (FPL 2011-TN95). The archaeological sites and historic structures within the direct and indirect-effects APEs for the transmission line corridors are listed in Section 2.7. The desktop investigation concluded that no known resources were found in the APE for the non-transmission lines offsite facilities, including water pipelines from the MDWASD SDWWTP and various access roads and bridges. However, resources do occur within or near the corridors for the transmission lines, including at least one sacred area as identified by the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida. There is the potential for archaeological sites and sites that likely contain human remains to occur within or near the corridors as well.

In a work plan prepared for the offsite facilities (FPL 2009-TN1515), FPL has committed to conducting comprehensive archaeological and above-ground historical resource surveys of these offsite facilities prior to construction, as well as preparing an unanticipated finds discovery plan. FPL reiterated this commitment, as well as their commitment to Florida State Conditions of Certification regarding cultural and historic resources, in a letter to the USACE dated March

31, 2016 (FPL 2016-TN4581). These surveys would be conducted pursuant to Section 106 of the NHPA and in coordination with the USACE, Florida SHPO, and Federally recognized tribes. If avoidance of any resources determined eligible for the NRHP were not feasible, appropriate minimization or mitigation measures shall be developed in coordination with the USACE and SHPO. In addition, the USACE, the Florida SHPO (FPL 2014-TN4058, Appendix 2.5A), and the Miami-Dade County Office of Historic and Archaeological Resources (NRC 2010-TN1458) have required FPL to conduct surveys and other studies of offsite areas and, if practicable, avoid National Register-eligible sites or mitigate effects in an acceptable manner, as determined through consultation with these agencies. They also require FPL to develop an unanticipated finds plan outlining the procedures to be followed if significant archaeological materials or human remains are encountered during construction. FPL has also committed to developing procedures for informing construction managers and workers to stop work if cultural materials or human remains are inadvertently discovered during construction and to notify the SHPO and USACE, who in turn shall inform the Federally recognized tribes (FPL 2014-TN4058). The special conditions that the USACE typically uses for permitting actions dictate that all work and ground-disturbing activities shall halt within a 100 m radius of any unanticipated discovery of cultural materials or human remains. All work would be halted until the discovery is resolved, per the permit's Special Conditions. Any land-disturbing activity that affects a cultural resource would require a cultural resource assessment.

For the purposes of the review team's onsite NEPA analysis, based on the information provided by FPL, consultation with the Florida SHPO, and the review team's independent evaluation, the review team concludes that the impacts from the construction and preconstruction activities of Units 6 and 7 project site APEs would be SMALL. This finding was based on (1) no known historic properties within the Units 6 and 7 onsite APEs, (2) FPL's commitment to develop procedures to follow in the event that ground-disturbing activities discover historic or cultural resources, and (3) consultation with the Florida SHPO that concluded with a finding of no historic properties affected for the Turkey Point Units 6 and 7 onsite APE (FDHR 2010-TN1455; Appendix 2.5A in FPL 2014-TN4058) and ongoing consultation efforts for transmission lines and offsite locations.

For the purposes of the review team's offsite NEPA analysis, based on the information provided by FPL, the USACE's ongoing NHPA Section 106 review for the project, consultation with Native American tribes, and the review team's independent evaluation, the review team concludes that the impacts from the construction and preconstruction activities for the proposed transmission lines and other offsite activities would be MODERATE with the potential for greater impacts. This finding was based on (1) the large number of known NRHP-eligible or potentially eligible resources that are located in the offsite areas and (2) USACE's ongoing NHPA Section 106 consultation with the Florida SHPO and Federally recognized tribes. Archaeological resources within the offsite direct-effects APE could be affected directly as could above-ground resources such as buildings and historic districts within the indirect-effects APE for the transmission lines, and they could be subject to visual impacts. The review team concludes that impacts on historic resources may be difficult to avoid and mitigation would be required by the USACE if adverse effects on these resources or unanticipated discoveries cannot be avoided. These mitigation measures would be determined by the USACE in consultation with the Florida SHPO, the Miami-Dade County Office of Historic and Archaeological Resources, and Federally recognized tribes. FPL has committed to working with the USACE, Federally recognized tribes, and the Florida SHPO to conduct comprehensive Phase I surveys prior to construction activities (FPL 2014-TN4058).

According to 10 CFR 50.10(a)(2)(vii) (TN249), transmission lines are not included in the definition of construction and are not an NRC-authorized activity. Because of this, the NRC staff concludes that the potential impacts on historic and cultural resources from NRC-authorized construction activities would be SMALL.

4.7 Meteorological and Air-Quality Impacts

Sections 2.9.1 and 2.9.2 describe the meteorological characteristics and air quality of the Turkey Point site. The primary impacts of building two new units on local meteorology and air quality would be from dust from land clearing and filling of the site, grading and compacting, open burning, exhaust emissions from equipment and machinery (including the temporary emissions from two ultra-low sulfur-fired boilers used to clean steam piping and tubing), concrete batch plant operations, and exhaust emissions from vehicles used to transport workers and materials to and from the site.

Section 3.9 and Section 4.4.1 of the Turkey Point ER (FPL 2014-TN4058) describe the preconstruction and construction activities that would be conducted at the Turkey Point site that would affect air quality. Section 3.9.1 of the ER specifically addresses the amount of land clearing, fill, and earth movement activity. Section 4.4.1.2 of the ER summarizes the air emissions from site-preparation and construction activities and the air emissions from the exhaust of construction equipment used during site preparation and construction. Section 3.10 describes the transportation activity associated with the transportation of construction workers to and from the site. The SCA Section 5.5 (FPL 2010-TN272) presented air emissions from earth movement during site preparation, as well as exhaust emissions from earth movement for site preparation, land filling, and facility construction activities. Air-quality impacts directly associated with these activities are described below in Section 4.7.1; air-quality impacts associated with transportation of construction workers are addressed in Section 4.7.2.

4.7.1 Construction and Preconstruction Activities

Development activities at the Turkey Point site would result in temporary impacts on local air quality. Major activities include earthmoving, placement of land fill, concrete batch plant operation, facility construction, operation of temporary boilers, and emission of vehicular exhaust. Emissions from these activities would include particulate matter, carbon monoxide, oxides of nitrogen, sulfur dioxide, and volatile organic compounds.

As discussed in Section 2.9.2, Miami-Dade County is an attainment area for all criteria pollutants for which National Ambient Air Quality Standards have been established under 40 CFR 81.344 (TN255). As a result, a conformity analysis for direct and indirect emissions is not required (40 CFR 93.153) (TN2495).

Emissions from preconstruction activities would result in the generation of fugitive particulate matter emissions, as well as vehicle and equipment exhaust emissions. Fugitive particulate matter emissions would be primarily from the transport of muck and spoils and the delivery of fill material over paved and unpaved roads at the site. Other site-preparation activities, such as grading, placement of fill, and wind erosion from depositing spoils upon existing berms within the Turkey Point site, also would generate particulate matter emissions. Other important emissions would be derived from the combustion of petroleum fuels related to construction equipment used in site preparation and construction, and from the temporary boilers.

Table 4-15 summarizes the expected annual emissions during site preparation and construction (FPL 2010-TN272; EPA 2011-TN1088; FERA 2014-TN4002; Simard et al. 2006-TN4001; Rybicki et al. 2000-TN4003). Mobile sources used in construction and site preparation were assumed to be Tier 3 equipment. Site preparation is assumed to occur over a period of 18 months. The clearing of the site of vegetation and burning of the vegetation was assumed to take place within 1 year. The analysis does not include the disposal of vegetation offsite, or vegetation left to decompose within the cleared lands. Offsite disposal would be done in accordance with approved local and State waste-disposal procedures and regulations. FPL would prepare a Post-Certification Waste Management Plan prior to removal of vegetation.

Table 4-15. Anticipated Annual Average Atmospheric Emissions (T/yr) Associated with Site Preparation and Construction of Proposed Units 6 and 7

Type	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOCs
Fugitive dust onsite	83.55	10.35				
Fugitive dust offsite (FPL-owned)	11.77	1.78				
Burning of vegetation	2.54	2.21			12.54	1.12
Boiler, batch plant, construction equipment onsite	15.48	12.31	133.44	0.67	111.91	12.67
Construction equipment offsite (FPL-owned)	2.67	2.67	48.15	0.09	46.36	5.35
Total Construction Emissions	**116.01**	**29.32**	**181.59**	**0.76**	**170.81**	**19.14**

CO = carbon monoxide; $PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less; PM_{10} = particulate matter with an aerodynamic diameter of 2.5 microns or less; NO_x = nitrogen oxides; SO_2 = sulfur dioxide; T/yr = tons per year; VOCs = volatile organic compounds.

As required by FDEP Rule 62-296.320(4)(c)3, F.A.C. (Fla. Admin. Code 62-296-TN555), reasonable precautions need to be implemented to prevent fugitive particulate emissions. FPL stated that prior to beginning construction activities it would develop a dust-control plan that identifies specific measures to implement to minimize fugitive dust emissions. This plan would describe the management controls and measures that FPL intends to implement to minimize the impacts of fugitive dust emissions on air quality. Current policies and procedures at the Turkey Point site address the requirements of regulations and permits. These policies and procedures may need to be supplemented to address specific measures to mitigate the air-quality impacts of the construction of proposed Units 6 and 7.

The dust-control plan would also identify specific mitigation measures to control fugitive dust and other emissions. Section 4.4.1.2 of the ER (FPL 2014-TN4058) lists mitigation measures specifically related to dust control that could be used. These measures include the following:

- stabilizing construction roads and unsuitable soils piles
- limiting speed on unpaved roads
- watering unpaved roads

- performing housekeeping (e.g., removing dirt spilled onto paved roads)
- covering haul trucks when loaded or unloaded
- minimizing material handling (e.g., drop heights, double handling)
- ceasing grading and excavation during high winds and air-pollution episodes
- re-vegetating road medians and slopes.

Finally, the plan would include control strategies to minimize daily emissions by phasing the project and performing construction vehicle maintenance.

Construction and preconstruction activities, such as operation of on-road construction vehicles, commuter vehicles, non-road construction equipment, and marine engines would also result in greenhouse gas (GHG) emissions, principally carbon dioxide (CO_2). The GHG footprint for two new nuclear units at the Turkey Point site is estimated to be 78,000 MT CO_2 equivalent (CO_2e) (an emission rate of about 11,100 MT CO_2e annually, averaged over the preconstruction/ construction period of 7 years). This is about 0.004 percent of the 290 million MT CO_2e total GHG emissions for the State of Florida in 2007 (FDEP 2010-TN2997). This also equates to about 0.0002 percent of the total U.S. annual emission rate of 6.5 billion MT CO_2e (EPA 2014-TN4008). Appendix J of this EIS provides the details of the review team's estimate for a reference 1,000 MW(e) nuclear power plant.

Based on its assessment of the relatively small construction equipment GHG footprint compared to total Florida and U.S. annual GHG emissions, the review team concludes that the atmospheric impacts of GHG from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities (including GHG emissions) would vary based on the level and duration of a specific activity, but the overall impact would be expected to be temporary and limited in magnitude. Considering the information provided by FPL and its commitment to developing and implementing a dust-control plan that would reduce particulate emissions plus other pollutants, as well as strategies to minimize daily emissions by phasing the project and performing construction vehicle maintenance, the review team concludes that the impacts from construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures would be adopted.

4.7.2 Transportation

In its ER (FPL 2014-TN4058), FPL estimates the maximum workforce for proposed preconstruction activities of about 1,200 workers; while a maximum workforce of 3,950 workers, working an average of 40 hours per week, would be needed for the construction of proposed Units 6 and 7. The workforce would be divided into two shifts with 70 percent assigned to the day shift and 30 percent to a swing shift. Each construction worker would be assumed to use a single vehicle to commute to and from work. The associated transportation trips would add the following emissions to Miami-Dade County: an additional 0.86 T/yr of PM_{10} (particulate matter with an aerodynamic diameter of 2.5 microns or less), 0.78 T/yr of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 microns or less), 74.6 T/yr of NO_x (nitrogen oxides), 0.30 T/yr of SO_2 (sulfur dioxide), 689 T/yr of CO (carbon monoxide), and 70.9 T/yr of VOCs (volatile organic carbons).

The current primary access road to Turkey Point site is a two-lane undivided road that would likely experience a significant increase in traffic during shift changes that could lead to periods of congestion and decreased air quality. FPL intends to develop a second entrance to relieve this congestion. Although the second entrance would not be completed before construction is scheduled to begin, it would be available within a few months.

Workforce transportation would also result in GHG emissions, principally CO_2. Assuming a 7-year period for construction and preconstruction activities and a typical workforce, the review team estimates that the total workforce GHG emission footprint for building up to two nuclear power plants at the Turkey Point site to be on the order of 86,000 MT CO_2e (an emission rate of about 12,300 MT CO_2e annually, averaged over the period of construction/preconstruction). This is about 0.004 percent of the 290 million MT CO_2e total GHG emissions for the State of Florida in 2007 (FDEP 2010-TN2997). This also equates to about 0.0002 percent of the total U.S. annual emission rate of 6.5 billion MT CO_2e (EPA 2014-TN4008). Appendix J of this EIS provides the details of the review team's estimate for a reference 1,000 MW(e) nuclear power plant.

Based on the roadway improvement plan and the generally favorable meteorological conditions for dispersal of air pollutants, the review team concludes that the impact on local air quality from the increase in vehicular traffic related to construction and preconstruction activities would be temporary and would not be noticeable. Based on its assessment of the relatively small construction and preconstruction workforce GHG footprint compared to the Florida and U.S. annual CO_2 emissions, the review team concludes that the atmospheric impacts of GHG from workforce transportation would not be noticeable, and additional mitigation would not be warranted.

4.7.3 Summary of Meteorological and Air-Quality Impacts

The review team evaluated the potential impacts on air quality associated with criteria pollutants and GHG emissions during Turkey Point site-development activities. The review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of Turkey Point site development on air quality from emissions of criteria pollutants and GHGs would be SMALL, and that no further mitigation would be warranted. Because the NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air-quality impacts of NRC-authorized construction activities would also be SMALL; the NRC staff also concludes that no further mitigation, beyond FPL's commitments, would be warranted.

4.8 Nonradiological Health Impacts

Nonradiological health impacts on the public and workers from building the proposed Turkey Point Units 6 and 7 include exposure to dust and vehicle exhaust, occupational injuries, and noise, as well as the transport of materials and personnel to and from the site. The land around the Turkey Point site is almost exclusively undeveloped and characterized by wetlands and occasional wooded tracts (FPL 2014-TN4058). The closest incorporated communities are Florida City and Homestead. Florida City is 8 mi west of the site and the municipal limits of Homestead are 4.5 mi west of the site. The nearest residences are approximately 2.7 mi

(Biscayne National Park and Homestead Bayfront Park transient residences for staff and visitors) and 3.9 mi (permanent residence) from the proposed Units 6 and 7 plant area. Biscayne Bay is immediately adjacent to the Turkey Point site (Figures 2-1 and 2-2 in Section 2.1) and the proposed Units 6 and 7 plant area. The area to the south and southwest of the site consists primarily of marshland and glades and remains sparsely populated. Extrapolating from data in the ER (FPL 2014-TN4058) and the FSAR (FPL 2015-TN4502), in 2010 approximately 139,000 people lived within 10 mi of the site and approximately 50,000 others are estimated to have worked or visited within this radius (e.g., at Turkey Point, commercial locations, and recreational areas). People who are vulnerable to nonradiological health impacts from site-preparation and construction-related activities include construction workers and personnel working at Turkey Point; people working or living in the vicinity or adjacent to the site; and transient populations in the vicinity (i.e., temporary employees, recreational visitors, tourists).

4.8.1 Public and Occupational Health

This section discusses the impacts of building proposed Units 6 and 7 on the nonradiological health of the public and the impacts from site preparation and development on the nonradiological health of workers. Section 2.10 provides background information about the affected environment and nonradiological health at and within the vicinity of the Turkey Point site.

4.8.1.1 Public Health

The physical impacts on the public from development activities at the Turkey Point site could include noise, odors, exhausts, and thermal emissions. FPL states in its ER that these physical impacts would be temporary and managed in compliance with applicable Federal, State, and local environmental regulations and would not significantly affect the Turkey Point site and the vicinity (FPL 2014-TN4058). Fugitive dust and fine particulate matter emissions, including PM_{10}, would be generated during excavation, backfilling, grading and compacting, concrete batching, vehicular travel over paved and unpaved roads, and when using sources of fill material to raise the elevation of the Units 6 and 7 plant area.

Construction equipment and offsite vehicles used for hauling debris, soil, construction equipment, and supplies would also produce emissions. Wind erosion over exposed land area might also generate fugitive dust, smoke, and other fine particulate emissions. Open burning associated with site-preparation activities could be conducted as needed.

As discussed in Section 4.7, operational controls would be imposed, and will be fully described in the applicant’s dust-control plan, to minimize fugitive dust and vehicular emission; these controls would include paving disturbed areas, using water suppression, covering truck loads and debris stockpiles, minimizing material handling, limiting vehicle speed, inspecting emission-control equipment, and maintaining fuel-burning equipment in good mechanical order and in accordance with local, State, and Federal emission standards (FPL 2014-TN4058). Given these measures, it is anticipated that no discernible impact on the local air quality in the vicinity of the Turkey Point site would be realized. Furthermore, there would be no general public access to the proposed plant area and, as discussed in Section 2.10 and as seen in Figure 2-41, the nearest residence (the transient residences in Homestead Bayfront Park) is approximately 2.7 mi from the proposed units at the Turkey Point site. Given the fugitive dust-suppression and vehicle exhaust emission-control measures discussed above, the applicant's compliance with Federal, State, and local air emission regulations, and the general public's distance from the site, the review team expects that the nonradiological impacts on public health from site-preparation and construction air emissions would be negligible and that additional controls beyond the actions identified above would not be warranted.

4.8.1.2 Construction Worker Health

The U.S. Bureau of Labor Statistics (BLS) reports take into account occupational injuries and illnesses as total recordable cases, which includes those cases that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. As noted in Section 2.10, the total recordable cases rate published by the BLS for 2010 for heavy and civil engineering construction was 3.8 per 100 full-time workers in the United States overall and 3.4 per 100 full-time workers in Florida. These rates are substantially lower than rates from previous years and are a culmination of several years of decreasing rates.

FPL used 2008 rates to estimate the number of total recordable cases for the site preparation and construction of proposed Units 6 and 7 (FPL 2014-TN4058). The national and State total recordable case rates were multiplied by the number of workers. The annual average total recordable cases for the 120-month period encompassing site-preparation, LWA, and construction activities were estimated by FPL for both units as well as the peak annual (12 months) total recordable cases. The resulting estimates are an annual average of 86 (based on U.S. data) and 93 (based on Florida data) recordable cases and a peak 12-month amount (months 34 to 45) of 161 (U.S.) and 173 (Florida) recordable cases. Over the entire 120-month site-preparation and construction period, the total numbers of recordable cases are estimated to be 860 (U.S.) and 930 (Florida).

The ER did not provide estimates of fatal injuries during site preparation and construction. Using an approach similar to that used for non-fatal injuries and illnesses, and using the latest fatal injuries annual U.S. rate (for 2007) of 10.4 per 100,000 from Section 2.10, Table 2-60, the staff estimated annual average number of fatalities during site preparation and construction of proposed Units 6 and 7 is 0.2; the peak 12-month amount is 0.4. Over the entire 120-month site-preparation and construction period, the total number of fatal injuries is estimated to be 2.2.

When interpreting these results, it is especially important to note that they are gross (total) injury estimates. If the workers were not employed building proposed Units 6 and 7, they would be doing other work or would be unemployed. Furthermore, as noted in Section 2.10, the injury rate for employment in utility construction is low compared to most other construction activities. Thus, the estimates developed above are conservative worst-case estimates of the impact of Turkey Point site-preparation and construction activities on workplace injuries.

Also of note is that the occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA (29 CFR 1910) (TN654) safety standards, practices, and procedures. Appropriate State and local statutes also must be considered when assessing the occupational hazards and health risks associated with site preparation and construction. FPL is expected to fully adhere to NRC, OSHA, and State safety standards, practices, and procedures during any activities related to site preparation/excavation or building the proposed facility.

Other nonradiological impacts on workers who are clearing land or building the facility discussed in this section include noise, fugitive dust, and gaseous emissions resulting from site-preparation and development activities. Control measures discussed in this section for the public, such as operational controls and practices, would also help limit exposure to workers (FPL 2014-TN4058). Onsite impacts on workers also would be minimized through adherence to an industrial safety program instituted by FPL that meets all applicable Federal and State safety requirements, as well as training and use of personal protective equipment to minimize the risk of potentially harmful exposures (FPL 2014-TN4058). Emergency first-aid care and regular health and safety monitoring of personnel also could be undertaken.

4.8.1.3 Summary of Public and Construction Worker Health Impacts

Based on adherence to permits and authorizations required by State and local agencies, control measures identified by FPL in its ER, and the review team's independent evaluation, the review team concludes that the nonradiological health impacts on the public and on workers for site-preparation and construction activities would be minimal, and no further mitigation would be warranted.

4.8.2 Noise Impacts

Development of a nuclear power plant project is similar to development of other large industrial projects and involves many noise-generating activities. The impact of noise upon humans is difficult to determine because of the varying (subjective) responses of humans to the same or similar noise patterns. Regulations governing noise from activities are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 (TN654) and 40 CFR Part 204 (TN653). The regulations in 29 CFR Part 1910 address noise exposure in the construction environment and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors.

The noise impacts of proposed Units 6 and 7 site-preparation and construction activities were evaluated by FPL (2010-TN272). The evaluation considered construction equipment associated with daytime and nighttime site preparation and construction of permanent features, such as foundations, buildings, cooling towers, and other components of each unit. Limited or no weekend construction is anticipated. The noise sources used for the evaluation were typical of conservative noise levels from similar equipment. The highest levels of construction noise from the proposed Units 6 and 7 plant area would be generated by impact wrenches, cranes, backhoes, front-end loaders, trucks, bulldozers, and operation of the concrete batch plant. The analysis predicts that the highest onsite construction noise level would be between 70 and 90 dBA (measured at a distance of 50 ft), although levels as high as 102 dBA are possible intermittently from sources such as bulldozers and pile drivers.

As illustrated in Table 2-60 in Section 2.10.2, noise strongly lessens with distance. Thus, peak noise levels of 95 dBA at a distance of 50 ft from the source would decrease to approximately 77 dBA at 400 ft. For context, and as described in Section 2.10, the sound intensity of a quiet office is 50 dBA, normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA. In contrast, based on the Turkey Point noise study (FPL 2009-TN1246; FPL 2010-TN272), which used both background noise measurements and noise modeling, the closest residences, which are 2.7 mi away at Homestead Bayfront Park, would experience a maximum noise level during the site-preparation and construction phase for proposed Units 6 and 7 of about 64.4 dBA during the daytime and 54.2 dBA during the nighttime, which would be equal or close to the measured background noise levels of 64.4 dBA during the daytime and 54.1 dBA during the nighttime. The day-night average sound level (L_{dn}) (calculated using the approach described in Section 2.10.2, which adds 10 dBA to nighttime sound levels) for both situations is estimated at 64.3 dBA, indicating that site-preparation and construction would have no impact at this location. Similarly, the nearest residences at Homestead Bayfront Park (2.7 mi from the proposed units) would experience a maximum noise level during the site-preparation and construction phase of about 49.7 dBA during the daytime and 47.8 dBA during the nighttime, which would be close to the measured background noise levels of 49.4 dBA for the daytime and 47.2 dBA for the nighttime. The L_{dn} at this location during the site-preparation and construction phase for proposed Units 6 and 7 thus would be about 55.4 dBA, while the background L_{dn} would be about 54.9 dBA, which indicates that site-preparation and construction would have little or no impact at this location. The day-care facility (2 mi from the proposed units), would experience a maximum noise level during the site-preparation and construction phase of about 50.2 dBA during the daytime and 50.4 dBA during the nighttime, which would be close to the measured background noise levels of 44.1 dBA for the daytime and 47.9 dBA for the nighttime. The L_{dn} at this location during the site-preparation and construction phase thus would be about 58.4 dBA, while the background L_{dn} would be about 55.1 dBA, which indicates that site-preparation and construction would have minimal impact at this location. Furthermore, as described in Section 2.10.2, NUREG–1437 (NRC 2013-TN2654) notes that L_{dn} noise levels below 60 to 65 dBA, as at these locations, are considered to be of small significance.

More recently, the impacts of noise were considered in NUREG–0586, Supplement 1 (NRC 2002-TN665). The criterion for assessing the level of significance was not expressed in terms of sound levels, but was based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG–0586, Supplement 1 (NRC 2002-TN665) is stated as follows:

> The noise impacts...are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts...are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Based on the temporary nature of building activities and the location and characteristics of the Turkey Point site, including its large size and exclusion area, as well as the distance to the nearest residences, the noise impacts from building proposed Units 6 and 7 would be minimal, and further control measures, beyond limiting activities to daytime hours would not be warranted.

As described in Section 4.4.1 of the ER (FPL 2014-TN4058), other noise generated by building proposed Units 6 and 7 would be the noise levels resulting from building new transmission systems and substation expansions. The noise generated from building the transmission lines and expansion of substations would include right-of-way clearing, access road and pad construction (where necessary), line construction, and right-of-way restoration. The noise-generating machinery required for these phases of building would include bulldozers, shearing machinery, chain saws, trucks, cranes, and possibly helicopters. The transmission line construction and expansion within the West corridor would be primarily on wetlands or agricultural or undeveloped land; therefore, any noise from the construction would be lessened prior to reaching receptors in the urban areas. The transmission line construction and expansion within the East corridor would be primarily on urban land. The noise would be attenuated by distance from the source. The transmission line construction activities would be taking place in both agricultural areas, where few people would be affected by the additional noise, and urban settings, where people already experience noise from construction, traffic, etc. Also, this phase of construction would be accelerated, short-term, and performed during daytime hours. Therefore, noise generated by the construction of the transmission systems and substations would result in small impacts and would not warrant mitigation.

As also described in the ER (FPL 2014-TN4058), noise related to building proposed Units 6 and 7 would be generated by building roadway expansions and improvements and an increase in traffic by the construction workforce on access roadways and onsite roads. The roadway construction noise would be associated with jack hammers, bulldozers, road pavers, road scrapers, earth movers, and trucks. The road expansions and the new access road would be constructed on agricultural or undeveloped land; therefore, any noise from the construction would be lessened prior to reaching receptors in the urban areas. Other road improvements would be made along existing roadways. The noise generated by these road construction activities would be of short duration and during daytime hours. Noise from the increase in traffic caused by the construction workforce would occur on existing roadways as well as the road extensions once they are completed and on the Turkey Point site. Because of the short duration of construction activities in a single location and settings in urban areas or in agricultural or undeveloped areas with few receptors, and limiting road construction to daylight hours, the impacts from noise from road construction and traffic would be minimal and mitigation beyond limiting activities to daytime hours would not be warranted.

4.8.3 Impacts of Transporting Construction Materials and Personnel to the Turkey Point Site

This EIS assesses the impact of transporting workers and construction materials to and from the Turkey Point site from the perspective of three areas of impact: the socioeconomic impacts, the air-quality impacts of dust and particulate matter emitted by vehicle traffic, and potential health impacts due to additional traffic-related accidents. Human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 4.4, and air-quality impacts in Section 4.7.2. The impacts evaluated in this section for two new nuclear generating units at the Turkey Point site are appropriate for characterizing the alternative sites discussed in Section 9.3 of this EIS. Alternative sites evaluated in this EIS include the existing Turkey Point site (proposed) and alternative sites at Martin, Glades, Okeechobee 2, and St. Lucie. There is no meaningful differentiation among the proposed and the alternative sites regarding the nonradiological environmental impacts from transporting construction materials and personnel to the Turkey Point site and alternative sites, so these issues are not discussed further in Chapter 9.

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used for transportation of construction materials and construction personnel to and from the Turkey Point site. The assumptions made to provide reasonable estimates of the parameters needed to calculate nonradiological impacts are discussed below. In the ER (FPL 2014-TN4058), FPL estimated material quantities for building two new AP1000 reactors. The review team divided these values by two to obtain the per-unit material requirements and estimated the following: approximately 77,200 yd^3 of concrete; 16,400 T of structural steel and rebar; 810,000 linear ft of cable; 298,000 linear ft of piping, and 7,200,000 yd^3 of backfill material. For consistency with previous environmental reviews, the staff increased the quantity of cable to 6.5 million linear ft per unit. Additional information used to develop the nonradiological impact estimates is as follows:

- The review team assumed that shipment capacities are approximately 13 yd^3 of concrete, 11 T of structural steel, 3,300 linear ft of piping and cable, and 20 yd^3 of backfill per shipment. It was assumed that these materials would be transported to the site over an estimated 5-year delivery schedule for COL activities outlined in the ER (FPL 2014-TN4058).

  The peak monthly workforce during the building of the two units was used to calculate the nonradiological transportation impacts. The peak monthly workforce was obtained by dividing in half the peak monthly workforce for building two units. In its ER (FPL 2014-TN4058), FPL estimated that a maximum of 3,950 workers would travel to and from the site on a daily basis during the peak building period for two units. The review team assumed that one-half of the workers, or 1,975 persons, would be assigned to each unit. Assuming conservatively that the average vehicle occupancy is 1 person per vehicle, there would be about 1,975 vehicles per day per unit. Each person was assumed by the review team to travel to and from the Turkey Point site 250 days per year.

- The review team assumed the average shipping distance for construction materials to be 50 mi one way based on the region of influence. The review team assumed the backfill material would be transported approximately 15 mi one way to bound the nonradiological impacts of traffic accidents (note there is an existing structural fill source less than 5 mi (8 km) from the proposed site).

- The review team assumed the average commuting distance for construction workers to be 20 mi one way. This assumption is based on U.S. Department of Transportation (DOT) data, which estimated the typical commute to be approximately 16 mi one way (DOT 2003-TN297).

- Accident, injury, and fatality rates for transporting building materials were taken from Table 4 in the *State-level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999-TN81). Rates for the State of Florida were used for construction material shipments, which are typically conducted in heavy-combination trucks. The data provided by Saricks and Tompkins (1999-TN81) are representative of heavy-truck accident rates and do not specifically address the impacts associated with commuter traffic (i.e., workers traveling to and from the site). However, a single source that provided all three rates to estimate the impacts from worker transportation to and from the site was not available. To develop representative commuter traffic impacts, a source was located that provided a Florida-specific fatality rate for all traffic for the years 2004 through 2008 (DOT 2008-TN411). The average fatality rate for the 2004 through 2008 period in Florida was used as the basis for estimating Florida-specific injury and accident rates and adjustment factors were developed using national-level traffic accident statistics from *National Transportation Statistics 2010* (DOT 2010-TN408). The adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the Florida-specific fatality rate to approximate the injury and accident rates for commuters in the State of Florida.

- The DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999-TN81) 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 from Saricks and Tompkins (1999-TN81) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (Blower and Matteson 2003-TN410). The University of Michigan Transportation Research Institute data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999-TN81), 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 apparent under-reporting. These adjustments were applied to the construction materials, which are transported by heavy-truck shipments similar to those evaluated by Saricks and Tompkins (1999-TN81) but not to commuter traffic accidents.

The estimated nonradiological impacts of transporting construction and backfill materials to the proposed Turkey Point site and of transporting construction workers to and from the site are listed in Table 4-16. The estimates would be doubled for the building of two units at the Turkey Point site. Based on Table 4-16, the nonradiological impacts are dominated by the transport of construction workers and backfill materials to and from the Turkey Point site. The estimated total annual transportation-related fatalities related to building the facility represent about a 0.2 percent increase above the average 316 traffic fatalities per year that occurred in Miami-Dade County, Florida, from 2004 to 2008 (DOT 2008-TN412). Increases for alternative sites were about 1.9 percent for the Martin site in Martin County (DOT 2008-TN413), 8.1 percent for the Glades site in Glades County (DOT 2008-TN414), 4.7 percent for the Okeechobee 2 site in Okeechobee County (DOT 2008-TN415), and 1.4 percent for the St. Lucie site in St. Lucie County (DOT 2008-TN416). These increases are small relative to the current traffic fatality risks in the areas surrounding the proposed Turkey Point site and alternative sites.

Based on the information provided by FPL, the review team's independent evaluation, and consideration of the number of shipments of building materials and the number of workers that would be transported to the site, the review team concludes that the nonradiological health impacts from transporting building materials and personnel to the proposed FPL site and alternative sites would be small, and no mitigation would be warranted.

Table 4-16. Estimated Impacts of Transporting Workers and Materials to and from the Turkey Point Site for a Single Unit

	Accidents per Year Per Unit	Injuries per Year Per Unit	Fatalities per Year Per Unit
Workers	**$4.6 \times 10^{+1}$**	**$2.1 \times 10^{+1}$**	**3.2×10^{-1}**
Materials			
Concrete	2.8×10^{-2}	1.6×10^{-2}	3.2×10^{-3}
Rebar, Structural Steel	6.9×10^{-3}	4.1×10^{-3}	8.0×10^{-4}
Cable	9.3×10^{-3}	5.4×10^{-3}	1.1×10^{-3}
Piping	4.2×10^{-4}	2.5×10^{-4}	4.9×10^{-5}
Backfill	2.5×10^{0}	1.5×10^{0}	2.9×10^{-1}
Total – Construction	**$4.9 \times 10^{+1}$**	**$2.2 \times 10^{+1}$**	**6.1×10^{-1}**

4.8.4 Summary of Nonradiological Health Impacts

As part of its evaluation of nonradiological health impacts, the review team considered the mitigation measures identified by FPL in its ER (FPL 2014-TN4058) and relevant permits and authorizations required by State and local agencies for building proposed Units 6 and 7. The review team evaluated nonradiological impacts on public health and on construction workers from fugitive dust, occupational injuries, noise, and transport of materials and personnel to and from the proposed Turkey Point Units 6 and 7 plant area. No significant impacts related to the nonradiological health of the public or workers were identified during the course of the review. Based on information provided by FPL and the review team's independent evaluation, the review team concludes that the nonradiological health impacts of site-preparation and construction activities associated with the proposed Units 6 and 7 would be SMALL, and no further mitigation would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff also concludes that the nonradiological health impacts of NRC-authorized construction activities would be SMALL and that control measure, beyond those described above would be warranted.

4.9 Radiation Exposure to Construction Workers

The sources of radiation exposure for construction workers include direct radiation exposure, exposure from liquid radiological waste discharges, and exposure from gaseous radiological effluents from existing Turkey Point Units 3 and 4 during the construction phase. In addition, during the construction of proposed Unit 7, workers would be exposed to radiation from proposed Unit 6. For the purposes of this discussion, construction workers are assumed to be members of the public; therefore, the dose estimates for the construction workers are compared to the dose limits for the public, pursuant to 10 CFR Part 20, Subpart D (TN283). FPL noted that all major building activities are expected to occur outside of the Turkey Point Units 3 and 4 exclusion area boundary, but inside the Turkey Point site boundary (FPL 2014-TN4058).

4.9.1 Direct Radiation Exposures

In its ER (FPL 2014-TN4058), FPL identified two sources of direct radiation exposure from the Turkey Point site: (1) Turkey Point Units 3 and 4 equipment associated with spent fuel and radwaste storage and handling; and (2) the independent spent fuel storage installation. In addition, FPL identified Unit 6 as a source of direct radiation exposure to Unit 7 construction workers. The NRC staff did not identify any additional sources of direct radiation during the June 2010 site visit or during document reviews.

FPL uses fence-line thermoluminescent dosimeters (TLDs) and environmental TLDs around the Turkey Point site. Although FPL's TLD measurements do not show any measurable increase in direct doses from Units 3 and 4 compared to the preoperational surveillance program, FPL conservatively assumed a direct radiation dose rate of 1 mrem/yr from each unit. FPL applied an occupancy time of 2,080 hr/yr resulting in a direct radiation dose from Units 3 and 4 of 0.47 mrem (FPL 2014-TN4058). In addition, for a fully loaded independent spent fuel storage installation (ISFSI), FPL calculated an annual dose to the construction worker of 0.013 mrem (FPL 2014-TN4058). Compared to the assumed dose contribution of 1 mrem per year from each of the existing units, the calculated dose rate of 0.013 mrem/yr from a fully loaded ISFSI is negligible.

According to Section 12.4.2.1 of the AP1000 Design Control Document (Westinghouse 2011-TN261), refueling water would be stored inside the containment instead of in an outside storage tank, as at other facilities, so it would not contribute significantly to external radiation levels at the proposed Turkey Point Unit 6 fence line. FPL stated that direct radiation exposure to construction workers beyond the proposed Turkey Point Unit 6 fence line from the containment building and other facility buildings would be negligible (FPL 2014-TN4058).

In addition, at certain times during construction, FPL would receive, possess, and use specific radioactive byproduct, source, and special nuclear materials in support of construction and preparations for operation. These sources of low-level radiation are required to be controlled by FPL's radiation protection program and have very specific uses under controlled conditions. Therefore, these sources are expected to result in a negligible contribution to construction worker doses.

4.9.2 Radiation Exposures from Gaseous Effluents

As presented in the ER (Section 4.5.3), FPL estimated the doses to construction workers at proposed Turkey Point Unit 7 from Turkey Point Unit 6 operation using expected annual airborne effluent releases (FPL 2014-TN4058). For the proposed Unit 6, the gaseous releases would come from the nuclear power station vent or the turbine building vent. The nuclear power station vent contains the following discharges: containment venting releases, auxiliary building ventilation releases, annex building releases, radwaste building releases, and the gaseous radioactive system releases. The turbine building vent contains the following discharges: condenser air removal system releases, gland seal condenser exhaust releases, and turbine building ventilation releases. For gaseous releases from Turkey Point Units 3 and 4, FPL determined the bounding releases based on the annual effluent reports from 2004 to 2008 (FPL 2014-TN4058). Using GASPAR II (Strenge et al. 1987-TN83), FPL estimated a total body dose from Unit 6 of approximately 5.2 mrem/yr based on a worker occupancy assumed to be 2,080 hours annually (FPL 2014-TN4058). The NRC staff performed confirmatory dose calculations using information contained in the FPL ER and 2 years of meteorological data as discussed in Appendix G.

4.9.3 Radiation Exposures from Liquid Effluents

In ER Section 4.5.2 (FPL 2014-TN4058), FPL discussed the radiation exposure from liquid effluents. FPL states that potable water for proposed Units 6 and 7 would be supplied from the MDWASD. Thus, a drinking water exposure pathway is not possible for the construction workers. Units 3 and 4 liquid effluents are released into the cooling-canal system (CCS), which is a possible exposure source for workers coming in contact with the CCS water or adjacent soils. FPL states that these pathways would be managed to ensure that doses are negligible (FPL 2014-TN4058).

As stated in Section 3.4.3, liquid effluents from proposed Units 6 and 7 would be discharged via deep-well injection. Therefore, during the construction of Unit 7, there would no Unit 6 liquid pathway dose due to normal plant operations.

4.9.4 Total Dose to Construction Workers

The maximum peak construction workforce for proposed Unit 7 during any month while proposed Unit 6 is operational would be no more than 2,800 people, assuming a site occupancy per construction worker of 2,080 hours annually. In addition, while this peak is assumed to last less than a year, for conservatism, FPL assumed that this peak workforce would be maintained over the course of an entire year (FPL 2014-TN4058). FPL estimated the annual dose to construction workers would be approximately 6.0 mrem based on the FPL workforce occupancy. This estimated total dose to construction workers is less than the 100-mrem annual dose limit to an individual member of the public found in 10 CFR 20.1301 (TN283).

The maximum estimated annual collective dose to construction workers, based on an annual individual worker dose of approximately 6.0 mrem and an estimated workforce of 2,800 workers, is approximately 17 person-rem (FPL 2014-TN4058; FPL 2015-TN4502). The maximum annual dose to a construction worker of 6.0 mrem/yr is much smaller than the approximately 311 mrem/yr that residents of the United States receive on average from background radiation (NCRP 2009-TN420).

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimate of doses to construction workers during the building of the proposed Units 6 and 7 is well within the NRC annual exposure limits (i.e., 100 mrem) designed to protect public health. Based on information provided by FPL and the NRC staff's independent evaluation, the NRC staff concludes that the radiological health impacts on construction workers engaged in building activities related to proposed Units 6 and 7 would be SMALL, and no further mitigation would be warranted. The NRC regulates radiation exposure from all NRC-licensed activities. Therefore, NRC staff concludes the radiological health impacts for NRC-authorized construction of proposed Turkey Point Units 6 and 7 would be SMALL, and no further mitigation would be warranted.

4.10 Nonradioactive Waste Impacts

This section describes the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste during building activities related to proposed

Turkey Point Units 6 and 7. The types of nonradioactive waste that would be generated, handled, and disposed of during building activities include cleared vegetation, building material debris, municipal waste, spoils, stormwater runoff, sanitary waste, dust, and other air emissions. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

4.10.1 Impacts on Land

Land disturbance would occur on about 600 ac of the Turkey Point site, exclusive of areas that have been previously disturbed. This includes the areas for proposed Units 6 and 7, laydown, parking, the nuclear administration and training buildings, the heavy-haul road, equipment barge-unloading area, spoils areas, RCWs and pipelines, and the FPL RWTF and pipelines (FPL 2014-TN4058). Most of the proposed Units 6 and 7 plant area requiring clearing and grubbing consists of sparsely vegetated mudflats along with smaller areas of open water, mangrove swamps, uplands, wetlands, fill areas, and roadways. Most of the land disturbance would occur during preconstruction activities.

Offsite lands that would be disturbed include about 128 ac for improved roads and about 7,000 ac for the corridors for the reclaimed wastewater and potable water pipelines, transmission line corridors, upgraded substation areas, and associated access roads (FPL 2014-TN4058). Within the transmission line corridors, trees would be replaced with low-growth vegetation (FPL 2014-TN4058).

Three spoils areas for the disposal of unsuitable[8] soils, muck, and other materials would be created along the two sides of the main return canal and at the southern end of the IWF. The three spoils areas would cover a total of approximately 200 ac and would have a capacity of approximately 2 million cubic yards when filled to the design elevation of 16 to 20 ft NAVD88 (FPL 2014-TN4058).

During site preparation, cleared vegetation would be burned (see Section 4.10.3), disposed of offsite, or left to decompose within the cleared lands. Offsite disposal would be in accordance with approved local and State waste-disposal procedures and regulations (FPL 2014-TN4058). Some vegetation could be mowed, cut, or chipped, and then spread to decompose in place. Some vegetation may be removed with unsuitable soils and muck and be placed in one of the spoil areas where it would decompose in place.

Dredging in the equipment barge-unloading area would generate dredge spoil, which would be spread on the IWF berms (FPL 2014-TN4058). No dredge spoil would be disposed in the marine environment.

Most of the plant equipment would be produced offsite and delivered in modular units, thereby reducing the generation of onsite waste (FPL 2014-TN4058). Building activities would generate small quantities of waste, such as scrap wood, wallboard, plastics, paper, and metal, which would be salvaged, recycled, or disposed of in a local landfill appropriate for handling building debris. Municipal trash generated by the workforce during building activities may include food waste, glass, metals, cloth, plastics, and paper. Trash would be collected in appropriate waste containers and disposed of in an approved offsite location. Building waste and trash would be

(8) "Unsuitable" is defined as not meeting FPL's requirements for onsite reuse as fill or topsoil.

handled, transported, and disposed of in accordance with all applicable Federal, State, and local regulations (FPL 2010-TN272).

The slurry trenches for the proposed diaphragm walls for the two nuclear islands would be excavated in vertical panels, as opposed to continuous trenching, thereby minimizing slurry requirements and allowing greater slurry reuse. Excess slurry from the building of the diaphragm walls would be dewatered and disposed of in the onsite spoils storage areas (FPL 2014-TN4058).

Waste asphalt from building roads or pipelines would be disposed of in accordance with all applicable Federal, State, and local requirements (FPL 2010-TN272).

Engineering projections of the soil cut-and-fill balance indicate that the proposed project would require more than 13 million cubic yards of additional clean fill to reach design grades in the plant area and along transmission line corridors and access roads (FPL 2014-TN4058). Therefore, no clean[(9)] excavation spoils are expected to require disposition offsite. Little or no organic soil is expected to require disposition offsite.

Based on the proposed practices for minimizing solid waste generation and the plans to manage solid wastes in compliance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts on land from nonradioactive solid wastes generated during the building of proposed Turkey Point Units 6 and 7 would be minimal, and no further mitigation would be warranted.

4.10.2 Impacts on Water

Building activities would generate liquid wastes from the sanitary wastewater-treatment system and from stormwater runoff.

During building activities, sanitation needs would be met by using portable sanitary waste facilities until completion of the packaged permanent wastewater-treatment facility, and as needed thereafter during peak construction periods (FPL 2014-TN4058). The temporary facilities could include centralized restroom and hand-washing trailers, as well as individual portable toilets. The provision of portable restrooms for building sites is governed by Fla. Admin. Code 64E-6.0101 (TN642). A licensed sanitary waste-disposal contractor would periodically remove, transport, and dispose of the sanitation waste (FPL 2014-TN4058).

FPL could use one of the UIC wells for sanitary wastewater disposal in accordance with the UIC permit (FPL 2014-TN4058).

FPL would use the Generic Permit for Stormwater Discharge from Large and Small Construction Activities administered by the FDEP for stormwater discharges during building activities. The application process for coverage under for the generic permit requires that FPL prepare a SWPPP and submit a Notice of Intent to the FDEP NPDES Stormwater Notices Center (FPL 2014-TN4058). Section 4.2.3.1 discusses the management of stormwater and the SWPPP.

(9) “Clean” spoils are defined as suitable for onsite reuse as fill or topsoil.

Runoff and erosion from the three spoils storage areas would be controlled by grading to limit surface flow into the IWF. Sediment-control materials could be used to further reduce the physical and ecological impacts of drainage from the spoils areas (FPL 2014-TN4058).

Based on the proposed practices for managing liquid wastes in compliance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts on water from nonradioactive liquid wastes generated during buildings activities would be minimal, and no further mitigation would be warranted.

4.10.3 Impacts on Air

Building activities would cause impacts on air quality via the generation of dust, the burning of cleared vegetation, and combustion of fuel in vehicles and equipment. Air-quality impacts from building activities are discussed in detail in Section 4.7.1.

Building activities at the Turkey Point site would generate dust from earthmoving activities and from the travel of vehicles and equipment on unpaved roads. Once cleared, exposed land areas may also generate fugitive dust as a result of wind erosion (FPL 2014-TN4058).

Open burning of vegetation from land clearing would generate additional particulate emissions. Burning would take place in accordance with Miami-Dade County Fire Rescue Department, Fire Prevention Division requirements if a permit was issued (Miami-Dade County 2012-TN1039). After permit issuance, burning would be contingent upon daily approval by the Miami-Dade County Fire Communication Office.

The large mass of concrete required for the building foundations and other structures would require the installation and operation of a temporary concrete batch plant. Activities at the batch plant associated with the movement of aggregates and cement would generate dust. Mitigation measures, such as the use of dust-suppression water sprays on aggregate stockpiles, would minimize this dust generation. Because the concrete batch plant would be located far from the site boundaries, no discernible impacts are expected at offsite locations (FPL 2014-TN4058).

The operation of diesel-powered heavy equipment would generate additional particulate emissions, primarily PM_{10} and smaller, as well as the gaseous combustion byproducts SO_2, NO_x, and CO. FPL has estimated the emissions from diesel engines and construction equipment of CO, NO_x, VOC, PM_{10}, and SO_2 to average 63.7, 65.9, 8.3, 3.7, and 0.14 T/yr, respectively (FPL 2014-TN4058). These emissions are expected to be consistent with emissions from other building projects of this size, and there should be no significant impacts on air quality at offsite locations during the building period. Traffic caused by workers commuting to and from the Turkey Point site would also produce vehicle emissions.

Along the transmission line corridors, vegetation with a mature height exceeding 14 ft would be cleared. Upland areas without heavy vegetation would be mowed, leaving the low ground cover largely intact. FPL may perform any open burning within the transmission line corridors (FPL 2010-TN272).

In general, emissions from building activities (including GHG emissions) would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. During building, FPL would implement emission controls, mitigation measures, and air-quality monitoring. The review team expects that impacts on air from nonradioactive airborne wastes generated during building activities would be minimal, and no further mitigation would be warranted.

4.10.4 Summary of Nonradioactive Waste Impacts

Solid, liquid, and gaseous wastes generated when building proposed Turkey Point Units 6 and 7 would be handled according to County, State, and Federal regulations. Solid waste would be recycled, disposed of in existing, permitted landfills, or, in the case of vegetative waste only, chipped and spread onsite or burned in accordance with applicable regulations.

Sanitary wastes would be removed to an existing licensed sanitary waste-treatment facility or discharged into a UIC well after being treated by the onsite sanitary waste-treatment plant to the levels stipulated in the NPDES permit. A SWPPP would specify the mitigation measures to be put in place to manage stormwater runoff.

To avoid any noticeable, offsite air-quality impacts, BMPs to control dust and minimize vehicle emissions would be expected.

Based on information provided by FPL and the review team's independent evaluation, the review team concludes that nonradioactive waste impacts on land, water, and air would be SMALL, and additional mitigation would not be warranted. Because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradioactive waste impacts of NRC-authorized construction activities also would be SMALL, and no further mitigation would be warranted.

4.11 Measures and Controls to Limit Adverse Impacts During Construction Activities

In its evaluation of environmental impacts during building activities for the proposed Turkey Point Units 6 and 7, the review team relied on FPL's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts
- compliance with applicable requirements of Federal and State permits or licenses required for building the new units (e.g., USACE Section 404 permit and the NPDES permit)
- identification of environmental resources and potential impacts during the development of the ER and the COL process
- incorporation of environmental protection requirements into construction contracts.

Table 4-17, which is the review team's adaptation from FPL's Table 4.6-1 (FPL 2014-TN4058), summarizes the measures and controls proposed by FPL to limit adverse impacts during the building of proposed Units 6 and 7 at the Turkey Point site.

Table 4-17. Summary of Measures and Controls Proposed by FPL to Limit Adverse Impacts During Construction and Preconstruction of Proposed Units 6 and 7

Impact Category	Specific Measures and Controls
Land-Use Impacts	
Site and Vicinity	According to FPL (ER Section 4.1.1.2) (FPL 2014-TN4058), site-preparation and site-development activities for proposed Units 6 and 7 would be conducted in accordance with applicable Federal, State, and local regulations and would be consistent with applicable zoning and land-use plans. FPL would acquire the necessary permits and authorizations (see Appendix H) and would implement environmental controls such as stormwater-management systems, fugitive dust control, and spill-containment controls before initiating earth disturbance. FPL stated (ER Section 4.1.1.2) (FPL 2014-TN4058) that it would use standard dust-control measures, and stabilize, contour, and revegetate permanently disturbed lands.
Transmission Line Corridors and Offsite Areas	FPL would be required to comply with applicable laws, regulations, and permit requirements. Standard industry construction practices that FPL proposes to use include erosion-control devices, matting to reduce compaction caused by equipment, use of wide-track vehicles when crossing wetlands, and restoration activities after the transmission lines are built. FPL has indicated that it will use existing rights-of-way to the extent practicable (FPL 2014-TN4058) and that it routinely uses standard industry construction practices, environmental Best Management Practices (BMPs), and mitigation measures to ensure adverse environmental effects of construction are avoided, minimized, or mitigated (FPL 2014-TN4058). FPL also stated that it will use restrictive land-clearing processes in forested wetland areas (right-of-way clearing and preparation), turbidity screens and erosion-control devices in areas of wetlands and water resources (access road/structure pad construction), existing access roads for ingress and egress to rights-of-way where available (access road/structure pad construction), and standard industry construction practices for foundation and structure excavation and construction (line construction).
Water-Related Impacts	
Hydrologic Alterations	Grouting at the base of the approximately 35 ft deep plant excavations and use of bentonite slurry walls would limit extraction of groundwater from the Biscayne aquifer and hydraulically isolate the plant excavations from Biscayne Bay and Biscayne National Park.
Water-Use Impacts	Areas affected by construction dewatering activities would be isolated with sheet piling technology or the equivalent if needed to control extraction of groundwater. The presence of the industrial wastewater facility and the berm to the east of the return canal would restrict surface-water flows and limit impacts on down-stream bodies of surface water or resources including wetlands and Biscayne Bay.
Water-Quality Impacts	Building activities related to the transmission lines and pipelines would comply with Federal and State regulations. Environmental BMPs would be applied, including use of existing rights-of-way to the extent practicable, erosion-control devices, matting to reduce compaction and post-construction restoration activities. Work would be performed under existing permits/plans and a stormwater pollution prevention plan (SWPPP) developed for the building activities.

Table 4-17. (contd)

Impact Category	Specific Measures and Controls
	Berms would be installed to direct onsite runoff to the industrial wastewater facility. Offsite: A perimeter berm could be used to restrict the flow of surface water onto the property. The berm could also be used in association with detention basins and a truck-wash facility to reduce surface-water runoff from the site and prevent soils from being unintentionally spread to offsite areas. Drainage ditches could be used to direct surface-water flow away from the site and could be reconnected to any drainage features that once flowed through the property to maintain surface flow. Cutoff walls (sheet piles) would be installed to isolate the equipment barge-unloading area from the turning basin. This work would be performed under permit requirements issued by the U.S. Army Corp of Engineers. Activities related to installation of deep-injection wells and injection monitoring wells is regulated by FDEP's Underground Injection Control Program and local permits. These regulations specify approved construction techniques and testing and monitoring requirements to ensure that groundwater quality is not adversely affected by construction of the wells. Any surface-water runoff related to construction of the deep-injection wells, monitoring wells, and associated equipment would be directed to the cooling canals of the industrial wastewater facility. Existing roads would be used to the extent practicable. Ditches and the use of culverts would allow stormwater drainage to be maintained along the road route. During onsite construction, stormwater runoff would be directed to retention basins before being discharged to the industrial wastewater facility. If modification to the existing draining ditches or drainage features is required, the impacts would be temporary and the disturbed areas would be returned to preconstruction conditions. All work would be performed in accordance with site-obtained permits. During offsite construction, surface water would be routed to areas that could accept the additional surface flow that would then alter the flow in the vicinity of the road. Cutoff wall technology including the use of a slurry wall could be used to limit potential impacts during construction dewatering activities. The water from dewatering activities would be directed into the cooling canals of the industrial wastewater facility. The construction activities would be performed in accordance with the required local, State, and Federal guidelines and accepted industry practices. The necessary permits would be obtained before beginning construction activities. The delivery pipeline routes would be recontoured afterward. Excavated material would be stockpiled in designated spoils areas. Sedimentation barriers would be installed to limit potential impacts on surface-water bodies. Sedimentation basins would also be used to minimize the potential for surface-water runoff impacts on nearby water bodies in accordance with FDEP regulations. Once construction activities are complete, the drainage would be restored to preconstruction conditions.

Table 4-17. (contd)

Impact Category	Specific Measures and Controls
	Sheet piles could be used to limit potential impacts during construction dewatering activities. Water from dewatering activities would be directed to the industrial wastewater facility. The necessary construction activities would be performed under a new SWPPP or under a modification of an existing Turkey Point SWPPP and associated spill-prevention plan that could include oil and fuel containment. Any minor spills of diesel fuel, hydraulic fluid, lubricants, or other construction-related pollutants during construction of the project would be cleaned up quickly to prevent them from moving into the groundwater or flowing to nearby surface water.
Ecological Impacts	
Terrestrial Ecosystems	Impacts on wetlands, including but not limited to mangrove forests, would be minimized by installation of culverts under existing road beds and the use of silt fences. Unavoidable wetland impacts would be mitigated through a series of wetland restoration projects on FPL-owned land and purchase of credits in two nearby wetland mitigation banks, the Everglades Mitigation Bank and Hole-in-the-Donut Mitigation Bank. Measures to reduce noise and vibration levels during construction may include staggering work activities and use of noise dampeners and noise-control equipment on vehicles and equipment. To the extent practicable, unnecessary lights would be turned off at night, lights would be turned downward or hooded directing light downward, and lower-powered lights would be used during construction to minimize impacts on wildlife. Impacts on wetlands within the wood stork core foraging area would mitigated as prescribed by regulatory agencies. To mitigate the potential for collisions or electrocutions, avian-friendly design standards would be used as provided for in the avian protection plan. Measures to reduce impacts on the eastern indigo snake include educating site personnel about snake identification and FWS requirements for reporting eastern indigo snake occurrences in the project area. Measures to reduce the impact on Florida panthers include speed limits and road restoration.
Aquatic Ecosystems	A project-specific management plan for crocodiles and other listed species has been created for this building activity. Mitigation measures may include warning signs and education material (for construction personnel) about the presence and status of crocodiles and restrictions of nocturnal activities. Traffic access at the north end of the cooling canals of the industrial wastewater facility may pose a threat to crocodiles crossing this road that would be mitigated by installation of a wildlife corridor to provide pathways for crocodiles to travel between wetlands on either side of this road. Construction of transmission facilities within the cooling canals of the industrial wastewater facility may avoid known crocodile nests and be conducted between nesting seasons. During in-water and nearshore construction activities, a Barge Delivery Plan would be followed to reduce risk of collision or injury of manatees from tug and barge operations or dredging (FPL 2010-TN272). In addition, FPL may follow the guidance provided by the NMFS (2006-TN3077) to protect sea turtles and Smalltooth Sawfish during nearshore construction activities. Spill-prevention techniques would include locating storage areas for petroleum

Table 4-17. (contd)

Impact Category	Specific Measures and Controls
	products at a safe distance from surface waters. Any spills of diesel fuel, hydraulic fluid, or lubricants during building would be cleaned up to prevent spilled fuel or oil from affecting aquatic resources. A Spill-Prevention, Control, and Countermeasure (SPCC) Plan would be implemented in accordance with EPA regulations (40 CFR 112) (TN1041). Spills would be attended to and not allowed to flow to nearby surface water. Modification to the equipment barge-unloading area would be performed using cutoff wall technology (sheet piles) to isolate the equipment barge-unloading area from the turning basin. Dredging, if necessary, would conform with guidance provided by the U.S. Army Corps of Engineers and dredging permit conditions. Building activities would be controlled to minimize any impacts on red mangroves or Mangrove Rivulus.
Socioeconomic Impacts	
Physical Impacts	The impact of fugitive dust on the surrounding environment would be minimized through the implementation of a dust-control plan. Construction activities would be phased to minimize daily emissions of particulate matter, carbon monoxide, oxides of nitrogen, sulfur dioxide, and volatile organic compounds. Proper maintenance of construction vehicles would be performed to maximize efficiency and minimize emissions. To the extent possible, FPL would minimize aesthetic impacts on the natural and built environment through the selection process of transmission line corridors, engineering options, and construction techniques used.
Social and Economic Impacts	Project information would be disseminated to municipal and county government authorities, nongovernmental organizations, and local media to enable business and individuals to make informed decisions and economic choices, as project construction is phased out. Project information would be disseminated to local and regional governmental and nongovernmental organizations to enable organizations to plan accordingly for new residential and commercial development, additional demand for water and wastewater services, law enforcement and firefighting services, and increased enrollment in public schools. Fill deliveries would be scheduled to not coincide with peak commuting hours; delivery of construction material would be scheduled to not be concentrated during peak hours of travel FPL would build a new entrance and access road and widen existing roads and turning lanes.
Environmental Justice Impacts	No mitigating measures or controlled are considered to be required.
Historic and Cultural Resources	FPL has developed a work plan describing additional cultural resources studies required for the offsite facilities. Further, prior to construction FPL would develop an unanticipated discoveries plan for the treatment of cultural resources inadvertently discovered during construction.
Radiation Exposure to Construction Workers	During construction, the plant area would be monitored to ensure that construction worker doses are as low as is reasonably achievable (ALARA). As conditions warrant, if necessary, additional actions would be taken to continue to ensure that doses are ALARA.
Nonradiological Health Impacts	• Comply with Federal, State, and local regulations governing construction activities and construction vehicle emissions.

Table 4-17. (contd)

Impact Category	Specific Measures and Controls
	• Comply with Federal and local noise-control ordinances. • Comply with Federal and State occupational safety and health regulations. • Implement traffic-management plan. • Control fugitive dust.
Nonradioactive Wastes	Hazardous and nonhazardous solid wastes would be managed according to County, State, and Federal handling and transportation regulations. Implement recycling and BMPs to minimize waste generation.

Source: Adapted from FPL 2014-TN4058

4.12 Summary of Construction and Preconstruction Impacts

The impact levels determined by the review team in the previous sections are summarized in Table 4-18. The impact levels for NRC-authorized construction are denoted in the table as being SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Impact levels for the combined preconstruction and construction activities are similarly noted. Socioeconomic categories for which the impacts are likely to be beneficial are noted as such in the Impact Level column.

Table 4-18. Summary of Impacts from Construction and Preconstruction of Proposed Turkey Point Units 6 and 7

Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Land-Use Impacts	Land-use impacts from placement of new transmission lines would noticeably affect existing land uses, but would not destabilize regional land-use patterns.	SMALL	MODERATE
Water-Related Impacts			
Water Use – Surface Water	Construction and preconstruction impacts on surface-water use would be negligible.	SMALL	SMALL
Water Use – Groundwater	Construction and preconstruction impacts on groundwater use would be negligible.	SMALL	SMALL
Water Quality – Surface Water	Construction and preconstruction impacts on surface-water and groundwater quality would be negligible.	SMALL	SMALL
Water Quality – Groundwater	Construction and preconstruction impacts on groundwater quality would be negligible.	SMALL	SMALL
Ecological Impacts			
Terrestrial Ecosystems	Construction and preconstruction activities would noticeably affect wetlands, wildlife, and Federally and State-listed plant and animal species at the Turkey Point site, in the vicinity of the site, and in areas traversed by associated offsite facilities such as transmission lines, pipelines, and access roads.	SMALL	MODERATE

Table 4-18. (contd)

Category	Comments	(NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Aquatic Ecosystems	Construction and preconstruction activities would have minimal impact on aquatic ecological resources and habitat with the exception of the American crocodile. The American crocodile may be disturbed by construction activities and is susceptible to injury or death by collisions with vehicles.	SMALL to MODERATE	SMALL to MODERATE
Socioeconomic Impacts			
Physical Impacts	Physical impacts from noise, air-quality, buildings, waterways, and aesthetics would be minor. Impacts on road quality would be noticeable and beneficial.	SMALL	SMALL (adverse) to MODERATE (beneficial)
Demography	The population relocating to the region for the site-development activities likely would be SMALL relative to the existing population base.	SMALL	SMALL
Economic Impacts to Community	Construction and preconstruction economic and tax revenue impacts on the communities nearest to Turkey Point are expected to be SMALL and beneficial in Miami-Dade County, Homestead, and Florida City.	SMALL (beneficial)	SMALL (beneficial)
Infrastructure and Community Services	Construction and preconstruction traffic impacts would be noticeable but not destabilizing; other infrastructure and community services impacts are expected to be limited.	MODERATE for traffic impacts SMALL for other infrastructure and community service impacts	MODERATE for traffic impacts SMALL for other infrastructure and community service impacts
Environmental Justice	There would be no disproportionate and adverse impacts on minorities or low-income populations from any potential pathways or practices of these populations.	NONE[(a)]	NONE[(a)]
Historic and Cultural Resources	Given the potential for indirect visual impacts on built resources from the construction of transmission lines, the offsite impacts of the project on cultural resources is MODERATE. However, because NRC-regulated activities do not include construction of transmission lines, impacts of NRC-regulated activities would be SMALL. Further, FPL has committed to develop procedures for the treatment of unanticipated cultural resources.	SMALL	MODERATE
Meteorology and Air-Quality Impacts	Impacts from emissions of criteria pollutants and GHGs would be temporary and limited to construction workforce and would not be noticeable.	SMALL	SMALL

Table 4-18. (contd)

Category	Comments	(NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Nonradiological Health Impacts	Emissions of dust and air pollutants would be limited by operational controls; noise impacts would comply with Federal, State, and County standards. Worker health and safety would be ensured by compliance with NRC, Occupational Safety and Health Administration, and State standards. Transportation impacts would be minimal.	SMALL	SMALL
Radiological Health Impacts	Doses to construction workers would be maintained below NRC public dose limits (10 CFR Part 20) (TN283).	SMALL	SMALL
Nonradioactive Waste	Impacts on water, land, and air from the generation of nonradioactive waste would be minimal.	SMALL	SMALL

(a) A determination of "NONE" for environmental justice analyses does not mean there are no adverse impacts on minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while there are adverse impacts, those impacts do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

5.0 OPERATIONAL IMPACTS AT THE TURKEY POINT SITE

This chapter examines environmental issues associated with the operation of proposed Units 6 and 7 at the Turkey Point Nuclear Power Plant (Turkey Point) site for an initial 40-year period as described by Florida Power & Light Company (FPL). As part of its application for combined construction permits and operating licenses (COLs), FPL submitted an Environmental Report (ER) that discussed the environmental impacts of plant operation (FPL 2014-TN4058). The U.S. Nuclear Regulatory Commission (NRC) staff, its contractor staff, and U.S. Army Corps of Engineers (USACE) staff (hereafter referred to as the "review team") independently evaluated information presented in FPL's ER (FPL 2014-TN4058) and supplemental documents, FPL responses to NRC Requests for Additional Information (RAIs), FPL's Site Certification Application (SCA) submitted to the Florida Department of Environmental Protection (FDEP) (FPL 2010-TN272), the FDEP review of the proposed project (State of Florida 2014-TN3637), USACE permitting documentation, as well as other government and independent sources.

This chapter is divided into 13 sections. Sections 5.1 through 5.11 discuss the potential operational impacts on land use, water, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health, radiological health, nonradioactive waste, and postulated accidents. Section 5.12 discusses measures and controls that would limit the adverse impacts of station operation during the 40-year operating period. In accordance with Title 10 of the *Code of Federal Regulations* Part 51 (10 CFR Part 51) (TN250), 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. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such, as appropriate. The review team's determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and County governments, such as infrastructure upgrades, as discussed throughout this chapter, are implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. A summary of these impacts is presented in Section 5.13.

5.1 Land-Use Impacts

This section provides information about the land-use impacts associated with operation of proposed Units 6 and 7. Section 5.1.1 discusses land-use impacts at the site and in the vicinity. Section 5.1.2 discusses land-use impacts at offsite transmission line corridors and associated offsite facilities. Section 5.1.3 summarizes the land-use impacts.

5.1.1 The Site and Vicinity

The sections below address land-use impacts from operation of Units 6 and 7 facilities on the Turkey Point site and vicinity.

5.1.1.1 Onsite Land-Use Impacts

Permanent facilities in the 218 ac plant area would include the Units 6 and 7 power blocks, cooling towers and makeup-water reservoir, Clear Sky substation, and associated infrastructure (FPL 2014-TN4058). Outside of the plant area but still on the Turkey Point site, permanent facilities would include the FPL reclaimed water-treatment facility (RWTF), reclaimed water pipelines, radial collector wells (RCWs) and pipelines, nuclear administration and training buildings, parking areas, laydown areas, expanded equipment barge-unloading area, security buildings, heavy-haul road improvements, transmission infrastructure, sanitary-waste pipelines, potable-water supply pipelines, access road improvements, and the spoils areas. Table 4-1 lists each element of the proposed project and the land that would be dedicated to each. As noted in Section 4.1.1.1, the review team is assuming for purposes of analysis that all of the land dedicated to the project would be permanently dedicated.

Because the land dedicated to the project would remain occupied by plant-related facilities throughout the operational life of Units 6 and 7, the review team expects that the land dedicated to the project would not be available for unrelated land uses over that time. However, below-grade facilities such as pipelines may have only limited permanent land-use impacts, because they are underground and, in most places, the land at grade could be used for certain other unrelated uses (e.g., parking or storage). This is discussed in more detail below for specific facilities. FPL states that former construction laydown areas would be permanently dedicated to the project over its operational life and may be used during operations (FPL 2014-TN4058). The review team therefore assumes that these areas would not be available for non-project-related land uses throughout the operational life of Units 6 and 7.

Because the Units 6 and 7 facilities would be built mostly in previously undeveloped lands away from other concentrated areas of development, the review team expects that operation of the Units 6 and 7 and associated facilities would not affect or interfere with other land uses on the site or in the vicinity. Units 6 and 7 would be situated near other power-generation facilities (Units 1 through 5). Therefore, operation of the proposed new units would not represent a substantial change in land-use characteristics. While some land uses in the vicinity could be sensitive to the specific effects of the operation of a nuclear power plant, those effects are addressed in other sections of this environmental impact statement (EIS) related to aesthetics, recreation, and traffic (all in Section 5.4); salt deposition and fogging from cooling-tower operation (Section 5.7); and ecology (Section 5.3). These effects do not however suggest a potential for substantial land-use inconsistencies. As described in Section 2.2, land in the vicinity is predominantly wetlands and forestland (FPL 2014-TN4058) and includes several environmentally protected areas designated by the Miami-Dade County Comprehensive Development Master Plan (Miami-Dade County 2012-TN1150), as well as several areas of public land. The review team's evaluation of potential ecological impacts (Section 5.3) does not suggest any serious land-use conflicts with environmentally protected areas. Agricultural land composes approximately 4.5 percent (approximately 2,858 ac) of the land within the vicinity (Table 2-3). The review team expects because the proposed new facilities would be sufficiently isolated from these agricultural lands that would prevent substantial conflicts with nearby agricultural use.

Zoning and Consistency with Land-Use Plans

As addressed in Section 4.1, the Miami-Dade County Comprehensive Development Master Plan (Miami-Dade County 2012-TN1150) land-use designation for the location of proposed Units 6 and 7 is *Environmental Protection, Subarea F*. Electrical generation and transmission facilities are among the land uses described as being consistent with this designation.

The 218 ac plant area and most of the surrounding land on the Turkey Point site is zoned as GU (Interim District), with the exception of the land occupied by existing Turkey Point Units 1 through 5 and the area north of the plant area, which are zoned as IU-3 (Industrial, Unlimited Manufacturing District) areas. The GU zoning district allows for nuclear reactors, provided that approval by Miami-Dade County of an *Unusual Use* for the site is obtained. FPL applied for *Unusual Use* approval for Units 6 and 7 from Miami-Dade County, which was granted in Resolution No. Z-56-07 (Miami-Dade County 2007-TN1085) by the Miami-Dade Board of County Commissioners in December 2007. No additional changes to land use within the Turkey Point site are proposed or required for operation of Units 6 and 7.

Mineral Resources

As stated in Section 2.2, there are no known oil or gas wells or any sand or rock mining located within the Turkey Point site boundary. Thus, the review team finds that operation of the proposed project would cause no impacts on oil, gas, or mineral resources.

Prime and Unique Farmland

There is no prime or unique farmland, or farmland of State or local importance, as defined in the Farmland Protection Policy Act (7 U.S.C. § 4201 et seq.) (TN708) on the Turkey Point site (USDA 2012-TN1314). No impacts on special status farmland are therefore expected. Operational activities on the site are not expected to affect agricultural operations.

Coastal Zone Consistency

The Florida Coastal Management Act (Fla. Stat. 28-380-TN1147) authorizes the Coastal Zone Management Section of the FDEP to certify consistency with the Florida Coastal Management Program for all Federal licenses, permits, activities, and projects, when such activities affect land or water use. The Site Certification issued by the State of Florida on May 19, 2014 constitutes the State's concurrence that the licensed activity or use is consistent with the Federally approved program under the Florida Coastal Management Act.

Comprehensive Everglades Restoration Plan

Operating the Units 6 and 7 facilities after they are built is not expected to substantially interfere with the objectives or implementation of the CERP.

5.1.1.2 Pipelines

Land that would be used for the below-ground reclaimed water pipelines is identified in Figure 2-5 (FPL 2014-TN4058). Maintenance access by Miami-Dade County or FPL during operations would be accomplished on public roads or through access agreements with adjacent landowners. Because the pipelines would be easily accessible from roadways, maintenance and repair activities are not likely to interfere with adjacent land uses. Once built, the RCW caissons and pumping station would require periodic maintenance. Because these facilities would be located below ground, land uses of the offsite land area or Biscayne Bay would not be substantially affected. Impacts on other resources are addressed in other chapters of this EIS.

5.1.1.3 Access Roadways

As described in Section 3.3, the proposed project includes road improvements for operational access. The proposed improvements include widening three existing roadways and upgrading existing unpaved roads to establish new paved roadways (FPL 2014-TN4058).

FPL has indicated that roadway improvements installed during development of proposed Units 6 and 7 may not be needed for operations and could be removed to accommodate future land-use demands, although this is not specifically proposed (FPL 2014-TN4058). If roadway improvements were to be removed by FPL, FPL states that it would remove previous building materials, maintain historical hydrology, and regrade to previous contours (FPL 2014-TN4058).

5.1.2 Transmission Line Corridors and Associated Offsite Areas

5.1.2.1 Transmission Line Corridors

The following subsection addresses operations within the transmission line corridors and at substations.

The land proposed for use as transmission line corridors for proposed Units 6 and 7 is described in Section 2.2.2.

FPL has indicated that it would acquire land or easements as necessary to establish the proposed transmission line rights-of-way and would restrict incompatible uses in the rights-of-way during operation of the transmission lines (FPL 2014-TN4058). FPL requires that land uses in rights-of-way be compatible with the safe and reliable transmission of electricity. In areas that are in active agricultural cultivation, FPL typically allows farmers to grow feed for livestock and tree crops within the transmission line rights-of-way, subject to height limitations for vegetation and operation (FPL 2014-TN4058). FPL's standard rights-of-way vegetation management and line-maintenance programs would be followed to maintain the rights-of-way and transmission lines (FPL 2014-TN4058). These programs include requirements for use of herbicide application according to Federal, State, and local regulations. In addition, FPL states that environmental Best Management Practices (BMPs) would be used to reduce soil erosion and sedimentation, and that vegetation management in forested wetlands would comply with Fla. Stat. 29-403.814-TN1259, General Permits.

Local communities have raised concerns about the visual impacts and potential indirect blight impacts as a result of FPL's proposed location of the transmission lines (State of Florida 2012-TN1248; State of Florida 2011-TN1260; State of Florida 2011-TN1261). In addition, the National Park Service (NPS) has expressed concerns about aesthetics and land-use effects of locating transmission lines near the Everglades National Park (NRC 2010-TN516).

During scoping for this EIS, local agencies expressed concerns about potential interference with local agency radio operations. While effects are largely dependent on tower height and signal frequency, because all radio frequencies in the FM range are higher than the frequency emitted by the lines and because the effect would diminish very quickly with distance, interference would be unlikely to occur (Exponent 2012-TN3710).

5.1.2.2 Substations

As described in Section 4.1, FPL has stated that building and/or expansion of several substations would meet applicable environmental regulatory requirements for their development and operation. Thus, the review team finds that operation of the proposed expanded substations (the Turkey Point, Levee, Davis, and Pennsuco substations) would be compatible with existing land uses near the substations (power generation, tree nurseries, and rock quarries).

5.1.3 Summary of Land-Use Impacts

The effects on land-use resulting from operation of proposed Turkey Point Units 6 and 7 would be minimal because the land to be used for operations is land that has been previously disturbed to build the new facilities. Operation and maintenance of permanent site-access roadways and pipelines would be compatible with the current land uses and would not affect any existing or planned land uses.

Operation and maintenance of transmission lines would also be generally compatible with the current land uses and would not affect any existing or planned land uses. However, Miami-Dade County and cities within the county have raised issues related to the aesthetic compatibility of parts of the proposed new transmission lines with some urban areas. In addition, NPS has raised compatibility questions regarding where parts of the proposed transmission lines would be situated close to or adjacent to Everglades National Park.

Based on information provided by FPL and the review team's independent review, the review team concludes that the land-use impacts associated with operation of Units 6 and 7 would be MODERATE. The MODERATE conclusion primarily reflects the compatibility of portions of the transmission lines with adjacent land uses.

5.2 Water-Related Impacts

This section discusses water-related impacts on the surrounding environment from operation of proposed Turkey Point Units 6 and 7. Details of the operational modes and cooling-water systems associated with operation of the proposed units are discussed in Section 3.2.2.2.

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, designated uses. At the site of the proposed Turkey Point Units 6 and 7, FDEP designates Biscayne National Park as an Outstanding Florida Water, meaning there is to be no degradation of its water quality (FDEP 62-302.400(14) and FDEP 62-302.700(9)(a)1) (Fla. Admin. Code 62-302-TN776). The canals in the area (constructed before November 28, 1975) are evaluated based on the limited aquatic life support and habitat limits of these waters (FDEP 62-302.400(4) [TN776]). The designated uses include navigation, recreation, visual aesthetics, fisheries, and consumptive water uses. The responsibility for any work in, over, or under navigable waters of the United States is delegated to the USACE. The FDEP is responsible for protecting and restoring the quality of Florida water, air, and land resources, and the Florida Department of Community Affairs is responsible for determining that projects are consistent with Florida's Coastal Management Program (FDEP 2012-TN1544).

Water-use and water-quality impacts involved with operation of a nuclear plant are similar to the impacts associated with the operation of any large thermoelectric power-generation facility. Accordingly, FPL must obtain the same water-related permits and certifications as any other large industrial facility. These include the following:

- Clean Water Act (CWA) (33 U.S.C. § 1251 et seq.) (TN662) - Section 401 is at 33 U.S.C. § 1341 (TN4764) Certification. This certification is issued by the FDEP as part of Florida's Power Plant Siting Act Certification (Fla. Stat. 29-403.501 2011-TN1068) and ensures that the project does not conflict with State water-quality standards. This certification is required before the NRC can issue a COL to FPL. Florida issued the final Order of Certification on May 19, 2014 (State of Florida 2014-TN3637). If a Department of the Army permit is issued, the 401 Water Quality Certification would be required in addition to a Coastal Zone Consistency Determination both of which are provided by the State of Florida.
- Department of the Army Permit. Authorization from the USACE would be required under CWA Section 404 (33 U.S.C. § 1344) (TN1019) for the discharge of dredge or fill material into waters of the United States associated with the site-preparation activities and construction of the nuclear power plant and its associated components. Authorization would also be required under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403) (TN4768) for the construction of structures or work in, under, or over navigable waters of the United States associated with the construction of the nuclear power plant and its associated components. The USACE will conclude its Clean Water Act Section 404(b)(1) Guidelines and public interest analysis for this permit decision in its Record of Decision. Furthermore, Section 14 of the Rivers and Harbors Act (33 U.S.C. § 408) (TN4769) requires authorization for any components of the project that would in any way impair the usefulness of a USACE Civil Works Project; a separate 408 review will be conducted to ensure the will be no inconsistency with the intended use that was authorized by Congress.
- Clean Water Act (33 U.S.C. § 1251 et seq.) (TN662) - Section 402 is at 33 U.S.C. § 1342 (TN4765) National Pollutant Discharge Elimination System (NPDES) permit. This permit would regulate limits of pollutants in liquid discharges to surface water. The U.S. Environmental Protection Agency (EPA) has delegated the authority for administering the NPDES program in Florida to the FDEP. The NPDES permits are part of Power Plant Siting Act certification. A stormwater pollution prevention plan (SWPPP) for construction would also be required.
- Water-use permit. Consumptive use of surface water or groundwater would require a permit from the FDEP or the water-management district.
- Groundwater well drilling and operating permits. Construction of water wells would require a permit from the South Florida Water Management District (SFWMD).
- FDEP Class I Industrial Waste Underground Injection Control Permits (Fla. Admin. Code 62-528-TN556). Underground Injection Control (UIC) wells are required to be constructed,

maintained, and operated so that the injected fluid remains in the injection zone, and the unapproved interchange of water between aquifers is prohibited. Class I injection wells are monitored so that if migration of injection fluids were to occur it would be detected before reaching the underground source of drinking water (USDW).

5.2.1 Hydrological Alterations

The staff assessed the following potential hydrological alterations associated with the operation of Units 6 and 7 and the resulting effects on the environment:

- Operation of RCWs under Biscayne Bay for use as a backup supply of cooling water that would remove water from Biscayne Bay, the industrial wastewater facility (IWF), and the Biscayne aquifer.
- Use of potable and service water for the proposed units that would be obtained from the existing Miami-Dade Water and Sewer Department (MDWASD) water supply, which comes from the Biscayne aquifer in Miami-Dade County.
- Injection of station blowdown water and other liquid waste streams into the Boulder Zone—a cavernous, high-permeability South Florida geologic horizon located at depths of approximately 2,900 to 3,500 ft in the Lower Floridan aquifer.
- Deposition of drift from Units 6 and 7 cooling towers, including associated salt and chemical contaminants, onto nearby aquatic and terrestrial systems. With the use of reclaimed water as the cooling-tower water supply, chemical contaminants could be present in the cooling-tower water and drift. With the use of the Biscayne Bay as a backup supply of water (via the RCWs), salt deposition could occur on terrestrial and aquatic systems.
- Stormwater runoff from buildings, pavement, and RWTFs, and accompanying changes in the quality of runoff water from the spoils disposal area.

The following water resources are of primary interest for the review of hydrologic alterations:

- Biscayne Bay;
- Biscayne aquifer;
- Boulder Zone;
- IWF (cooling canals); and
- water resources on offsite/adjacent areas.

In the summer of 2014, the IWF experienced elevated temperatures, elevated salinities, elevated algae, and decreased water-surface elevations (see Section 2.3.1.1, Industrial Wastewater Facility). As discussed in Section 2.3.1.1, in response to these changes water was pumped into the canals from the Biscayne aquifer, Upper Floridan aquifer (also called the UFA), and the L-31E Canal. Continued actions are planned and the review team considered the consequence of the possible changes for the future affected environment.

The staff determined the only plausible change to the draft EIS impact assessment would be from the operation of the RCW. The review team identified no plausible significant changes in impacts from the operation of Units 6 and 7 under reclaimed water operation because the operation does not withdraw water from the Upper Floridan aquifer, the Biscayne aquifer, or

Biscayne Bay. As discussed Section 3.1, the AP1000 reactor design does not rely on either the reclaimed water supply or the RCWs to shut down safely.

Neither the conditions observed in the IWF in the summer of 2014 nor the subsequent response by FPL changed the review team's understanding of the current affected environment. However, future plans (see Section 2.3.1.1, Industrial Wastewater Facility) would change the affected environment in ways that were not explicitly discussed in the draft EIS. For instance, continued freshening of the cooling canals with water from wells in the Upper Floridan aquifer and the Biscayne aquifer, and withdrawals from the L-31E Canal may result in a sustained higher water-surface elevation and lower salinity in the IWF than observed during 2014 through 2015. In addition, efforts to retract the hypersaline plume to beneath FPL's property boundary would alter water pressures in the Biscayne aquifer and result in a general reduction of the salinity of groundwater in the Biscayne aquifer on the Turkey Point site.

Neither the exact design of systems for implementing either of the above actions nor their efficacy is fully known. Therefore, the review team considered a broad range of future conditions to determine if they might change the minimal incremental impact of the operation of the RCWs discussed in the EIS. The review team evaluated the hydrological alterations and their potential effects on the above-mentioned resources as discussed below.

5.2.1.1 Biscayne Bay

Hydrological alterations that may affect Biscayne Bay due to the operation of proposed Turkey Point Units 6 and 7 include (1) RCW operation, (2) drift deposition, and (3) stormwater runoff.

Effect of Radial Collector Well

To evaluate the effect of RCW pumping on salinity in Biscayne Bay, the U.S. Geological Survey (USGS), in conjunction with NRC conducted a numerical modeling study of the Biscayne Bay-Biscayne aquifer system (NRC 2014-TN3078; Appendix G). The model used for this study is a three-dimensional surface and groundwater model and was derived from a previously developed and calibrated model of the Biscayne aquifer and Biscayne Bay (Lohmann et al. 2012-TN1429). The NRC contracted with the USGS to modify the model to include the proposed RCWs, the IWF, and a dewatering well used during the building of proposed Units 6 and 7. The model incorporates tidal exchange with the Atlantic Ocean and freshwater inflows from canals and groundwater. The model was calibrated to groundwater heads, canal base flows, and the location of the saltwater-freshwater interface, salinity, and temperature in Biscayne Bay. The calibration period covered a 9-year simulation period from 1996 through 2004. The USGS prepared an administrative report (NRC 2014-TN3078) that documents the modeling analysis, which includes the effects of operating the RCW pumping on the surface and groundwater system. The review team summarized this administrative report, which is provided in Appendix G of this EIS.

The base case and all scenario model runs were made for a simulation period from 1996 through 2004 (the calibration period), during which time the effects of RCW pumping were examined via the differences in results for piezometric head and salinity. The base case was derived from the calibrated model with the addition of the cooling canals of the IWF and the wells used for dewatering of the plant area during building. The two dewatering wells were set to pump for a 6-month period (June 2001 through December 2001 of the simulation period) with a maximum pumping rate of 98,320 m^3/d) (9,128 gpm). The scenarios were derived from the base case with the addition of the RCWs. The USGS analysis (NRC 2014-TN3078) examined several RCW pumping scenarios, but the review team used the continuous-pumping scenario for its examination because it provided the most conservative analysis of the effects of the RCW operations. Continuous pumping is the most conservative scenario because it allows no time for the groundwater system to recover from RCW pumping.

Much of the assessment of RCW pumping used by the review team was based on the salinity time-series analyses provided by the USGS analysis of model results (NRC 2014-TN3078). However, the review team conducted additional analyses of the model results, which included examination of salinity time series at locations in Biscayne Bay in addition to those examined by the USGS (NRC 2014-TN3078). These additional locations were close to and north of Turkey Point (Appendix G, Figure G-5). The review team was also interested in examining the spatial distribution of salinity and salinity differences in Biscayne Bay produced by RCW pumping. The review team selected two dates that had either a relatively large salinity increase or a relatively large salinity decrease between the continuous-pumping scenario and the base case. The relatively large salinity increase occurred on 10/3/2003, while the relatively large salinity decrease occurred on 10/25/2004. The plot of the time series of salinity differences shown in Figure G-9 in Appendix G indicates these dates.

The review team's examination of salinity time series indicated that the salinity difference between the continuous pumping scenario and the base case was mostly within ±1 psu, with only transient increases to near 2 psu (Appendix G, Figure G-9). The review team examined the spatial distribution results on the date of a large increase (10/3/2003) and found the largest increases were less than about +2.3 psu. Also, the salinity increases greater than +1 psu occurred in a relatively small area (14.4 km^2 [5.57 mi^2]) located north of Turkey Point (Appendix G, Figure G-8); the maximum salinity within this area was about 30.8 psu. The review team examined the spatial distribution results on a date of a large salinity decrease and found salinity decreases less than -1 psu occurred in an area that was 24.2 km^2 (9.33 mi^2) in size located north of Turkey Point (Appendix G, Figure G-10); the maximum salinity within this area was about 31.8 psu. Overall, these results show that the temporal and spatial variation of salinity with continuous RCW pumping was minimal. The review team notes that the actual duration of pumping will not be continuous. As required by the FDEP Conditions of Certification (COCs; State of Florida 2014-TN3637), operation of the radial wells is to be limited to 60 days or less per year. This short duration of pumping will allow time for the groundwater system to recover after any pumping from the RCW and will limit the entrainment of saltwater and reduce alterations of salinity patterns within Biscayne Bay. Therefore, the effect on Biscayne Bay salinity of any permitted pumping would be much reduced from the already minimal salinity change found by the review team in the USGS modeling analyses for a continuous-pumping scenario. The NRC staff is aware that on April 20, 2016, a Florida court, (State of Florida 2016-TN4781) remanded the Conditions of Certification to the Florida Siting Board insofar as the COCs relate to proposed transmission lines and associated mitigation measures in the East Everglades. The remand, however, did not require reconsideration of the COCs related to operation of the RCWs. Accordingly, the original COC limiting RCW operation to 60 days per year remains undisturbed. Even if the COCs related to RCW operation are revisited, the review team considers it reasonable to expect that Conditions of Certification similar to or no less effective than those originally issued in regard to RCW operation will be in place before construction and operation of the proposed units begins.

Effect of Drift Deposition

While using treated reclaimed water as the source for makeup water, FPL would operate the cooling system to achieve four cycles of concentration (FPL 2014-TN4058). While using the RCWs (Biscayne Bay saltwater) as the source for makeup water, the system would operate at 1.5 cycles of concentration. Any residual contaminants in the treated reclaimed water and the chemical constituents of saltwater could be concentrated in the cooling-water system due to evaporative losses during cooling, although any individual contaminant could also have losses due to volatilization and environmental decay, thereby decreasing the concentration.

Small droplets of water (drift) and salt particles would be emitted from the cooling towers during operation. For the Turkey Point Units 6 and 7 combined drift rate from the circulating-water system and service-water system towers the expected maximum drift rate would be approximately 8 gpm (Table 3-6). As a result, salt along with any potential contaminants in the cooling water could be deposited on the area surrounding the cooling towers. When using treated reclaimed water for makeup water, priority pollutants and contaminants of emerging concern (CECs) could be contained in the drift. When using the RCWs, priority pollutants contained in seawater could occur in drift. Section 2.3.3.1 lists concentrations of contaminants that were detected in Biscayne Bay.

The review team has conducted analyses to estimate drift deposition of chemical contaminants on aquatic and terrestrial habitats. Four general categories of chemical constituents are included in the drift-deposition analysis: general water chemistry (e.g., total dissolved solids [TDS]), metals (e.g., copper), volatile organic compounds (VOCs; e.g., 1,4-dichlorobenzene), and CECs (e.g., 4-nonylphenol). The constituent TDS concentration increases in the cooling water by evaporation due to operation of the cooling towers. The high concentration of TDS in the cooling water results in drift with a high concentration of TDS. Evaporation of the water in the drift results in salt particles, which are deposited in the area surrounding the cooling towers. The other constituents (metals, VOCs, and CECs) are assumed to be carried with the drift particles in the same ratio as in the source water.

The EPA (2012-TN1018) identifies CECs as previously undetected chemicals in water or chemicals that are detected at concentrations different than expected, and for which human health and environmental risks are unknown or poorly known.

The estimated drift-deposition rates are used for determining aquatic and terrestrial ecological effects. The specific habitats examined include the cooling canals of the IWF, nearshore Biscayne Bay, and terrestrial areas west of the proposed Units 6 and 7 cooling towers. The potential concern for the cooling canals, while not a water body regulated for water quality, is related to the potential impact on the Federally protected crocodiles, which nest on the cooling-canal berms at several locations at the IWF. For Biscayne Bay, the concern relates to the designation by FDEP of Biscayne National Park as an Outstanding Florida Water (FDEP 2010-TN156).

The review team independently estimated drift deposition with the use of makeup water from reclaimed water and from Biscayne Bay water. Drift deposition is determined by the flow rate through the cooling towers and TDS concentration of the cooling water—higher TDS concentration produces higher deposition rates. The review team used the CALPUFF model to independently compute drift-deposition rates from the cooling towers. Using the total drift deposition of salt computed from CALPUFF for both reclaimed wastewater and Biscayne Bay marine water, the review team estimated the salt deposition and the associated drift deposition for representative chemical contaminants. The review team assumed that the ratio of contaminant concentration to TDS concentration was the same in the cooling-tower water as it was in the makeup water supplied by Miami-Dade County to FPL, including an adjustment for cycles of concentration. This conservative approach assumes no loss of contaminants via removal at FPL's RWTF, biodegradation, or volatilization. This conservative approach provides the worst case of loading via drift deposition from the cooling towers. It includes the assumption of increased concentration with increased cycles of concentration.

The TDS for makeup water derived from the reclaimed water source is expected to be 680 mg/L, which the review team calculated from Miami-Dade wastewater TDS concentrations and then assumed four cycles of concentration for estimating the drift concentrations. For saltwater, the makeup-water TDS concentration used was approximately 34,300 mg/L (FPL 2012-TN263) with a drift concentration assuming 1.5 cycles of concentration. The review team assumed there was no alteration of salinity from treatment.

To evaluate the potential effects of cooling-tower deposition on the aquatic resources of Biscayne Bay, the review team first performed a screening-level assessment to identify chemicals and constituents likely to occur at ecologically relevant concentrations in both reclaimed water and Biscayne Bay seawater obtained from the RCW system. As stated above, four general categories of chemical constituents were included in the initial screen: general water chemistry (e.g., TDS), metals (e.g., copper), organic compounds (e.g., 1,4-Dichlorobenzene, phenanthrene), and CECs) commonly found in pharmaceuticals, personal care products, and other consumer products. Likely concentrations in reclaimed water and Biscayne Bay seawater were obtained from technical data provided by FPL (2012-TN263), a study by Lietz and Meyer (2006-TN1005) on CECs from the Miami-Dade South District Wastewater Treatment Plant (SDWWTP), and information available in a 2011 study by the Biscayne Bay Coastal Wetlands Rehydration Pilot Project (Miami-Dade County 2011-TN1006). Detected concentrations of general water chemistry parameters (Section 2.3.3.1), organic compounds, and metals were compared to existing EPA freshwater and marine water-quality criteria, which are readily available for many compounds and believed to be protective of aquatic life. Compounds exceeding established water-quality criteria were retained in the screening-level assessment for fate and effects modeling. For chemicals lacking established water-quality criteria, such as many CECs, detected concentrations in reclaimed or Biscayne Bay water were compared to toxicological benchmarks available on EPA's ECOTOX (Ecotoxicology) Database (EPA 2012-TN1525). Chemicals present at >1/10 of a benchmark were retained in the screen and included in fate and effects modeling, as described in Section 5.3.2. Table 5-1 presents the review team's estimated drift-deposition rates for these compounds for three separate areas: the cooling canals of the IWF, adjacent areas west of the IWF, and Biscayne Bay. Compounds included for fate and effects analysis in the cooling canals included nine CECs and one metal. Constituents identified in Biscayne Bay seawater at levels above EPA criteria included only chlorides and sulfides. Areas west of the IWF were examined only for deposition rate and are considered in terrestrial ecology sections (Section 5.3.1).

Table 5-1. Estimated Annual Average Deposition Rates from Cooling-Tower Drift

Constituent Concentrations			Review Team-Estimated Annual Average Drift-Deposition Rates		
Constituent	Category	Concentration (µg/L)	Cooling Canals (g/m^2-yr)	Western Areas/Model Lands (g/m^2-yr)	Biscayne Bay (g/m^2-yr)
Reclaimed Water					
TDS	Wastewater	680,000[(a)]	0.34	0.18	0.082
1,4-Dichlorobenzene	Insect repellant	1.3[(a)]	6.6×10^{-7}	3.4×10^{-7}	1.6×10^{-7}
3 Beta-coprostanol	Human digestion	2[(b)]	1.0×10^{-6}	5.2×10^{-7}	2.4×10^{-7}
4-Nonylphenol	Detergent metabolite	4[(b)]	2.0×10^{-6}	1.0×10^{-6}	4.8×10^{-7}
Acetyl-hexamethyl-tetrahydro-naphthalene (AHTN)	Polycyclic musk (e.g., tonalide)	4[(b)]	2.0×10^{-6}	1.0×10^{-6}	4.8×10^{-7}
Hexahydrohexa-methylcyclo-pentabenzopyran (HHCB)	Polycyclic musk (e.g., galaxoide)	0.5[(b)]	2.5×10^{-7}	1.3×10^{-7}	6.1×10^{-98}
Phenanthrene	Polycyclic aromatic hydrocarbon (PAH) compound	0.6[(b)]	3.0×10^{-7}	1.5×10^{-7}	7.3×10^{-98}
Warfarin	Pharmaceutical	0.12[(b)]	6.1×10^{-8}	3.1×10^{-8}	1.5×10^{-8}
17 Beta-estradiol (E2)	Hormone	0.035[(b)]	1.8×10^{-8}	9.0×10^{-9}	4.2×10^{-9}
Triclosan	Antimicrobial	120 [(d)]	8.1×10^{-5}	4.1×10^{-5}	1.9×10^{-5}
Copper	Metal	9.6[(a)]	4.9×10^{-6}	2.5×10^{-6}	1.2×10^{-6}
Phosphorus	Nutrient	183[(e)]	9.3×10^{-5}	4.8×10^{-5}	2.3×10^{-5}
Radial Collector Well Water					
TDS	Sea water	35,800,000[(a)]	6.1	3.1	1.6
Chloride	Sea water	20,700,000[(a)]	3.5	1.8	0.90
Sulfide	Sea water	8,000[(a)]	1.4×10^{-3}	7.0×10^{-4}	3.5×10^{-4}
Phosphorus	Nutrient	670[(e)]	3.4×10^{-4}	1.8×10^{-4}	8.3×10^{-5}

(a) FPL 2012-TN263.
(b) Lietz and Meyer 2006-TN1005.
(c) Contaminant with lowest environmental effect concentration.
(d) Miami-Dade County 2011-TN1006.
(e) FPL 2014-TN4058.

The salt-deposition rates over the nearshore of Biscayne Bay are lower with the use of reclaimed water (0.0069 g/m^2/mo) than with the use of marine waters for Biscayne Bay obtained from the RCWs (0.1292 g/m^2/mo). With the use of either the reclaimed water or RCWs, the deposition rates of potentially associated chemical contaminants are extremely low. Only TDS, chloride, and sulfide have deposition rates greater than 10^{-6} g/m^2/mo, and chloride and sulfide naturally occur in marine waters.

The review team considered the impact of contaminant drift deposition on Biscayne Bay by first examining the volumetric tidal exchange in the nearshore region of the Turkey Point site. The review team used the tidal elevation data from the Virginia Key station (NOAA 2012-TN1321) to compute the tidal range and volume change over the drift-deposition area in the CALPUFF model. (Because other National Oceanographic and Atmospheric Administration stations within Biscayne Bay had only limited historic data, they were not used.) The review team computed the average depth in this region to be 1.24 m and the median tidal range to be about 0.6 m. Using this tidal range and the computed volume in the nearshore region potentially affected by drift deposition, the review team calculated a median volumetric tidal exchange of 48 percent of the total nearshore volume. This means that almost half the volume is exchanged with each turn of the tide. Consequently, with the extremely low contaminant-deposition rates (Table 5-1) and high tidal exchange rate, contaminant concentrations from drift deposition in the water column would be too small to detect.

Effect of Stormwater Runoff

The site hydrology prior to construction is discussed in Section 2.3.1.1. Modifications to the land surface made during preconstruction and construction activities would alter the site hydrology, and these alterations would remain during plant operations. As discussed in Section 4.2.1.4, stormwater runoff from spoils areas, and nuclear administration and training buildings areas would be managed with environmental controls and directed to the IWF. Stormwater runoff from the RWTF area, except for the equipment area runoff, would be routed to stormwater management basins before being released to its surrounding wetland area. As discussed in Section 3.2.2.1, no direct stormwater discharges would be made to Biscayne Bay. Therefore, during operations, no noticeable effect of stormwater runoff in the hydrologic conditions of the Biscayne Bay is expected.

5.2.1.2 Biscayne Aquifer

Hydrological alterations affecting Biscayne aquifer that would be associated with the operation of Turkey Point Units 6 and 7 are the RCWs removing water from the aquifer beneath Biscayne Bay, and the additional demand for MDSWD-supplied potable water to meet the need for process and potable water. Removal of water by the RCWs is expected to (1) increase the velocity of water movement from the bay into the bed of the bay, (2) reduce aquifer hydraulic head within the aquifer under the bay, (3) influence aquifer hydraulic gradients in the vicinity of the hypersaline plume, and (4) change the water chemistry in sediments between the bay floor and the radial well laterals by increasing the flow of oxygenated water. These alterations to the groundwater flow system are described below.

Changes in the Velocity of Water Movement into the Bed of Biscayne Bay from Operation of the Radial Collector Wells

Water pumped by the RCWs will be drawn downward through the sediment and rock formations underlying Biscayne Bay and laterally through the more permeable zone where the well laterals are installed. The review team calculated that the vertical velocity of saltwater approaching the bay bottom would average 0.0003 ft/min (0.000152 cm/sec) or about 0.4 ft/d if all of the pumped water flowed homogeneously into the bay bottom within a polygon encircling the RCW laterals at the expected maximum flow rate of 86,400 gpm (327 m^3/min) (FPL 2014-TN4058). This assumption is conservative in that a large portion of the water is expected to move into the aquifer through the bay floor outside of the polygon and then move laterally through the aquifer to the wells. The review team estimated that the average vertical permeability of the aquifer confining layer is about 0.7 ft/d compared to 10,000 ft/d for the highly permeable portion of the aquifer (see Section 2.3 of the EIS). However, the approach velocity will vary laterally across the bay floor because of variations in the vertical permeability of the sediment and limestone that lie between the bay bottom and the permeable layer of the aquifer where the radial collector laterals will be placed. The review team analyzed a possible worst-case scenario for approach velocity by assuming that an enhanced vertical permeability flow path exists near the RCW laterals with a permeability of 1,000 ft/d, which is 1,428 times higher than the average vertical permeability. This results in a calculated maximum approach velocity of 0.43 ft/min at the enhanced vertical permeability feature. In reality, water pumped by the RCWs would likely infiltrate the bay bottom over a much larger area resulting in lower velocities.

Changes in Aquifer Hydraulic Head from Operation of the Radial Collector Wells

The RCWs installed under Biscayne Bay would pump saline groundwater from the Biscayne aquifer at a depth between 25 and 40 ft beneath the bay floor (Section 3.2.2). The review team determined that this pumping would reduce hydraulic head in the Biscayne aquifer resulting in flow of water from the overlying bay and from relatively permeable sediment layers that compose the Biscayne aquifer. Impacts on the inland portion of Biscayne aquifer are determined by the volume of water captured by the RCWs that comes from the inland portion of the aquifer compared to the volume that comes from the bay. Removing relatively large volumes of water from the inland aquifer could lower the water table in the inland portion of the aquifer, affecting existing water-supply wells and increasing saltwater intrusion to the Biscayne aquifer.

In regard to the Biscayne aquifer, saltwater from the sea has already intruded into the groundwater in the Biscayne aquifer in the vicinity of the Turkey Point site, which has resulted in elevated salinity in that groundwater. This saltwater intrusion from the sea is unrelated to operations at Turkey Point. Because of its elevated salinity, groundwater from the Biscayne aquifer in the vicinity of the Turkey Point site cannot be used as a drinking water source without treatment. Seepage of saline water from the IWF cooling canals associated with the existing Turkey Point Units 3 and 4 has also resulted in locally higher groundwater salinity near the cooling canals. Analyses from the USGS groundwater-surface water model presented in the EIS show that in the absence of remediation of the IWF hypersaline plume, increases in groundwater salinity may occur inland from Turkey Point because of movement of the existing hypersaline plume regardless of whether or not the proposed units are built and operated. The model-predicted increase in groundwater salinity is not caused by RCW pumping or other activities related to the proposed units. The model-predicted increase in groundwater salinity also does not reach the location of drinking water wells.

The review team determined that RCW drawdown effects are unlikely in the inland areas west and south of the IWF because the IWF cooling canals, the interceptor ditch, and the L-31E canal create hydraulic barriers that isolate the inland Biscayne aquifer from the RCWs. Effects on saltwater intrusion and inland wells in the Biscayne aquifer would also be reduced by the limitations on use of the RCWs, which is expected to be limited to 60 days per year, or less (FPL 2012-TN1262; State of Florida 2014-TN3637). The review team evaluated information about the reliability of the components of the reclaimed water system and determined that the RCW supply system would be called into use infrequently and for durations much shorter than 60 days. The NRC review team determined that there is a large volume of treated municipal wastewater that can be used for cooling the proposed plants without affecting the ability to meet demands for fresh water. Miami Dade Water and Sewer Department is required to direct 60 percent of the wastewater flows to reuse by 2025 and to cease using ocean outfalls by 2025 under the Florida State Ocean Outfall Legislation Compliance Plan (Miami Dade County 2013-TN4786). Therefore, the NRC staff concluded that the reclaimed water supply is reliable. The review team further determined that the primary reclaimed water source is reliable because of the reliability of the proposed reclaimed water-treatment facility and associated pipelines. Further, the review team also considered alternative sources of cooling water in EIS Section 9.4.2, none of which are environmentally preferable to the proposed sources of cooling water. In view of the high reliability of the reclaimed wastewater source and the availability of the RCW system as a backup, there is no need to consider additional backup sources of cooling water. If the RCWs are needed for a backup supply of water, the maximum pumping rate would be 86,400 gpm (327 m^3/min) (FPL 2014-TN4058). The minimum volume expected to be pumped per year for RCW maintenance and testing purposes would be a total of 40,000 gal (151.4 m^3).

The RCWs are designed so that nearly all the water comes from Biscayne Bay rather than from the inland aquifer because of the location of the RCW laterals a relatively short distance beneath the bay. However, the review team determined that the volume of water that would be removed from the inland aquifer is difficult to predict with certainty because it depends on several hydrogeologic features and parameters that are incompletely quantified. Water flowing to the RCWs from the bay must move through the bay floor or through permeable layers of the limestone bedrock exposed to seawater, either in the bay or at the continental shelf. As described in Section 2.3 the bottom of the bay consists of either sandy material, exposed rock, or a sandy muck. Areas of sand or sandy muck are usually signified by the presence of seagrass. However, the review team has observed that silty sediments are present in some areas of the Biscayne Bay floor near the proposed RCW location. These silty sediments could impede the downward flow of water from the bay to the laterals.

FPL used a local-scale groundwater flow model of the Biscayne aquifer to simulate the effects of construction dewatering and operational cooling-water withdrawals from proposed RCWs in sediments beneath Biscayne Bay. Results and details of the model configuration and calibration were provided in FPL's groundwater model report (FPL 2011-TN1440).

As described in Section 5.2.1.1, the USGS (2012-TN1441) also performed numerical modeling analysis of RCW operation to confirm the effect of RCW pumping on the Biscayne aquifer and Biscayne Bay. A detailed description of the USGS model is provided in Appendix G of this EIS. The review team used results from both of these models in its assessment of groundwater impacts at the Turkey Point site. However, neither of the models was the sole basis of the review team's assessment because such models are only an approximation of the real physical system.

According to FPL's groundwater modeling (FPL 2014-TN4069), the RCWs would draw produced water from Biscayne Bay (approximately 98 percent), the IWF cooling canals (approximately 2 percent), and the inland portions of the Biscayne aquifer (less than 0.3 percent) (FPL 2014-TN4058).

The USGS model also showed that nearly all of the water produced by the RCWs would come from Biscayne Bay with minor, seasonally variable, amounts of water coming from the inland portion of the Biscayne aquifer, from the IWF, and from nearby freshwater canals. The USGS model had a larger domain and included the effects of variable density fluid and changes in water levels at freshwater canals, which were ignored in the FPL model. However, the USGS model had a coarser discretization than the FPL model. Although the scale and discretization of the USGS model was not appropriate for providing accurate estimates of water volumes captured by the RCWs from different sources, it did provide information about potential RCW effects on salinity in the Biscayne aquifer and Biscayne Bay. For the continuous pumping scenario, the operation of the RCWs decreased aquifer salinity in an area centered northwest of Turkey Point. This was caused by the replacement of hypersaline water from the IWF with fresher water from the aquifer, adjacent canals, or Biscayne Bay. As described in Appendix G, the USGS model predicted increasing aquifer salinity in a ring around the IWF from continued migration of the IWF hypersaline plume. Predicted increases were near 40 psu in areas west of the IWF. The increase was predicted for scenarios both with and without RCW pumping and is not related to construction or operation of the proposed units.

If the RCWs are used as a backup supply of cooling water, the proportion of water flowing into the RCWs from the Biscayne aquifer is expected to be small, with over 95 percent of the water flowing into the RCWs coming from the overlying Biscayne Bay. This estimate is supported by separate groundwater modeling efforts performed by FPL and by the USGS, as described above. The modeling provided evidence that pumping of the RCWs as a backup water supply for 60 days per year or less would be unlikely to cause a significant increase in salinity within the bed of Biscayne Bay or within the bay itself compared to the variability that occurs under current conditions. The models also indicated that pumping the RCWs for 60 days per year or less is unlikely to cause a noticeable change in the existing extent of saltwater intrusion or to noticeably lower groundwater levels to such an extent that it would affect other users of the Biscayne aquifer. The review team recognizes that complete knowledge of the hydrologic system associated with the RCWs is not now available, and that uncertainties therefore remain in the impact analysis. Further, future operational and environmental conditions are not known with certainty. A vast number of future scenarios are plausible. The sources of uncertainty in the RCW analysis include: heterogeneity in subsurface parameters, lack of experience with RCW systems in carbonate strata, and uncertainty in the potential need for using the backup water supply. Uncertainties in the future site environment include: freshening of IWF cooling canals, remediation of the subsurface hypersaline plume, and the magnitude and rate of future sea level rise. In view of these uncertainties, the review team has taken care to avoid relying too heavily on numerical models, and has concludes that even the general conservatism adopted in the analysis does not ensure that the analysis is bounding of all future conditions. Accordingly, the review team does not rely solely on the output of any numerical model.

Numerical models are numerical representations of complex processes occurring in three dimensions over time. The appropriate role of a numerical model is to test assumptions of the behavior of complex systems. While running a numerical model numerous times with different parameters cannot compensate for all uncertainties, the models employed here have been tested and benchmarked within the conditions that limit their application. In this assessment the review team used models to test possible consequences of changes in the affected environment and uncertainty in some subsurface parameters within the capability of the models employed. This information was combined with the geography of the RCW field (such as the relatively short distance from the laterals to the bottom of Biscayne Bay relative to the distance from the laterals to the Homestead well fields) and the COC requirement of a monitoring program with mitigation options. The review team determined that the proposed monitoring of RCW construction and operation that is included is sufficient to detect unexpected behavior in a timely manner. While all possible mitigation measures have not yet been spelled out, in accordance with the COCs, the review team considers the ultimate mitigation of ceasing operation of the RCWs as ensuring prevention of any impacts in a timely manner. “When harm occurs, or is imminent, SFWMD will require Licensee to modify withdrawal rates or mitigate the harm” (FDEP COCs Page 61).

All groundwater models are subject to uncertainty caused by model assumptions and limited characterization data. Therefore, results from both the USGS model and the FPL groundwater model were only used qualitatively by the review team to understand potential impacts. The model results combined with the available characterization data supporting the leaky character of the Biscayne aquifer, and give confidence that the fraction of fresh groundwater that would be captured by the RCWs is small compared to the fraction that would come from saltwater in the bay. The review team estimated that the worst-case volume of groundwater removed from the Biscayne aquifer could reasonably be as high as 4,500 gpm during RCW operation. This represents 5 percent of the water produced by the RCWs and is conservatively 166 times greater than the fraction estimated by the base-case FPL groundwater model.

The review team determined that the proposed monitoring of RCW construction and operation is sufficient to detect unexpected behavior in a timely manner. While all possible mitigations are not detailed in the Conditions of Certification, the review team considers the ultimate mitigation of ceasing operation of the RCWs as ensuring prevention of any impacts in a timely manner. “When harm occurs, or is imminent, SFWMD will require [the] Licensee to modify withdrawal rates or mitigate the harm” (FDEP COCs Page 61). If reclaimed water is not available and the 60-day limitation on RCW pumping is exhausted, the plant can be safely shut down. Cooling the main condenser is not a safety function in the AP1000 design. Accordingly, there is no NRC requirement for a contingency plan to supply for emergency backup cooling water to the main condenser if reclaimed water is not available and the 60-day limitation on RCW pumping is exhausted. The plant can be safely shut down if water is not available from either source. Safety-related cooling water is stored onsite, and can be replenished from multiple sources. In a situation where the RCWs water may be needed, the EIS analyzes the case in which the RCWs would not operate more than 60 days per year as a bounding case. The case of continuous pumping was also analyzed as a sensitivity case. The primary source of cooling water, reclaimed wastewater from the Miami-Dade Water and Sewer Department, should be highly reliable, and therefore the availability of backup cooling water supplies need not be evaluated. Further, the review team also considered alternative sources of cooling water in EIS Section 9.4.2, none of which are environmentally preferable to the proposed sources of cooling water. In view of the high reliability of the reclaimed wastewater source and the availability of the RCW system as a backup, there is no need to consider additional backup sources of cooling water. Saline water from the RCWs beneath Biscayne Bay would only be used when reclaimed treated wastewater is not available in sufficient quantity or quality, and for a maximum of 60 days per year, as permitted under the Florida State Conditions of Certification. These limited periods of pumping of the RCWs will reduce the hydraulic head in the aquifer beneath Biscayne Bay near the wells and, therefore, will remove some water from the aquifer. However, the proportion of water flowing into the RCWs from the aquifer is expected to be small and over 95 percent of the water flowing into the RCWs is expected to be from the overlying Biscayne Bay. This estimate is supported by separate groundwater modeling efforts performed by FPL and by the USGS (Appendix G).

The models indicated that pumping the RCWs for 60 days per year or fewer is unlikely to cause a noticeable change in the existing extent of saltwater intrusion or to noticeably lower groundwater levels to such an extent that it would affect other users of the Biscayne aquifer. A vast number of future scenarios are plausible. The sources of uncertainty in the RCW analysis include heterogeneity in subsurface parameters, lack of experience with RCW systems in carbonate strata, and uncertainty in the potential need for using the backup water supply. Uncertainties in the future site environment include freshening of the IWF cooling canals, remediation of the subsurface hypersaline plume, and the magnitude and rate of future sea-level rise. In view of these uncertainties, the review team has taken care to avoid relying too heavily on numerical models, and concludes that even the general conservatism adopted in the analysis does not ensure that the analysis is bounding of all future conditions. Accordingly, the review team does not rely solely on the output of any numerical model.

Changes in the IWF Hypersaline Plume

If it becomes necessary to use the backup water supply, RCW pumping of saline groundwater from Biscayne aquifer beneath Biscayne Bay, could also affect movement of the hypersaline groundwater plume from the IWF cooling canals (described in Section 2.3.1.2). Under current conditions, most of the hypersaline water leaking from the cooling canals into the underlying groundwater system flows eastward beneath Biscayne Bay and likely mixes with bay water. The movement of this water in the subsurface is affected by tidal fluctuations that reverse the flow direction and by the complex mixing pattern of the ground waters with differing densities (Hughes et al. 2010-TN1545). Some hypersaline groundwater may move westward, although the interceptor ditch located on the west side of the IWF is operated to prevent inland movement of hypersaline groundwater (FPL 2014-TN4058). Pumping from the RCWs would increase the hydraulic gradient to the northwest. Both the FPL and USGS groundwater models (Appendix G) predict that some hypersaline water from the cooling canals would be drawn into the RCWs during extended periods of pumping. The increased gradient during RCW pumping would likely increase the flow velocity of hypersaline water eastward under Biscayne Bay and may change the area affected by the hypersaline plume.

After publication of the draft EIS, the review team performed additional groundwater modeling of the interaction between the planned RCWs, the existing hypersaline plume, and the cooling canals using a 2D cross-section model and a limited-extent 3D model. A more detailed description of this review team focused analysis is provided in Appendix G and in Oostrom and Vail (2016-TN4739). These models accounted for fluid density effects caused by salinity and temperature. The simulations were performed to better understand how the existing hypersaline plume may be affected by RCW pumping combined with remediation actions stipulated in a recent Consent Agreement between FPL and Miami-Dade County (Miami Dade County v. Florida Power & Light 2015-TN4505).

The modeling was useful in showing salinity changes that occur in the aquifer near the RCWs when the wells are operated. The results showed that when the wells are not operating hypersaline water from the cooling canals is present in the high-permeability zone where the well laterals are installed. This saline water would be drawn into the wells during the first few days of RCW pumping, resulting in increasing, then decreasing, salinity at the well. The salinity of the water produced by the operating RCW eventually would drop to about the concentration of the bay water. Water flowing down through the bed of the bay and into the RCWs would be expected to have about the same salinity as bay water. When RCW pumping ceases, water in the high-permeability zone would again increase in salinity because of the migration of water from the hypersaline plume into the high-permeability zone. This migration of hypersaline water into the high-permeability zone would occur regardless of the presence of the RCWs.

Predicted future change in sea level and its effect on interactions between the RCWs and the hypersaline plume were also simulated. The additional modeling confirmed that pumping of the RCWs would move hypersaline water toward the RCWs and would remove some groundwater captured by the RCWs from the hypersaline plume region of the Biscayne aquifer. The model also indicated that RCW pumping is not likely to reduce the effectiveness of hypersaline plume remediation actions specified in the Consent Agreement.

Changes in Groundwater Chemistry Caused by Movement of Bay Water into the Aquifer

Operation of the radial wells will induce water from Biscayne Bay to enter the material bottom at the top of the bay floor in the vicinity of the RCWs. The natural variability of the substrate will result in some preferential flow paths. The water chemistry along these flow paths may be altered as the well-oxygenated water from the Bay displaces the existing pore water. The substrate water quality is unknown and the nature of preferential flow paths is also currently unknown. However, previously in this section the review team has estimated the extent of the area possibly influenced by the RCW operation. Any increase in the density of preferential flow paths would reduce the area of influence and thereby reduce the extent of the changes in substrate water quality.

Changes in Hydraulic Heads and Saltwater Intrusion from Increased Demand on the MDWASD Potable-Water Supply

As described in Chapter 3 of this EIS, potable and service water for operation of the proposed units would be obtained from the MDWASD potable water-supply pipeline. Potable water from the MDWASD is almost entirely from the Biscayne aquifer in Miami-Dade County. Average increased demand for MDWASD potable water was estimated to be 1.5 Mgd based on normal use of 936 gpm with an occasional maximum use of 2,553 gpm for operating the proposed units (FPL 2014-TN4069). This represents less than 0.5 percent of the 349.5 Mgd that MDWASD is permitted to pump each year from the Biscayne aquifer (SFWMD 2012-TN1318). Any additional groundwater withdrawals required to meet Miami-Dade County needs will be managed under SFWMD policies to minimize impacts on the Biscayne aquifer. Therefore, the review team determined that the impact of this increased demand for potable water from MDWASD on Biscayne aquifer water levels and saltwater intrusion along the coast will be negligible.

5.2.1.3 Boulder Zone

Hydrologic alterations affecting the Boulder Zone of the Lower Floridan aquifer would result from the injection of up to 90 Mgd of blowdown water and other liquid waste streams from the proposed units. The injected water would include effluent from the sanitary waste-treatment plant, wastewater-retention basin, and liquid radwaste treatment system. The estimated injection rate is approximately 20 Mgd when only reclaimed water is used as a cooling-water source, as high as 90 Mgd when only saltwater from the RCWs is used, and between 20 Mgd and 90 Mgd if a combination of these water sources is used (FPL 2014-TN4058). However, the review team has determined that since reclaimed water will be the primary source injection rates higher than 20 Mgd will occur only on rare occasions and for short durations.

Composition of Injected Wastewater

Chemical constituents and concentrations in the injected water would vary depending on whether the source of cooling water is reclaimed water or saltwater from the RCWs. Chapter 3 provides details about the plant processes that affect the blowdown water composition and properties. Chemical constituents and concentrations expected to be present in water injected in the Boulder Zone are listed in Table 3-5 (Section 3.4.4.2) for both 100 percent reclaimed water as a cooling-water source and for 100 percent saltwater from the RCWs. FPL estimated these concentrations (FPL 2012-TN263) by adjusting the expected influent concentrations (reclaimed water or saltwater) based on the chemical changes expected to be caused by the RWTF, the circulating- and service-water systems, concentration in the cooling towers, and dilution to reduce radionuclide concentrations prior to discharge into the UIC wells. The concentrations for the reclaimed water case were estimated from analysis of composite effluent samples collected at the Miami-Dade SDWWTP from 2007 to 2011 and reported to the FDEP's UIC program. Concentrations for the saltwater case were based on analysis of samples collected from the production well during a pumping test conducted on Turkey Point from April 4 through May 5, 2009, from a monitoring well (MW-1 D2) on the Turkey Point site, and from a surface-water sampling location in Biscayne Bay (SP-1).

Upward migration of wastewater into an USDW, which has occurred at several Class I municipal disposal wells in Florida, was historically prohibited by Federal and State Underground Injection Control (UIC) regulations and the Safe Drinking Water Act (SDWA). Previously, facilities where migration into USDWs had occurred would have been forced to cease injecting and adopt an alternate wastewater disposal method. However, due to the severe local restrictions on wastewater disposal alternatives in Florida, the EPA revised the Federal UIC requirements for Florida to allow continued disposal well operations where migration had occurred, provided the injected wastewater is given "pretreatment, secondary treatment, and high-level disinfection prior to injection" in order to "provide an equivalent level of protection to USDWs as provided by the existing no-fluid-migration requirement of the Safe Drinking Water Act" (EPA 2005-TN4766). EPA considered this alternative to be "as effective as confinement of fluids in protecting USDWs from contaminants in wastewater" (EPA 2005-TN4766) and stated that after additional treatment, "the movement of fluids into the USDWs, whether known or suspected, should not endanger the USDWs because the quality of the wastewater has been treated to a level that is no longer a threat to USDWs" (EPA 2012-TN4782). EPA indicated that it understood that FDEP, which oversees the UIC program in Florida would propose state regulations that were equally or more stringent.

On April 29, 2004, FDEP and MDWASD entered into a Consent Order to address issues including fluid movement at the SDWWTP (Miami-Dade County 2014-TN4758). In accordance with the 2004 Consent Order, MDWASD was to treat wastewater at the SDWWTP to a higher than secondary treatment, including additional filtration and high-level disinfection (HLD) before disposal via injection wells. The impacts of migration of injected wastewater receiving advanced treatment from the SDWWTP was evaluated prior to implementation of this system using numerical modeling conducted by the USGS (Dausman et al. 2008-TN4757) and is discussed below. The HLD Facility at SDWWTP was completed in FY2013 (Miami-Dade County 2014-TN4758) and reclaimed water received by FPL from the SDWWTP and injected into the Boulder Zone will receive both filtration and high level disinfection as part of this advanced treatment. Additional sampling performed at the SDWWTP from 2013 to 2014 to determine seasonal variability of the concentrations of heptachlor, ethylbenzene, tetrachloroethylene and toluene, which are constituents in treated wastewater, also provide insight into the effect of this treatment on constituent concentrations. Concentrations for these constituents determined through this more recent sampling were below both EPA maximum contaminant levels and laboratory method detection limits, as indicated in the footnotes to Table 3-5 (NRC 2015-TN4773). These were lower than the values reported in Table 3-5 and may better represent the concentrations expected in reclaimed water that will be received by Turkey Point. The concentrations do not reflect the additional reduction which would occur due to treatment, volatilization, and dilution at the Turkey Point site before injection. In view of the above, the treatment that the reclaimed wastewater will receive at the SDWWTP will provide protection to the USDW even in the event of upwelling. Confinement of the wastewater below the USDW, which is discussed below, will provide an additional level of protection.

Evaluation of Confinement of Injected Wastewater in the Saline Lower Floridan Aquifer

The purpose of the evaluation of deep well injection presented in the FEIS is to determine the impacts to water resources that might reasonably occur if Units 6 and 7 are licensed. The responsibility to demonstrate that plant effluent injected in to the Boulder Zone will not impact overlying USDWs is that of FPL and is required as part of the FDEP UIC permit. To evaluate the impacts of deep well injection at the Turkey Point site, the review team 1) reviewed studies that characterized the confining ability of the MCU and the causes and extent of upwelling at other deep well injection sites, 2) compared hydrogeological conditions and parameters at the sites at which upwelling occurred to conditions and parameters at the proposed site, 3) evaluated numerical modeling of flow of injected wastewater presented by the applicant and performed confirmatory calculations, and 4) considered the injection well testing and groundwater monitoring requirements of the FDEP UIC program. As a result of this evaluation, the review team concluded that significant upwelling of injected wastewater is not likely at the Turkey Point site and that, if upwelling did occur it would not noticeably impact overlying USDW aquifers.

As described in Section 2.3.1.2, the Boulder Zone contains saline water and is regionally isolated from the overlying Upper Floridan aquifer by a thick section of low-permeability sediments of the middle confining unit (MCU). Information from an exploratory well constructed at the Turkey Point site identified highly porous and permeable rocks that form the upper portion of the Boulder Zone at a depth of 3,020 to 3,232 ft below the drill pad.

Almost all of the injected wastewater is expected to be from periods when Units 6 and 7 are using reclaimed water as a cooling-water source. Because the injected wastewater would have a lower TDS content and an elevated temperature compared to the native water in the Boulder Zone, the injected wastewater would have a lower density than that native water, resulting in buoyancy. Wastewater from periods when the plants are using water from the RCWs is expected to have a higher density than the native Boulder Zone water, resulting in negative buoyancy. These periods are expected to be rare and of short duration.

As described in Section 2.3.1.2 of this EIS, the naturally-occurring hydraulic gradient in the Boulder Zone is small and water flows slowly to the west. The natural gradient is very small compared to the pressure developed at the injection point into the Boulder Zone by the injection pumps, as discussed below. Accordingly, the injected reclaimed wastewater will be forced in all directions from the injection point into the Boulder Zone. In addition, when reclaimed wastewater is used, buoyant forces will dominate the small natural gradient due to the lower density warm injectate, resulting in an overall upward hydraulic gradient in the Boulder Zone. Upward flow of injected wastewater would nonetheless be inhibited by the more than 1,465 ft thick sequence of predominately low-permeability rocks that lie between the Boulder Zone and the USDW aquifer (FPL 2012-TN1577).

FPL performed an analysis of the pressure buildup by the injected wastewater (FPL 2014-TN3932). FPL calculated a maximum total pressure increase of 158 psi in the injection formation from the combined injection pressure of 12 injection wells plus buoyancy of the injectate based on a reclaimed water source. This is much lower than the calculated 1,235 psi minimum pressure that could create or open a fracture in the overlying confining zone (FPL 2013-TN3931).

Based on the above evaluation, the review team concluded that in general the matrix of the MCU would confine injected effluent and that incidences of upwelling at other sites have been coincident with features that provide vertical pathways for upward migration such as fractures or improperly completed wells. Site data indicates that substantial fracturing of the confining layers is not evident at the Turkey Point site and well construction related issues are not expected to create potential for upwelling at the Turkey Point site because of improved understanding of the confining zones within the MCU and improved construction techniques. However, studies of other injection sites indicate that if rapid vertical migration occurs, it is not likely to reach the Upper Floridan aquifer and that, if it did, it would not noticeably impact drinking water quality. This is discussed in greater detail in Sections 2.3.1.2 and 5.2.3.2 and within the following portions of this section.

Extent of Upwelling at Deep Well Injection Facilities

Maliva et al. (2007-TN1483) reports that of the more than 180 Class I UIC wells, “in the majority of injection well systems, no vertical movement of injected fluids has been detected in the monitoring zones.” Seventeen sites have experienced migration, however upwelling into the USDW had occurred at 8 of those sites. Three of these sites are in southeast Florida and include the SDWWTP, which is north of the Turkey Point site. Previous reports indicated that injectate had migrated into the Upper Floridan aquifer (Starr et al. 2001-TN1251; 68 FR 23673 [TN3658]; EPA 2003-TN4759). However, more recent studies, such as Maliva et al (2007-TN1483) and Walsh and Price (2010-TN3656) have clarified that while migration has reached the USDW at some Class I injection facilities, no impact has been reported for the Upper Floridan aquifer in southeast Florida including at the SDWWTP. As discussed in Section 2.3.1.2, this is likely because the earlier studies referenced above considered the APPZ, where upwelling was detected, to be the lower part of the Upper Floridan aquifer. As a result of more recent characterization of the Floridan aquifer in south Florida (such as Reese and Richardson 2008-TN3436), it is now understood that the APPZ is separated from the Upper Floridan aquifer in south Florida by the upper confining unit of the MCU. Results from characterization at EW-1 indicate that the upper confining unit of the MCU may separate the APPZ from the Upper Floridan by approximately 250 ft.

Also, the base of the USDW is defined by the depth at which TDS exceeds 10,000 mg/L. The depth at which groundwater TDS exceeds 10,000 mg/L may occur beneath the base of the Upper Floridan Aquifer as it does at the SDWWTP. Therefore, upwelling into the USDW does not necessarily indicate that upwelling has reached the Upper Floridan aquifer. However, review of data from well EW-1 indicate that the base of the USDW and Upper Floridan aquifer occur around the same depth at the Turkey Point site.

Potential Causes of Upwelling of Injected Wastewater through the Middle Confining Unit

Many studies have been conducted to characterize the confining nature of the MCU and determine the causes of upwelling, where it has been observed. Studies have evaluated whether observed migration was caused by flow through the matrix of the MCU or through pathways provided by either natural geologic features or well-related problems. These studies generally conclude that the MCU matrix provides adequate confinement, that rapid flow results may result primarily from well-related issues, and that significant upwelling has not occurred at injection sites. These studies are summarized in the following paragraphs.

Starr et al. (2001-TN1251) reviewed “existing information that describes geology, hydrogeology, and geochemistry at the South District Wastewater Treatment Plant” to determine “the ability of the confining layer above the saline aquifer to prevent fluid migration into the overlying freshwater aquifer.” The aquifers referred to are the Boulder Zone (the “saline aquifer”) and the Upper Floridan aquifer (the “freshwater aquifer”). However, the Upper Floridan aquifer is brackish, not fresh, in the vicinity of the site. The Starr study expressed concern over the adequacy of the data set being evaluated and concluded that “the geologic data provided for review are not sufficient to demonstrate that the Middle Confining Unit is a competent, low hydraulic conductivity layer that is capable of preventing upward migrations of fluids from the

Boulder Zone into the overlying underground source of drinking water" or USDW. According to the report:

- "Although the confining layer above the Boulder Zone may in fact be competent, these data sets are not adequate to draw this conclusion."
- "A caveat to this interpretation is that the hydraulic characterization test methods employed may not adequately represent the less permeable hydrostratigraphic units, and hence the hydraulic data set may not adequately describe the actual site conditions."
- "…the geochemical data do not show a spatial pattern of contamination that is consistent with widespread upward migration of contaminated water through a highly permeable confining layer."

Rather than indicating a lack of confinement by the MCU, the study concludes that "the Middle Confining Unit and/or upper portion of the Lower Floridan Aquifer is a better confining unit than indicated" by the data that was provided for review. The study concluded that overall the spatial distribution of contaminants "suggests that isolated conduits, such as inadequately sealed wells or natural features, provide pathways for contaminated water to migrate upward from the Boulder Zone, but contaminants are not migrating upward through the Middle Confining Unit across a broad area."

This lack of observed migration across a broad area was also investigated by Maliva et. al. (2007-TN1483). Maliva, et al., studied vertical hydraulic conductivity data from core plugs from the MCU at 29 South Florida injection well sites (including the SDWWTP) and performed variable density solute-transport modeling. They observed that "matrix hydraulic conductivities of the limestone and dolostones that constitute the confining strata between the injection zone and the base of the USDW in South Florida are sufficiently low to retard significant vertical fluid movement" and that minimal vertical migration would occur through sections where vertical hydraulic conductivity was 10^{-6} cm/sec or less. As discussed in Section 2.3.1.2, intervals of dolomitic limestone and dolomite with hydraulic conductivities measured as low as 10^{-6} cm/sec occur within the MCU at well EW-1 at the Turkey Point site. As a result, these intervals at the Turkey Point site would be expected to prevent or limit vertical migration.

McNeill (2002-TN4571) recognized a thin "important low-permeability interval" which "appears to act as a competent confining unit" between the Boulder Zone and Middle Confining Unit throughout southeastern Florida. He referred to this interval as the Dolomite Confining Unit and identified characteristics of the unit that were indicative of confinement. These included zones in which the data showed high core recovery and low hydraulic conductivity, and other confining characteristics as indicated by geophysical logs. The review team observed zones with similar confining characteristics at several depths within the MCU at well EW-1 at the Turkey Point site.

Several studies indicated that upwelling may result from natural features or well-related issues. Dausman et al. (2010-TN4760) agreed that MCU "heterogeneity cannot explain all the effluent migration" and indicated that upwelling at the SDWWTP can generally be attributed to "…flow through a channelized pathway caused by well construction." At the SDWWTP, McNeill (2002-TN4571) indicated that upwelling likely occurred because 10 of 17 injection wells were drilled through but completed above the Dolomite Confining Unit at the base of the MCU, effectively leaving an open hole and upward pathway through which injected effluent could migrate.

Lastly, Walsh and Price (2010-TN3656) evaluated well logs and water chemistry data at the SDWWTP and determined that while natural features could not be ruled out, enhanced vertical flow pathways that allowed upwelling likely resulted from issues related to well installation or failure because effluent appeared to bypass deeper monitored intervals before being detected at higher depths.

Even if the MCU matrix is generally confining and wells are installed properly, upwelling may still result from fracturing or other natural geologic features within the confining zone. Cunningham (2012-TN4576; Cunningham 2013-TN4573; Cunningham 2014-TN4051; Cunningham 2015-TN4574) evaluated injection sites for natural vertical high conductivity features (such as karst collapse structures) using seismic-reflection data. He stated that “if present at or near wastewater injection utilities, these features represent a plausible physical system for the upward migration of effluent injected into the Boulder Zone to overlying EPA-designated USDW in the upper part of the Floridan aquifer system.” In the most recent study, karst collapse features have been identified in the vicinity of the North and South District Wastewater Treatment Plants as well as locations beneath Biscayne Bay and have been found to extend from the MCU to above the Upper Floridan aquifer (Cunningham 2015-TN4574). These structures are beyond the zone of influence of the injection wells proposed at the Turkey Point site, as described below. At an injection well operated by the City of Sunrise in Broward County a collapse structure was implicated in the observed migration of injected wastewater from the Boulder Zone to the uppermost permeable zone within the Lower Floridan aquifer however migration of contaminants above the Lower Floridan aquifer was not observed at this site (Cunningham 2014-TN4051). Migration above the APPZ and into the Upper Floridan aquifer resulting from natural features has not been identified at any site in south Florida.

Deep seismic data has not been collected at the Turkey Point site. In the absence of seismic data, Cunningham (2015- TN4574) suggests that, “other evidence for karst collapse includes borehole log signatures that indicate highly fractured rock,” and that fractures would be indicated by “..high travel times measured on borehole sonic log data.” Walsh and Price (2010-TN3656) reported that at the SDWWTP “no fracturing of the confining strata had been reported.” Using geophysical (sonic) logs from injection sites in south Florida, Maliva et al (2007-TN1483) and McNeill (2002-TN4571) described signatures and travel times for fractured rock. Staff evaluated travel times and signatures on sonic logs obtained at well EW-1 at the Turkey Point site and found sections of the MCU to have log signatures and transit times consistent with unfractured rock. Dissolution rates for limestone and dolostone presented by Palmer (2016-TN4755) are low, indicating that if fractures in the MCU at the Turkey Point site are absent or poorly developed, such fractures are not likely to become conduits capable of upwelling over the life of the plant. In order for rapid flow of injected effluent to occur from the Boulder Zone through the MCU as a result of these natural features, they would have to occur within the zone of influence of an injection site and create a set of pathways that compromise the approximately1500 ft thick MCU. However, characterization data indicates that these features are not evident at the site and modeling suggests that the expected zone of influence of injected wastewater is not expected to extend far beyond the boundaries of the Turkey Point site, as described below.

The review team evaluated the potential for upwelling due to flow through a competent MCU matrix or pathways created by natural features or well-related issues. Review of hydrogeological parameters at the site indicate that the MCU would be expected to offer confinement absent the presence of conduits. Results of borehole characterization activities at exploratory well EW-1 (FPL 2012-TN1577) and DZMW-1 (MHC 2014-TN4052) indicated that there were thick sections of low permeability sediments between the Boulder Zone and the Upper Floridan aquifer at the proposed Turkey Point injection site. Monitoring results from the water-injection testing at these wells above these low permeability strata did not indicate pressure fluctuations indicative of lack of confinement due to matrix flow or flow through pathways caused by either improper well construction or natural features (FPL 2014-TN4052). Installation, testing and monitoring required by the FDEP UIC permit are designed to prevent upwelling resulting from improper well construction and detect upwelling associate with the wells if it occurs. The review team notes that the one injection well has been drilled and characterization of the thickness and competency of the MCU is also required at each subsequent well location by the UIC permit process. The UIC permit for each well may not be issued unless adequate confinement has been demonstrated by the well-specific characterization data. The review team believes that enhanced vertical flow through the confining units to the Upper Floridan aquifer is extremely unlikely, and if leakage associated with an injection well did occur it could be detected and mitigated as required by the FDEP UIC program.

Extent of Injected Wastewater Migration at the Turkey Point Site

In order to understand the fate of injected wastewater at the Turkey Point site the review team evaluated local and regional site studies and modeling of the SDWWTP site, modeling conducted at the Turkey Point site by FPL, and independent confirmatory modeling by the review team.

Dausman et al. (2008-TN4757) modeled migration of two plumes from the SDWWTP of wastewater injected into the Boulder zone: one comprised of secondarily treated wastewater and another of wastewater receiving HLD, which has since been implemented along with additional filtration at the SDWWTP site. The Dausman study concluded that over a projected 148-year injection period (from 1983 forward) the resulting plume would extend "…outward about 13 mi from the site in the MFA, just beneath the UFA." The MFA, or Middle Floridan aquifer, is another name for the APPZ. Modeling also indicates that the initial concentration of constituents in the plumes would be significantly reduced through dilution, to less than 5 percent of the original injected concentration by the end of the modeling timeframe.

This prediction of limited vertical and horizontal effluent migration is supported by modeling and analysis performed by FPL and independent confirmatory analysis performed by the review team. FPL provided information about modeling and analysis of several scenarios of potential upward migration of injectate (FPL 2013-TN3931) in support of the safety analysis of the proposed plants. The scenarios in the analysis focused on the fate and transport of radionuclides over a 61-year injection period followed by a 41-year period with no injection, and used conservative assumptions that would tend to maximize the upward migration of effluent. In each scenario, injected wastewater was predicted to expand radially around the point of injection since injection rates would exert a stronger influence on flow than the negligible flow rates naturally occurring within the Boulder Zone. Injected wastewater was not predicted to extend more than around 4 mi beyond the point of injection over the modeled timeframe. This is bounded by the transport distance of 13 mi predicted by Dausman et al. (2008-TN4757). The extent of migration resulting from injection at Turkey Point would be expected to be less because injection rates would be around 20 percent of those at the SDWWTP and the injection period would be less than half that which was modeled by Dausman et al. (60 years vs 148 years).

One scenario evaluated by FPL determined that, in the absence of well-developed pathways, upward movement of injectate would be limited to approximately 300 ft into the MCU. The primary confinement portion of the MCU above the injection zone is 985 ft thick (FPL 2012-TN1577) and is overlain by an additional 480 ft thickness of moderate- to low-permeability layers of rock below the Upper Floridan aquifer. The staff performed a separate confirmatory analysis (Appendix G) and found that upward migration of injectate from the Boulder Zone would likely be less than 300 ft. These estimates of limited upward migration are supported by the conclusions from the studies of matrix flow through the MCU discussed earlier in this section.

FPL's safety analysis also considered a scenario in which a pathway through the MCU exists. In this scenario, a hypothetical water-supply well located 2.2 mi from the reclaimed wastewater injection site was drilled into the USDW aquifer and an instantaneous bypass/failure of the MCU occurred at the water supply well. The 2.2 mi distance is based on the nearest privately owned parcel of land. The FPL analysis showed that the transit time through the Boulder Zone from the injection well to beneath the offsite location would be at least 10 years, and the maximum radionuclide concentrations for tritium would not occur until year 21 (FPL 2013-TN3931). This analysis was conservative in that it did not account for transit time through the MCU and did not account for dilution of effluent within the Boulder Zone or Upper Floridan aquifer. It assumed that 100 percent of the water pumped by the water-supply well would be from the Boulder Zone with no dilution in the Avon Park Permeable Zone (APPZ) or the Upper Floridan aquifer. The review team performed a separate confirmatory analysis of this scenario (Appendix G), which predicted concentrations of radionuclides at the hypothetical well that were similar to those calculated by FPL. The assumptions of vertical migration in this scenario were made to determine a bounding dose. The conditions and parameters in this scenario have not been observed at operating injection sites and are not reasonably foreseeable based on the hydrogeology at the Turkey Point site.

FPL also considered impacts at the nearest user of brackish Upper Floridan aquifer groundwater, which is the Ocean Reef Club located on Key Largo 7.7 mi from the injection site. This scenario conservatively assumed that water from the existing irrigation supply well is used for drinking and other domestic purposes and there is a failure of confinement between the Boulder Zone and the Upper Floridan aquifer at the location of the water-supply well. FPL's radiological safety analysis at the Ocean Reef Club showed that radionuclide levels in the Upper Floridan aquifer would remain at inconsequential levels throughout the 100-year analysis period. This is expected since the wastewater is not predicted to travel this far beyond the injection well. Estimates of potential doses resulting from each of these scenarios are discussed in Section 5.9 of this EIS. While this evaluation considered the transport of radionuclides, predictions related to flow direction and horizontal extent would also apply to non-radiological constituents in the injected water.

The review team evaluated the impacts of this and other scenarios (direct injection into the Upper Floridan aquifer, upward migration through the MCU and rapid migration through preferential pathways through the MCU) using results from published risk assessments and modeling studies as well as expected constituent concentration data from reclaimed water at the Turkey Point site. The results are set forth in Section 5.2.3.2.

Another controlling factor on the direction of flow of injected wastewater was determined to be the structure of the confining layers that overly the Boulder Zone. McNeill (2002-TN4571) evaluated the structure and extent of a unit he called the Dolomite Confining Unit, which occurs at the base of the MCU in southeast Florida. McNeill indicated that while there is local variability in the bottom depth of the Dolomite Confining Unit, the overall dip of the unit is to the southwest. This implies that as distance beyond the injection well increases, flow of buoyant injected effluent may be more influenced by the structure of the base of the confining unit rather than injection pressure. As a result, any migration within the Boulder Zone beyond the site would move northeast toward (but beneath) the bay and away from areas in which the upper aquifers are used. As mixing, cooling and dilution occur, buoyancy of the injectate will decrease, causing it to eventually be subjected to the slow westward movement of the native water within the Boulder Zone (Meyer 1989-TN2255).

Finally, as described in Section 2.3.1.2 of the EIS, treated municipal wastewater injected into the Boulder Zone has migrated into relatively permeable zones within the MCU at the SDWWTP north of Turkey Point site, but has not reached the Upper Floridan aquifer. Studies have indicated that this migration could have resulted from well construction issues. Walsh and Price (2010-TN3656) presented a conceptual model that postulates the vertical migration through the lower portion of the MCU, below the APPZ, is fluid-density driven. Walsh and Price also determined that if migration into the APPZ occurred, “the transport mechanism appeared to be a horizontal flow with mixing of ambient waters” which would likely diminish the buoyant forces and reduce the impact above the APPZ. This conceptual model of horizontal flow in the APPZ overcoming the vertical flow component that dominated flow within the more confining MCU strata was also illustrated in a numerical modeling scenario by Maliva et al (2007-TN1483). This indicates that even where migration through the bottom portion of the MCU has occurred, upwelling to the upper MCU and the overlying Upper Floridan aquifer is not likely. This could partially explain why recent studies have indicated that upwelling to the Upper Floridan aquifer has not occurred at injection sites.

Based on the foregoing, the review team has determined it is reasonable to conclude that injected wastewater is not expected to migrate far beyond the site in the Boulder Zone, that upwelling to the Upper Floridan aquifer is not likely at the site, and that if significant upwelling through the MCU did occur, horizontal flow and mixing within the APPZ would likely prevent upwelling above the MCU. While not quantified by the review team, modeling near the site indicates that natural dilution of injected wastewater could significantly reduce the concentrations of constituents in wastewater. There are no users of groundwater within the Boulder Zone near the site, there are no users of groundwater within the Upper Floridan aquifer overlying the predicted extent of wastewater migration, and wastewater is not expected to migrate upward into the Upper Floridan aquifer.

Lastly, relative risk assessments of wastewater disposal methods in southeast Florida indicate that “distance has a major impact on risk” with the already low risk decreasing dramatically as distance from the injection well increases (Bloetscher et al. 2005-TN4756). The study considered scenarios that included breach of the MCU and determined that risk to receptors up to 5 mi from the injection well was minimal, which is similar to the migration distance indicated by site and regional modeling, as discussed above. Risk assessments that consider deep well injection are discussed in greater detail in Section 5.2.3.2.

5.2.1.4 Industrial Wastewater Facility (Cooling Canals)

Hydrological alterations affecting the IWF cooling canals, that would be associated with the operation of the proposed Turkey Point Units 6 and 7, may occur due to (1) drift deposition of contaminants on in the IWF (2) stormwater discharge to the IWF, (3) runoff from spoils piles, and (4), withdrawal of water from the IWF due to radial well operation.

Drift Deposition

The review team has conducted analyses to estimate drift deposition of chemical contaminants on aquatic and terrestrial habitats; these estimated depositions would be used for determining aquatic and terrestrial ecological effects. The methods of estimating drift deposition are discussed in the Biscayne Bay section above, and the estimated deposition rates are provided in Table 5-1, which includes the IWF cooling canals. Table 5-1 provides deposition rates with the use of reclaimed water as cooling-tower makeup water. The table includes concentrations in wastewater (or Biscayne Bay), ratios of constituent concentration to TDS concentration, and calculated deposition rates for each constituent to areas around the cooling towers.

The potential concern for the cooling canals, while not a water body regulated for water quality, is related to the potential impact on Federally protected crocodiles, which nest on the cooling-canal berms at several locations of the IWF. Most of the IWF is also designated critical habitat for the crocodile.

As noted in the section about Biscayne Bay, with the use of either the reclaimed water or RCWs, the deposition rates of potentially associated chemical contaminants is extremely low. Only TDS, chloride, and sulfide have deposition rates greater than 10^{-6} g/m^2/mo, and the IWF has concentrations of those that are greater than marine waters.

Using water and mass balance methods, the review team also calculated the equilibrium concentrations of contaminants within the cooling canals from drift deposition. To compute the mass balance, the review team first calculated a water balance using the cooling-canal storage information from the *Cooling Canal System Modeling Report* (Golder 2008-TN1072) and the FPL 2012 *Uprate Report* (FPL 2012-TN3439). The water balance data from FPL (2012-TN3439) was averaged by month and repeated over a 9-year period to provide inflows and outflows to the cooling canals for use in the mass balance calculations. Loading to the IWF and the flow balance of the IWF is discussed in Section 4.2.1.4. Figure 5-1 shows the review teams computed cooling-canal volumes for this period.

For the next step, the review team calculated the mass balance of each constituent in Table 5-1 using the hydrologic fluxes of the IWF to account for dilution of contaminant concentrations from drift deposition. For a conservative estimate, no loss of contaminants was assumed in the cooling canal from degradation or volatilization. Figure 5-2 provides an example of contaminant concentrations calculated from the mass balance of 1,4-dichlorobenzene, which is an insect repellent. Concentrations increase from the initial value of 0 µg/L and reach a dynamic equilibrium within approximately 4 years. The only input of contaminant is from cooling-tower drift, and the primary loss is via the seasonal inflows and outflows of groundwater, which produces the variation in volume shown in Figure 5-1. The maximum computed increase in concentration was 0.00070 µg/L. The same calculation was made for other potential contaminants deposited in the cooling canal from drift; the maximum concentrations attained are listed in Table 5-2. Comparison of the contaminant concentrations with detection limits indicates that all of the concentrations from this mass balance calculation are below current detection limits. Other chemical constituents with concentrations that were not measured in the reclaimed water, but which could have concentrations similar to those measured by MDWASD, would be expected to result in concentrations in the IWF as found above.

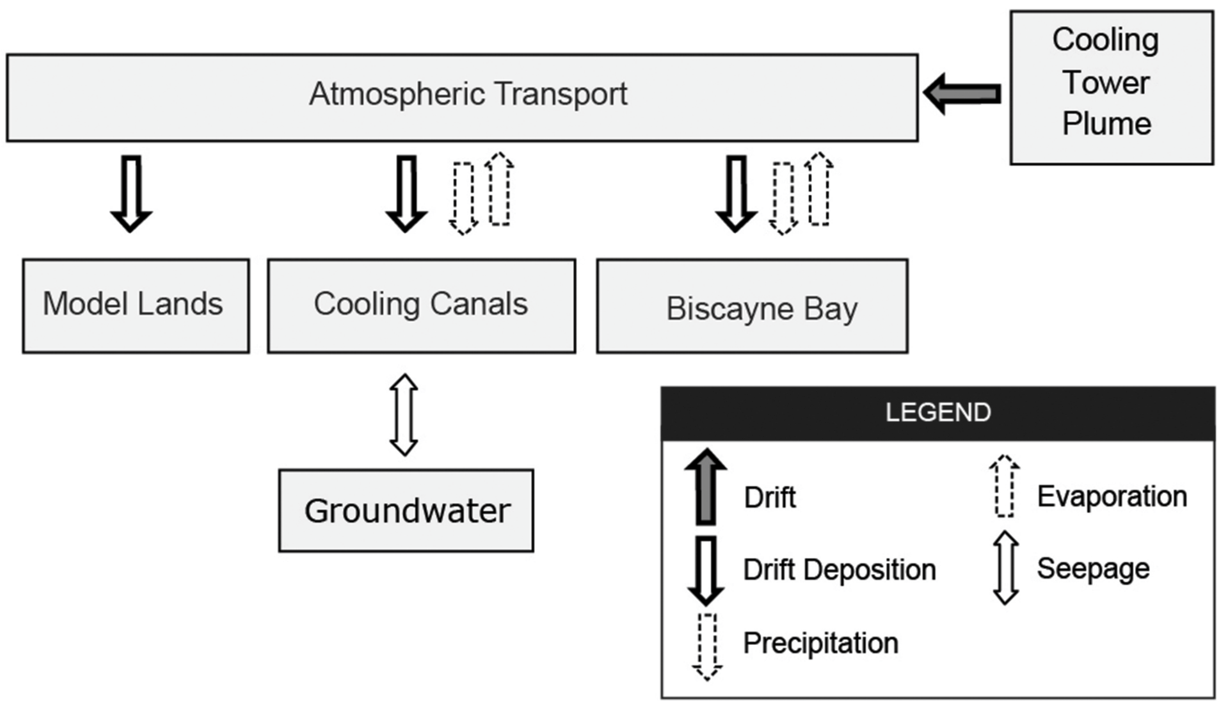

Figure 5-1. Schematic of Hydrologic and Mass Exchange Processes Considered in Estimating the Effects of Drift Deposition on the IWF Cooling Canals, Model Lands, and Biscayne Bay

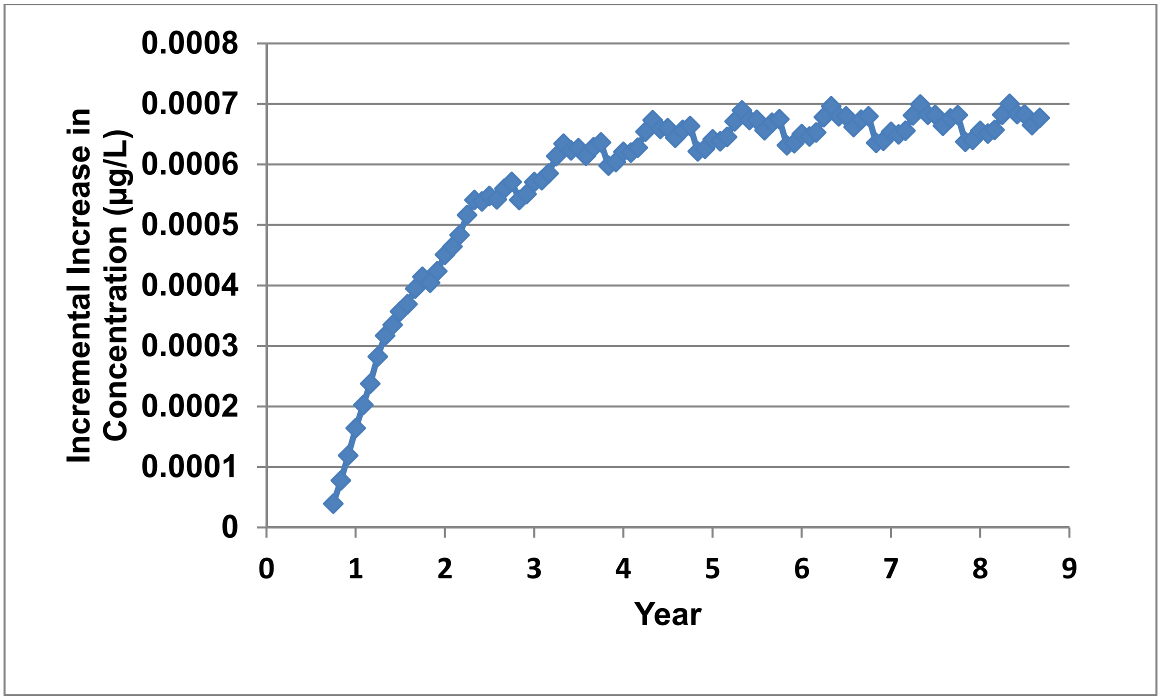

Figure 5-2. Concentrations of 1,4-Dichlorobenzene Based on Annual Average Drift Flux from the Cooling Towers over a 9-Year Period. ***Hydrologic conditions are those used to estimate the cooling-canal volumes shown in Table 5-2.***

Table 5-2. Estimated Contaminant Concentrations in the Cooling Canal from Drift Deposition. ***Detection or reporting limits are provided for comparison. Drift deposition is assumed to be the only source of contaminants.***

Contaminant	Method Detection Limit (µg/L)	Maximum Incremental Increases of Concentration in Cooling Canals (µg/L)	Category
	Reclaimed Water		
1,4-Dichlorobenzene	0.1[(a)]	0.00070	Insect repellant
3 Beta-coprostanol	0.52[(a)]	0.0011	Human digestion
4-Nonylphenol	0.64[(a)]	0.0022	Detergent metabolite
Acetyl-hexamethyl-tetrahydro-naphthalene (AHTN)	0.08[(a)]	0.0022	Polycyclic musk (e.g., tonalide)
Hexahydrohexamethylcyclo-pentabenzopyran (HHCB)	0.12[(a)]	0.00027	Polycyclic musk (e.g., galaxoide)
Phenanthrene	0.08[(a)]	0.00032	Polycyclic aromatic hydrocarbon (PAH) compound
Warfarin	0.012[(b)]	0.000064	Pharmaceutical
17 Beta-estradiol (E2)	2[(b)]	0.000019	Hormone
Triclosan	Unknown	0.060	Antimicrobial
Copper	6.0[(c)]	0.0052	Metal

(a) Lietz and Meyer 2006-TN1005.
(b) reporting limit
(c) FPL 2012-TN263.

Effect of Stormwater Discharge

Section 3.2.2.1 discusses stormwater drainage for the plant area which includes a proposed makeup-water reservoir (FPL 2011-TN303). Stormwater discharge locations are shown in Figure 3-4. The site hydrology prior to building is discussed in Section 2.3.1.1. According to Table 2-10, the average annual runoff to the IWF cooling canals from the plant area prior to building would be is 1,163 ac-ft from an annual average precipitation depth of 57.15 in. The review team estimated after building the annual stormwater runoff from the same area would be 1,141 ac-ft, considering that the makeup-water reservoir would collect rainfall but not contribute to the stormwater runoff to the IWF.

Because of the reduction in volume of stormwater and the use of the BMPs for stormwater management, as discussed in Section 3.4.2.1, the review team concludes that the hydrological alterations to the IWF due to stormwater discharge would be undetectable.

Runoff from Spoils Piles

As indicated in Section 3.2.2.3, spoils would be disposed of along sections of the IWF berms. The effect of pore-water drainage from spoils piles is discussed in Section 4.2.1.4 and the review team calculated the maximum incremental increase in concentration of total Kjeldahl nitrogen (TKN) and total phosphorus (TP). During operation of Turkey Point Units 6 and 7, runoff from precipitation could leach TKN and TP from the spoils piles. There is a potential for the runoff to discharge into the IWF. While not a water body regulated for water quality, there is concern related to the potential impact on Federally protected crocodiles, which nest on the cooling-canal berms at several locations of the IWF.

Based on the review team's independently calculated disposal area of 222 ac, an annual precipitation depth of 77.43 in. (SFWMD 2012-TN1523), and assuming that all precipitation runs off the spoils pile, the review team estimated the annual volume of runoff to be 1,430 ac-ft. This gives an annual average discharge of 1.98 cfs. For the evaluation of the potential maximum impact, the review team made several assumptions: (1) the volume of runoff drainage was added to the IWF continuously until a dynamic equilibrium was established, (2) the nutrient concentrations in the pore-water drainage were represented by average concentrations reported in the Round 2 SCA documentation with conservatively no decrease in average concentration over time, and (3) the constituents were conservative (no loss except by dilution). Round 2 of the Florida SCA review (FPL 2010-TN3664) reports nutrient concentrations measured from muck leachate samples. The average nutrient concentration measured in the muck leachate for TKN was 0.31 mg/L (FPL 2010-TN3664). TP was not detected, so half the detection concentration was used, that is, 0.15 mg/L (FPL 2010-TN3664). Using the estimated average discharge and the concentrations, the review team computed the daily load of TKN to be 1.50 kg/d and of TP to be 0.73 kg/d.

To compute the maximum incremental increases of concentrations, the review team used the same water and mass balance methods discussed under Drift Deposition above. Based on the estimated daily loads for TKN and TP, the maximum incremental increase in concentration for TKN would be 32 μg/L and for TP would be 16 μg/L.

5.2.1.5 Effect of Radial Collector Well Operation

As described in the Section 2.3.1.2, the IWF cooling canals interact with groundwater in the underlying Biscayne aquifer. Operation of the RCWs will reduce hydraulic head in the aquifer under Biscayne Bay in the vicinity of the wells and is likely to cause groundwater under the IWF to move northeast during the brief and infrequent periods that the RCWs are pumped for either a backup supply of makeup water or for well maintenance. The review team determined, based on the reliability of the components of the reclaimed water system, that the RCWs would be called into use infrequently and for limited durations.

5.2.1.6 Offsite/Adjacent Areas

Hydrological alterations affecting the offsite/adjacent areas that would be associated with the operation of Turkey Point Units 6 and 7 may occur as a result of (1) drift deposition from cooling towers, and (2) stormwater runoff.

Effect of Drift Deposition

The review team has conducted analyses to estimate drift deposition of chemical contaminants on aquatic and terrestrial habitats; these estimated depositions would be used for determining aquatic and terrestrial ecological effects. The methods of estimating drift deposition are discussed in the Biscayne Bay section above, and the estimated deposition rates are provided in Table 5-1, which includes offsite areas west of the site. The potential concern for offsite areas is the accumulation of salt and contaminants in terrestrial and wetland habitats.

Table 5-1 provides deposition rates with the use of reclaimed water and marine water from Biscayne Bay as cooling-tower makeup water. The table includes concentrations in wastewater (or Biscayne Bay source water), ratios of constituent concentration to TDS concentration, and calculated deposition rates for each constituent to areas around the cooling towers. The focus in this section is the offsite areas. In the area west of the project area, which includes a portion of the Model Lands, the deposition rate for TDS is 0.0146 $g/m^2/mo$, and as noted in the Biscayne Bay section, the deposition rate of potentially associated chemical contaminants is extremely low ($<2.0x10^{-7}$ $g/m^2/mo$).

Regions further west (including Everglades National Park) would be expected to have exponentially lower deposition rates; those rates are not calculated in the deposition analysis. The upper bound would be a salt-deposition rate of approximately 0.01 $g/m^2/mo$ at the edge of the modeled deposition area, which is lower than the average deposition rate of 0.0146 $g/m^2/mo$ for areas west of the site. Also, there is an exponential rate of decrease in salt deposition with increasing distance from the cooling towers, so that an upper bound of 0.01 $g/m^2/mo$ is likely much too large. Estimated deposition rates for the chemical contaminants would be on the order of 10^{-7} to 10^{-11} $g/m^2/mo$. For comparison, this is approximately equivalent to one 3 oz bottle of 100 percent DEET applied to 10,000 ac (15.6 mi^2) over 1 month.

Effect of Stormwater Discharge

Section 3.4.2.1 discusses stormwater drainage from the RWTF area. Stormwater discharge locations are shown in Figure 3-4. The local site hydrology prior to building is discussed in

Section 2.3.1.1. According to Table 2-10, the average annual runoff from the RWTF area prior to building is 207 ac-ft from an annual average precipitation depth of 57.15 in. calculated for the period from 2000 to 2010. The review team estimated stormwater discharge from the RWTF area after building to be 169 ac-ft, assuming 100 percent runoff of precipitation. The annual average runoff following building decreases largely due to the removal of the open basins as contributing areas. The maximum annual precipitation during the period was 71.53 in. during 2005, which produces 212 ac-ft of runoff after building compared to 259 ac-ft (Table 2-10) prior to building.

The review team discussed stormwater management with SFWMD experts and they identified no conditions to suggest that stormwater mitigation could not be achieved with the BMPs discussed in Section 3.4.2.1. The review team concludes that the alteration of the hydrology outside of the site due to stormwater discharge from the RWTF would be minimal.

5.2.2 Water-Use Impacts

A description of water-use impacts on surface water and groundwater is presented in the following sections. Overall, the water resource usage for proposed Turkey Point Units 6 and 7 operations would be limited because of the use of reclaimed water from Miami-Dade County for cooling-system makeup-water needs during normal operations. The use of RCWs to collect saltwater from Biscayne Bay at the Turkey Point site would serve as a backup supply of makeup water. In addition, water would be provided by the MDWASD for general plant operations, including potable-water supply, raw water to the demineralizer, firefighting water, and media filter backwash. The MDWASD obtains its water from groundwater supply wells.

5.2.2.1 Surface-Water-Use Impacts

As indicated in Chapter 3, the primary makeup-water supply for cooling water is reclaimed water from the MDWASD. This reclaimed water is considered a freshwater source, and because it is being reused, its use causes no withdrawals from surface waters, so there is no impact on surface-water users. Therefore, the NRC staff determined that the impact of operation of the proposed Units 6 and 7 on surface-water users would be SMALL and no mitigation would be required.

5.2.2.2 Groundwater-Use Impacts

The use of reclaimed water from the MDWASD as a makeup-water supply would cause no new withdrawals from groundwater, so there would be no impact on groundwater users from the use of reclaimed water.

During the irregular and brief durations that the RCWs installed beneath Biscayne Bay could be used as a backup supply of makeup water, most water would be drawn into the wells from the bay. However, some fraction of water would be withdrawn from the inland portion of the Biscayne aquifer. The RCWs would only be used when reclaimed water from the MDWASD is not available in sufficient quantity or quality. The review team determined, based on the reliability of the components of the reclaimed water system, that the RCWs would be called into use infrequently and for durations much shorter than the 60-day maximum allowed per year under the FDEP final Conditions of Certification (State of Florida 2014-TN3637). This limited use greatly reduces potential RCW impacts on groundwater users.

An important question in evaluating the potential impacts of pumping the RCWs is the relative fraction of water that would come from the inland aquifer and freshwater canals to the west of the bay compared to the fraction coming from saltwater in the bay. The aquifer performance test conducted on the Turkey Point peninsula (see Section 2.3.1.2), where the RCWs would be installed, indicated that the Biscayne aquifer was a "leaky" aquifer separated from a constant-head water source by a partially confining layer of lower permeability material (bay-floor sediment and upper layers of the Miami Limestone). The bay-floor sediment was estimated by FPL to have an average vertical hydraulic conductivity of 0.7 ft/d (FPL 2009-TN1263). A separate analysis of the aquifer performance test by the review team resulted in an average vertical hydraulic conductivity of 0.6 ft/d for the bay-floor sediment. These vertical hydraulic conductivity values are high enough to allow a significant amount of leakage from Biscayne Bay (saltwater) to flow vertically through the sediments and reach the radial collector laterals between 25 and 40 ft below the bottom of the bay.

The review team evaluated the potential impacts of the maximum 60 d/yr pumping of the RCWs with regard to other users of Biscayne aquifer groundwater. FPL specified a RCW pumping rate of 86,400 gpm (FPL 2014-TN4058) during times that the RCW backup supply is needed. A maximum volume of 7.5 billion gallons (28,000,000 m^3) of water would be pumped during the 60-day period that would be allowed per year. Because of the large uncertainty in calculating or modeling the fraction of groundwater that would potentially be removed from freshwater resources, including the inland portion of the Biscayne aquifer and freshwater canals, the review team took a conservative approach and estimated that 5 percent of the water produced from RCWs would come from the freshwater inland portion of the Biscayne aquifer. This would equate to removing 375 million gallons per year of water from the inland aquifer and/or freshwater canals during 60 days of backup pumping. By comparison, about 31.4 billion gallons of groundwater were pumped from the Biscayne aquifer in Miami-Dade County during 2005 (Marella 2009-TN1521). The review team estimated that the volume that could be removed from the aquifer per year by 60 days of pumping of the RCWs is about 2 percent of the approximately the 19.3 billion gallons of annual groundwater discharge to the Biscayne Bay estimated by Langevin (2001-TN1338) for a 100 km length of southeast Florida coastline.

The rates and durations of maximum permitted RCW use are unlikely to cause a significant decrease in groundwater levels or in freshwater canal discharge rates (see Appendix G). As stated above, the RCWs are expected to be used infrequently as a backup water supply and for durations much shorter than 60 days based on the staff's evaluation of the reliability of the reclaimed water system. Therefore, the impact on groundwater users from the planned pumping of the RCWs for maintenance or their infrequent pumping to supply backup water for less than 60 d/yr would be minor.

Changes to the environment could be affected by the operation of Turkey Point Units 6 and 7 and have happened since the publication of the draft EIS. Those which are expected to continue in conformance with recent regulatory actions are discussed in Section 2.3.1. The review team determined that the hydrological alterations resulting from operating the RCWs in this potentially altered environment are consistent with those described above (and see

Appendix G.2). This determination is based on the FPL numerical model analysis, the review team's independent numerical modeling analysis, and the review team's knowledge and expertise. The conceptual models that served as the basis for the numerical models are based on available characterization information for the Turkey Point site and surrounding region. Uncertainties in the information and conceptual model were addressed in some cases by performing multiple model runs while varying key parameters in the model and in other cases by using conservative parameter values. However, uncertainties remain that do not allow the review team to assert that no other conceptual models that may result in more adverse impacts from RCW operation are plausible. Heterogeneity in subsurface parameters, lack of experience with RCW systems in carbonate strata, and uncertainty in the future site environment (e.g., freshening of IWF, remediation of subsurface hypersaline plume, sea-level rise) all warrant the review team to exercise care to avoid relying on numerical models alone.

Maintenance of facilities, including roads, pipelines, transmission lines, underground utilities, and others, may require occasional dewatering of excavations. The volumes of water that would be extracted from the Biscayne aquifer for these activities would be limited and regulated by the State or local agencies. Based on the information provided by FPL and the review team's independent evaluation, the impact of these activities on groundwater users would also be minor.

Because reclaimed water from the MDWASD would be used as the primary makeup-water supply for cooling water and the limited use of the backup RCWs would extract a very small fraction of pumped water from the inland Biscayne aquifer, the expected operational usage of groundwater is not expected to have a noticeable effect on saltwater intrusion, migration of the hypersaline plume from the IWF, or on water levels at freshwater supply wells. Additional extraction of groundwater by MDWASD to meet plant requirements for potable and service water is negligible compared to the current demand.

The review team did not rely solely on the output of numerical models. Numerical models are numerical representations of complex processes occurring in three dimensions over time. Such models were never intended to be exact representations of the system being modeled. The appropriate role of a numerical model is to test assumptions of the behavior of complex systems. Even running a numerical model numerous times with different parameters cannot reveal the impact of all uncertainties on the possible outcome. In this assessment, the review team also used numerical models to test possible consequences of changes in the affected environment and uncertainty in some subsurface parameters (see Appendix G.2). This information was combined with the review team's knowledge of the geography of the RCW field (e.g., the relatively short distance from the laterals to the bay bottom relative to distance from the RCW laterals to the canals and the Homestead well fields, elevation of water in the IWF near the RCWs, etc.) and the expectation that the monitoring program and mitigation options required by the Conditions of Certification (State of Florida 2014-TN3637) will be implemented.

In making its impact determination, the review team relied on the requirement of a monitoring program and a reasonable expectation that timely detection and mitigation of impacts would prevent the occurrence of impacts greater than those described above. The review team determined that the proposed monitoring of RCW construction and operation included in the Conditions of Certification would be sufficient to detect unexpected behavior in a timely manner.

While all possible mitigation measures have not yet been spelled out, in accordance with the Conditions of Certification, “When harm occurs, or is imminent, SFWMD will require [the] Licensee to modify withdrawal rates or mitigate the harm” (State of Florida 2014-TN3637). The review team considers that the ultimate mitigation of ceasing operation of the RCWs will prevent unacceptable impacts in a timely manner.

The review team assessed the impact of operating Units 6 and 7 in the affected environment that was present in 2013 and described in Revision 6 of the ER and found the impacts to be small. The staff analyzed the impacts of operating Units 6 and 7 on a variety of conditions representing possible future affected environments that could occur depending on the efficacy of the actions prescribed by the Administrative Order and the Consent Agreement. Regardless of which of these possible futures actually occurs, the impact of operating Units 6 and 7 would be minor. Therefore, the staff concludes that operational groundwater-use impacts would be SMALL, and mitigation beyond the FDEP final Conditions of Certification (State of Florida 2014-TN3637) would not be warranted.

5.2.3 Water-Quality Impacts

This section discusses the impacts on the quality of water resources from the operation of proposed Turkey Point Units 6 and 7. Surface-water impacts include chemical, radiological, and physical changes to nearby bodies of surface water including Biscayne Bay. Impacts on groundwater quality include chemical, thermal, and radiological impacts from the discharge of blowdown water from the proposed Units 6 and 7 cooling towers and other treated wastes to the Boulder Zone.

5.2.3.1 Surface-Water-Quality Impacts

As described in Section 3.4, liquid effluents from the proposed Units 6 and 7 operations would be disposed of via UIC (deep-injection) wells. Wastewater from the sanitary and potable-water systems would be treated at a planned sanitary waste-treatment plant, mixed with cooling-tower blowdown, and discharged to the Boulder Zone through the deep-injection wells. Because liquid effluents would not be disposed to bodies of surface water, there would be no impacts on surface-water quality from Units 6 and 7 operations.

A SWPPP and an erosion and sedimentation control plan, similar to those used at other large industrial facilities, would be in place during the operation of proposed Units 6 and 7 (FPL 2014-TN4058). During operation of Units 6 and 7, stormwater runoff from the plant area would be directed to the IWF. Because BMPs would be used to manage stormwater runoff and minimize the discharge of contaminants to the IWF, the staff considers the water-quality impact of stormwater runoff from the site on the IWF to be minimal.

During operation of Units 6 and 7, stormwater runoff from the RWTF area would be routed to two stormwater management basins before being released to its surrounding wetland area via riprapped aprons to reduce erosion potential (Section 3.2.2.1). Because the stormwater basins would be designed to meet the water quality criterion of Miami-Dade County, the staff considers the impact of stormwater runoff from the RWTF area on the water quality of the receiving wetlands to be minor.

Operation of the RCWs, if and when needed during operation of Units 6 and 7 would not result in discharges to Biscayne Bay because they are used only to withdraw saltwater. Therefore, the staff determined that the impact of any potential changes in surface-water chemistry as a result of the use of the RCWs on Biscayne Bay water quality would be minor.

Section 3.2.2.3 states that spoils will be disposed on the berms of the IWF. Runoff from precipitation on the spoils piles at disposal area B along the C-107 canal has the potential to enter Biscayne Bay via the C-107 canal and Card Sound. To evaluate the potential water-quality impact from runoff from spoils piles, the review team calculated the maximum incremental increase of concentration from a discharge into Card Sound. As discussed in Section 4.2.3.1, the review team determined that approximately 5 percent of the disposal area lies adjacent to the C-107 canal. As used in Section 5.2.1.4, the review team's calculation of discharge used an annual precipitation depth of 1,967 mm (77.43 in.) (SFWMD 2012-TN1523). Using the disposal area, precipitation depth, and assuming 100 percent runoff, the review team estimated an average discharge rate of 0.0028 m^3/s. The average nutrient concentration measured in the muck leachate for TKN was 0.31 mg/L (FPL 2010-TN3664). TP was not detected, so half the detection concentration was used, that is, 0.15 mg/L (FPL 2010-TN3664). As discussed in Section 4.2.3.1, the review team used the Hydrologic Engineering Center's River Analysis System (HEC-RAS) water-quality model (USACE 2014-TN4128) and available bathymetry for Biscayne Bay and Card Sound (NOAA 2014-TN3665) to estimate the maximum incremental increase in concentration in Card Sound. Using the discharge rate, concentrations, and flow and mass balance approach, the review team computed the maximum incremental increase in concentration to be 1.11×10^{-6} mg/L for TKN and 7.67×10^{-7} mg/L for TP. For reference, the maximum TP concentration of 40 samples taken in Card Sound by the NPS for the period October 30, 2006 through June 30, 2008 was 8.8×10^{-3} mg/L. The review team determined that the conservatism in this analysis bounded the incremental impacts and that the changes would be undetectable. Because any inflow to Biscayne Bay from Card Sound would be subject additional dilution by tidal exchange, maximum incremental increases of concentration in Biscayne Bay would be even smaller due to mixing from tidal exchange.

The review team determined that there were no surface-water users that would be affected by changes in water chemistry because of the operation of the proposed Turkey Point Units 6 and 7. Therefore, the impacts of surface-water quality would be SMALL, and mitigation for water quality would not be warranted beyond the FDEP final Conditions of Certification (State of Florida 2014-TN3637).

5.2.3.2 Groundwater-Quality Impacts

Radial Collector Well Impacts

As discussed above, operation of the RCWs could remove some groundwater from the inland portion of the Biscayne aquifer, thereby resulting in an increase in the amount of saltwater intrusion into the aquifer. However, the review team determined that the volume removed from the inland aquifer would be a small fraction of the pumped volume, and based on the reliability of the components of the reclaimed water system, the RCWs would be called into use infrequently and for durations much shorter than the 60-day maximum allowed per year under the FDEP final Conditions of Certification (State of Florida 2014-TN3637). This limited use greatly reduces potential RCW impacts on saltwater intrusion.

Changes to the environment could be affected by the operation of Turkey Point Units 6 and 7 and have happened since the publication of the draft EIS. Those which are expected to continue in conformance with recent regulatory actions are discussed in Section 2.3.1. The review team determined that the hydrological alterations resulting from operating the RCWs in this potentially altered environment are consistent with those described above (and see Appendix G.2). This determination is based on the FPL numerical model analysis, the review team's independent numerical modeling analysis, and the review team's knowledge and expertise. The conceptual models that served as the basis for the numerical models are based on available characterization information for the Turkey Point site and surrounding region. Uncertainties in the information and conceptual model were addressed in some cases by performing multiple model runs, while varying key parameters in the model, and in other cases by using conservative parameter values. However, uncertainties remain that do not allow the review team to assert that no other conceptual models that may result in more adverse impacts from RCW operation are plausible. Heterogeneity in subsurface parameters, lack of experience with RCW systems in carbonate strata, and uncertainty in the future site environment (e.g., freshening of IWF, remediation of subsurface hypersaline plume, sea-level rise) all warrant the review team to exercise care to avoid relying on numerical models alone.

UIC Impacts

Injection of blowdown water and other liquid waste streams into the Boulder Zone creates a potential for contamination of groundwater in the overlying Floridan USDW aquifer. The top of the injection zone is estimated to be 2,915 ft below ground surface and 1,465 ft below the base of the deepest USDW, based on information collected at the EW-1 well completed in May 2012 (FPL 2012-TN1264). The expected lower density of injectate compared to native water in the Boulder Zone will result in an upward flow potential.

Injected contaminants would have to move upward through a 985 ft thickness of the middle Floridan confining unit to reach potentially permeable saline intervals including the APPZ, if it is present at the site. Contaminants would then have to migrate upward through another 480 ft of mostly low-permeability rock to reach the lowermost USDW aquifer. The review team determined that without a preferential flow path such as an open borehole or permeable fracture zone, the rate of contaminant migration through the estimated 985 ft of overlying low-permeability sediments within the MCU would be extremely slow, dilution of the contaminants would occur through the process of dispersion, and injected contaminants are unlikely to reach the deepest USDW aquifer.

FPL determined hydrologic properties of aquifers and confining units during the drilling and completion of EW-1 (FPL 2012-TN1577) and DZMW-1 (FPL 2012-TN4053). The borehole information and flow tests did not indicate the presence of enhanced vertical flow paths from either improper well construction or natural vertical pathways. As required by FDEP's UIC program, a short-term injection test was performed on EW-1 following its conversion to deep-injection well DIW-1. Pressures were monitored at the injection well head and within the water columns of both zones of the dual-zone monitoring well located approximately 75 ft from the injection well. The monitored interval depths are: 1) 1,400−1,420 ft within the Upper Floridan aquifer, and 2) 1,850−1,870 ft within the middle Floridan confining zone. Water was pumped into the injection zone for a total of 9 hr and 33 min at approximately 7,000 gpm. The results showed that there was a pressure increase of about 4 psi in the injection zone. The only measurable pressure response observed in either monitored interval was attributable to tidal influence (FPL 2014-TN4052).

The lower portion of the MCU from about 1,900 ft to 2,915 ft below ground surface contained water with high TDS content, indicating a lack of communication with the Upper Floridan USDW aquifer. Data from geophysical logging, core analyses, and in situ flow (packer) tests also indicated that the interval from 1,900 to 2,900 ft consists of dense limestone and dolomite with low permeability. The review team's evaluation of these data confirmed the presence of confining layers and a lack of evidence for extensive vertical pathways through the MCU. This is discussed in greater detail in Section 5.2.1.3.

Upward migration of wastewater within the MCU has occurred at the Miami-Dade SDWWTP and was attributed to enhanced vertical flow likely caused by a well construction problem (Walsh and Price 2010-TN3656; McNeill 2000-TN4572; McNeill 2002-TN4571). Such a construction problem is not expected at the Turkey Point site because the pilot hole would be cemented before reaming and tests would be performed every 5 years to verify well integrity (FPL 2011-TN51). As discussed in Section 2.3, lower injection rates planned for the proposed site relative to the SDWWTP (20 Mgd vs 97 Mgd) would also aid in limiting formation pressures and the potential for vertical movement of effluent. While it is possible that an unknown vertical pathway could exist within the area of influence of the injection wells that could lead to eventual upward migration of wastewater, such a pathway is not indicated by site specific data.

Because of the relatively low concentrations of contaminants the impacts of upward migration, if it occurred, would be expected to be minor. The monitoring requirements of the FDEP UIC program are also designed to detect for leaks before significant releases to upper aquifers may occur.

In addition, several assessments have been conducted to evaluate the risk to human and ecological health from wastewater disposal methods utilized in South Florida, including deep well injection. One assessment published by the EPA incorporated site characterization data and concentrations of "representative stressors" present in injected wastewater into fate and transport models, one of which was specific to Dade County. These models evaluated two scenarios of flow of injected wastewater through the MCU; flow through the MCU matrix (referred to as "porous media flow") and rapid flow through preferential flowpaths (such as a failed well or natural conduit). Final concentrations of stressors were determined at receptor locations that included the USDW and also wells screened higher within the Upper Floridan aquifer. The stressors that were evaluated included three constituents that are also present in wastewater to be injected at Turkey Point and listed in Table 3-5. These are ammonia, nitrate, and PCE (tetrachloroethylene). The models indicated that concentrations that may reach receptor locations would be below the maximum contaminant level in all cases. In these scenarios, the initial injected concentration of PCE was slightly lower than the maximum contaminant level but higher than the concentration expected for injected effluent at Turkey Point (Table 3-5). For PCE specifically, the initial concentrations were calculated to be reduced by 95 percent to 100 percent when they reached the USDW and the well within the Upper Floridan aquifer. As a result, the study concluded that overall risk to human health from deep well injection was “low where there have been impacts to USDWs; however, exposure of current water supplies is unlikely” and that “risks would be furwther reduced when the injected wastewater is treated to reclaimed water standards” (EPA 2003-TN4759). The reduction in concentration during migration of injected wastewater estimated by this risk assessment is large and correlates well with that presented by Dausman et al. (2008-TN4757), who estimated dilution amounts of up to 95 percent, as discussed in Section 5.2.1.3. If the concentrations calculated for Turkey Point effluent were used as the initial concentration in this analysis, the expected final concentrations expected at the USDW or Upper Floridan aquifer well would also be so low as to be undetectable. Final concentrations could be further reduced due to advanced treatment received by reclaimed water at SDWWTP, as discussed in Section 5.2.1.3.

Another comparative assessment of wastewater disposal methods in southeast Florida evaluated impacts of deep well injection to a variety of receptors based on multiple exposure routes (Bloetscher et al 2005-TN4756). These routes included direct leakage of injection wells into the Biscayne Aquifer and the Upper Floridan aquifer, as well as rapid vertical migration from deep injection wells into the Upper Floridan aquifer. This study concluded that risk were “lower, in general, for injection well disposal, due to natural barriers between the injection point and population centers.” The study also suggested that as distance from the injection well increased, risk to receptors decreased, with the lowest relative risk at distances of 5 mi (or greater). This distance bounds the migration distance expected for wastewater injected at Turkey Point as predicted by modeling studies and discussed in Section 5.2.3.1.

These risk assessments, which included evaluations of impact to the Upper Floridan aquifer, indicate that, even if upwelling of injected wastewater were to occur, offsite concentrations would be below applicable drinking water limits or even laboratory detection limits and impacts would be negligible. As mentioned above, the Boulder Zone is not used as a groundwater source and the Upper Floridan aquifer, which is brackish, is not used as a source of groundwater in the area in which migration of the injected cooling water may reasonably be expected.

The Boulder Zone UIC wells would be permitted by FDEP as Class I UIC wells with a total capacity of 90 Mgd. Locations of the injection and monitoring wells and additional details about well construction are described in Section 3.2.2.2 of this EIS. UIC permits issued by FDEP require institutional controls and monitoring programs to detect upward migration of injected wastewater. Detection of contaminants at monitoring wells completed in the confining zone or in the Upper Floridan aquifer would require remedial action (Fla. Admin. Code 62-4-TN1084). The EPA risk assessment states that the UIC permit process, “offers better opportunities to evaluate the suitability of specific well sites and injection zones. The permit process is also designed to anticipate and prevent potential problems related to well operation (and adverse impacts resulting from injection)” (EPA 2003-TN4759). Characterization, monitoring, and testing required by the UIC permit process would be completed for each of the 12 planned injection wells at the Turkey Point site.

Because of the evidence of adequate isolation of the Boulder Zone from the overlying USDW by layers of low-permeability rock, the potential effect of advanced treatment received by reclaimed wastewater before leaving the SDWWTP, the evaluation of the extent and fate of injected effluent at the Turkey Point site, risk assessments of deep well disposal, and the UIC monitoring requirements, the review team determined that the Upper Floridan aquifer USDW would be protected from degradation. Contaminants would be introduced to the Boulder Zone from the injected wastewater. However, because the salt content of ambient groundwater in the Boulder Zone is similar to seawater, this aquifer is not considered a potential, current, or future source of irrigation or drinking water. Impacts of the limited operation of the RCWs on saltwater intrusion in the Biscayne aquifer are also minor. Therefore, the staff concludes that operational groundwater-quality impacts would be SMALL, and mitigation beyond the FDEP final Conditions of Certification would not be warranted.

5.2.4 Water Monitoring

Section 6.3 of the ER (FPL 2014-TN4058) describes the hydrologic monitoring program that would be used to control potential adverse impacts of Turkey Point operations on surface water and groundwater, and it identifies alternatives or engineering measures that could be implemented to reduce these impacts. Because this section primarily describes FPL's plans for future monitoring, its language is based closely on FPL's description of the monitoring program in the ER.

5.2.4.1 Surface Water

Because there are no freshwater streams on the Turkey Point site, no operational monitoring of streams is necessary. Based on the modeling analyses of the effect of backup RCWs pumping on the adjacent nearshore area of Biscayne Bay and on the reliability analysis of the availability of reclaimed water, the operations of Turkey Point Units 6 and 7 would not affect the nearby waters of Biscayne Bay. Several stations in Biscayne Bay are currently monitored for salinity, including those near Turkey Point: BISC 12/13, BISC18/19, BISCA6, and BBCW10 (Bellmund 2012-TN4118).

5.2.4.2 Groundwater

Most pre-application monitoring wells are within the footprint of the proposed construction area on the Turkey Point site and would need to be decommissioned before construction activities begin. Permanent wells completed in the Biscayne aquifer would continue to be monitored during and after the plant construction period to establish a pre-operational baseline for the shallow groundwater flow system. FPL (2014-TN4058) proposes to install monitoring wells near the location of the RCWs and inshore from the RCWs to monitor groundwater quality and hydraulic head during RCW operation. Groundwater monitoring requirements related to the RCW system are also imposed by the State of Florida final Conditions of Certification (State of Florida 2014-TN3637).

A monitoring program including measurements of groundwater hydraulic head and groundwater-quality parameters in aquifers overlying the Boulder Zone would also be implemented to comply with requirements of the FDEP UIC permits and ensure that injected wastewater does not migrate into the USDW within the Upper Floridan aquifer. As described in Section 3.2.2.2 of this EIS, a minimum of six dual-zone monitoring wells would be installed so that a dual-zone monitoring well is between each pair of injection wells to provide samples of groundwater in the deepest USDW aquifer (defined as containing groundwater with less than 10,000 mg/L TDS) and in the zone below the deepest USDW.

Section 6.6 of the ER (FPL 2014-TN4058) describes the chemical monitoring program. The objective of chemical monitoring is to identify changes in water quality that may result from the proposed Turkey Point operations.

As described in Section 3.2.2.2 of this EIS, 10 primary UIC wells and 2 backup UIC wells are planned.

5.3 Ecological Impacts

This section describes the potential impacts on ecological resources from the operation of two new reactor units at the Turkey Point site, as well as the operation of the associated offsite facilities, which include new transmission lines and potable- and reclaimed water pipelines. The operational impacts for terrestrial and wetland ecosystems are discussed in Section 5.3.1, and those for aquatic ecosystems are addressed in Section 5.3.2. The evaluation of potential impacts on terrestrial and aquatic biota from radiological sources is discussed in Section 5.9.5

5.3.1 Terrestrial and Wetland Impacts Related to Operations

The greatest potential for impacts on terrestrial habitats and species from operation of proposed Turkey Point Units 6 and 7 is expected to be caused by cooling-system operations and the operation and maintenance of the transmission lines and pipelines. Issues considered by the review team include local deposition of dissolved solids (commonly referred to as salt deposition); deposition of chemical contaminants with the use of reclaimed water; increased local fogging, precipitation, or icing; increased local noise levels; a risk of avian mortality caused by collision with tall structures; and possible hydrological changes to shoreline habitats adjoining Biscayne Bay. The review team also considered whether increased traffic and nighttime lighting associated with operation could affect wildlife. These operational impacts are discussed further in Section 5.3.1.1. Issues considered with respect to the operation and maintenance of the transmission system include collision mortality and electrocution, exposure to electromagnetic fields (EMFs), and the vegetation maintenance within transmission line corridors. Impacts of the transmission lines on terrestrial resources are discussed in Section 5.3.1.2. The potential effect of these operational impacts on important species and their habitats, including Federally and State-listed species, is addressed in Section 5.3.1.3.

As described in Chapter 3, the cooling system proposed for Turkey Point Units 6 and 7 includes a reclaimed water pipeline and treatment facility as well as a RCW system embedded under Biscayne Bay. It is anticipated that most of the makeup water would be reclaimed water from the MDWASD, but that the RCWs would also withdraw seawater from the Biscayne Bay when necessary to meet operational demands. The ratio of water supplied by the two makeup-water sources would vary based on the quantity and quality of reclaimed water available. The heat would be transferred to the atmosphere in the form of water vapor and drift. Vapor plumes and drift, including salts and other solutes in the drift, can affect crops, ornamental vegetation, and native plants. The review team considered whether water withdrawals could increase salinity levels in the Biscayne Bay and alter shoreline vegetation and habitats. In addition, the review team considered whether bird collisions were possible with the proposed mechanical draft cooling towers and other tall structures, and whether wildlife could be affected by noise generated by operation of the cooling towers.

Potable water for operations would also be supplied by MDWASC. The MDWASC obtains water from the Biscayne aquifer and its water withdrawals are regulated under the County's consumptive use permit from the SFWMD. The high salinity of the Biscayne aquifer in the immediate vicinity of proposed Units 6 and 7 excludes local groundwater as a source of potable water and thus would preclude dewatering of local wetlands (FPL 2014-TN4058). See Section 2.3 for a complete description of hydrologic features within the region. Electric transmission systems have the potential to affect terrestrial ecological resources through corridor maintenance, bird collisions with transmission lines, and EMFs (NRC 2013-TN2654). New transmission lines (500 kV and 230 kV) would be installed to incorporate power generated by proposed Units 6 and 7 into the Florida electric grid system.

5.3.1.1 Terrestrial Resources – Site and Vicinity

Impacts on the FPL Turkey Point site and vicinity from the proposed operation of two new units are described in this section.

Impacts of Cooling-System Operations

The following discussion addresses possible impacts on vegetation from cooling-tower drift, icing, fogging, and increased humidity. No residential areas or row crop agricultural land exists on or adjacent to the Turkey Point site. Proposed Units 6 and 7 would use a closed-cycle circulating-water system. Three mechanical draft cooling towers would be used to remove excess heat from each unit by transferring it to the atmosphere. An additional mechanical draft cooling tower would be used to remove heat from the service-water system for each unit. Water droplets blown from the cooling towers (i.e., cooling-tower drift) would unavoidably be released into the atmosphere as fine droplets.

Cooling Tower Drift – TDS: Cooling-tower drift contains dissolved solids (known as "salt") that can be deposited on nearby vegetation. Depending upon the source of makeup water, the TDS concentration in the drift can contain high levels of salts that damage exposed vegetation. Vegetation stress can be caused by salt deposition from drift, deposited either directly onto foliage or from accumulation in soil (NRC 2013-TN2654). Dissolved salts within makeup water obtained from the RCWs would far exceed salts dissolved within the reclaimed water, and the maximum levels expected in saltwater would be 34,000 mg/L (Section 5.7.2). Assuming that the makeup water would be obtained entirely from the RCWs and the cooling system would be operated at 1.5 cycles of concentration, the maximum rate of saltwater droplets at approximately 50,000 mg/L expected to escape the cooling towers would be 70 g/s from each cooling tower during normal operation. Salt drift would be deposited in various directions from the cooling towers, with most of it falling over the IWF on FPL's Turkey Point site and over Biscayne Bay. The highest deposition would occur near the makeup-water reservoir on the island that composes the plant area and could be as high as 105 kg/ha/mo (kilograms/hectare/month) (see Section 5.7.2). However, salt deposition is expected to decrease rapidly with increasing distance from the cooling towers and the maximum estimated offsite deposition over naturally vegetated land would be about 4 kg/ha/mo in the Everglades Mitigation Bank (EMB) Phase II immediately west of the IWF (Figure 5-3) (FPL 2014-TN4058).

Stress to local plant life could be caused by high salt deposition from drift, either directly onto foliage or indirectly from salt accumulation in soils. Visible leaf damage has been observed when TDS are deposited at a rate as low as 10 kg/ha/mo (NRC 2013-TN2654). TDS deposition at this rate would be expected to occur on the proposed Units 6 and 7 plant area, within the IWF, and on nearshore areas of Biscayne Bay immediately southeast of the cooling towers (FPL 2014-TN4058). The predominant vegetation within the expected zone of high salt deposition on the Turkey Point site is mangrove, particularly the red mangrove (*Rhizophora mangle*). Mangroves are salt-tolerant species that occur only in saline and brackish environments in South Florida. Salt deposition at rates that could affect plant life would only occur very near the cooling towers and decrease rapidly with distance from the cooling towers (Figure 5-3). Visible leaf damage may occur from salt deposition very near the cooling towers or on the island containing the plant area. Almost all of the area of high salt deposition would be developed and little vegetation is expected to remain. Some vegetation found on berms within the northern quarter of the IWF may be affected by salt deposition, but most plants occurring there would be salt-tolerant species because the industrial wastewater already contains elevated salt concentrations. Salt deposition outside the Turkey Point site boundary, including lands within the EMB, is not expected to occur at levels that might affect vegetation. Many piscivorous birds use the IWF for foraging and loafing (FPL 2014-TN4058). Salt deposition from drift is not expected to affect the distribution and abundance of fish within the facility. Therefore, impacts on terrestrial resources from salt drift within the proposed Units 6 and 7 plant area and offsite are expected to occur, but considering the existing hypersaline environment the effects are expected to be minimal.

Adverse impact on vegetation from soil salinization is not expected to be an issue within the areas receiving salt-drift deposition. Much of this area is already considered hypersaline due to operation of the existing facilities and the IWF. Potential soil salinization problems at energy facilities are generally limited to arid regions (NRC 2013-TN2654). The review team considered whether cooling-tower drift could increase the salinity of surface water in wetlands on the FPL Turkey Point site. Surface water is seasonally present within wetlands on the site, but much if not all of the wetlands within the proposed Units 6 and 7 plant area and those associated with the IWF are brackish or marine. Substantial freshwater wetlands are only located to the west of the site. Considering the very low contribution to surface-water salinity from cooling-tower drift and the low likelihood for substantial concentration of salts in surface waters, cooling-tower drift is not expected to impair freshwater ecosystems on, or in the vicinity of, the Turkey Point site.

Cooling Tower Drift – CECs: The reclaimed water serving as the primary makeup-water supply contains various chemical contaminants, including CECs and metals. Cooling-system configuration during operation using reclaimed water would achieve four cycles of concentration (FPL 2014-TN4058), further concentrating contaminants within the cooling water. Much like TDS, CECs and metals would also be deposited in the environment through cooling-tower drift. A previous evaluation of organic compounds, CECs, and metals within Miami-Dade wastewater was conducted. This evaluation included efforts to detect 129 different compounds, including 65 organic wastewater compounds, 24 pharmaceutical compounds, 37 antibiotic compounds, and 3 hormones (Lietz and Meyer 2006-TN1005). Effluent samples were analyzed, and

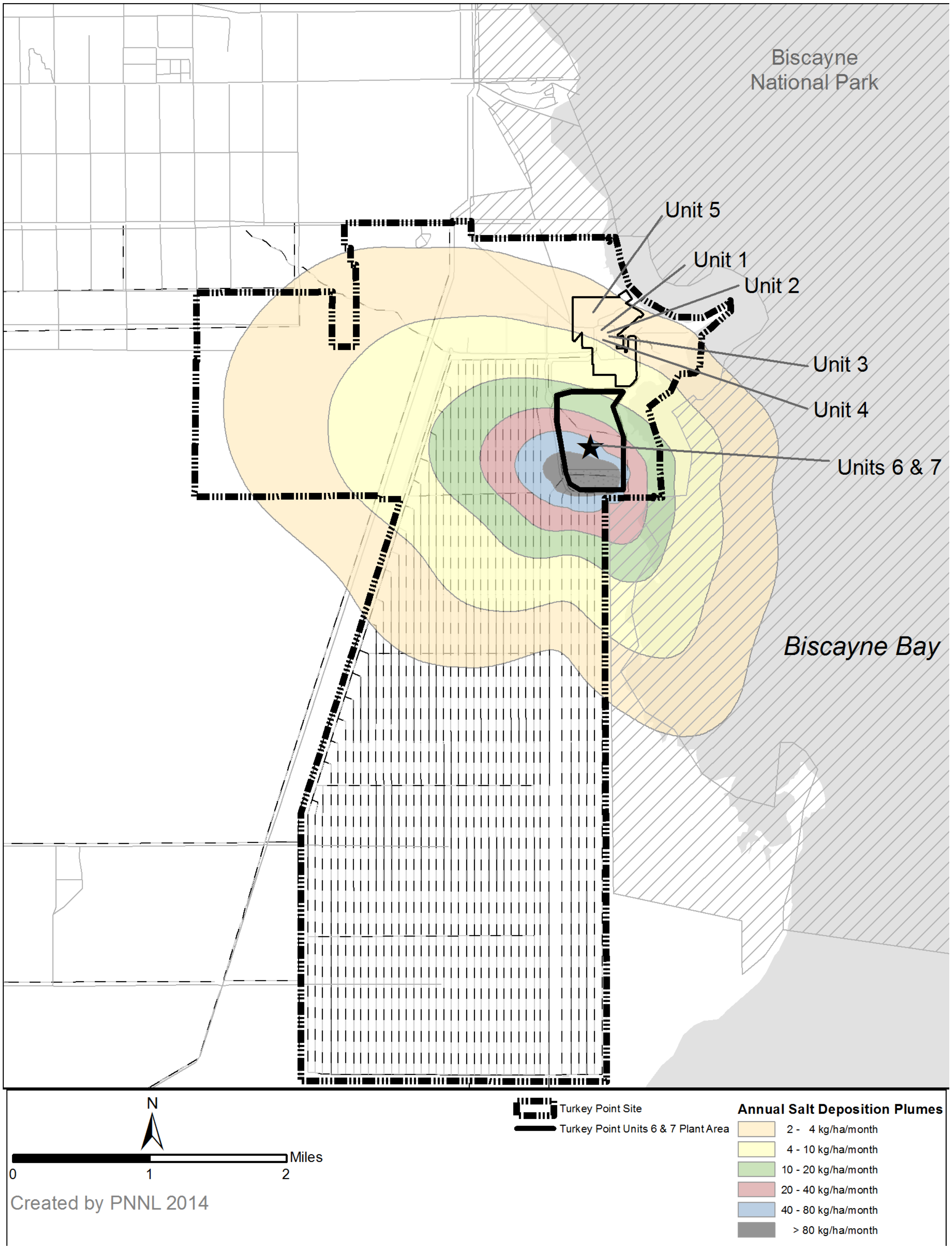

Figure 5-3. Predicted Monthly Salt Deposition from Cooling-Tower Operation Using Makeup Water Only Supplied by the Radial Collector Wells (Source: FPL 2014-TN4058).

compounds detected included 20 organic compounds, 11 pharmaceutical compounds, 8 antibiotic compounds, a hormone and a metal (Table 5-1). The NRC staff acknowledges this list of contaminants is not exhaustive but is a representative list of different chemical classes known to occur in the reclaimed water from SDWWTP (FPL 2012-TN263; Lietz and Meyer 2006-TN1005; Miami-Dade County 2011-TN1006). The mode for ecological effects of environmental pollutants on terrestrial biota would be primarily through bioaccumulation into the tissues of plants and small aquatic organisms and biomagnification through the food chain to higher-level consumers such as insect- or fish-eating birds. Concentrations of many predicted contaminants would be orders of magnitude (less than one in several hundred to several thousand) below current analytical method detection limits, and they are much lower (4 to 40,000 times) than the toxicological benchmarks used in the screening assessment (see Table 5-3 and Sections 5.2.2.1 and 5.3.2.3 for effects modeling on aquatic organisms). Furthermore, the reclaimed water used for cooling would receive high-level disinfection at the SDWWTP prior to entering the Turkey Point reclaimed water-treatment facility. This level of disinfection is greater than the secondary treatment required for reclaimed water used for irrigation for public and private use (Fla. Admin. Code 62-610-TN1269). Additional treatment of the reclaimed water would occur at the RWTF, to include additional filtration, prior to being used as cooling water (FPL 2014-TN4058). The review team acknowledges that the list of CECs assessed, while representative, does not exhaustively address every contaminant that may potentially occur within the reclaimed water, and that the potential for bioaccumulation and biomagnification of even minute amounts of contaminants still exists. However, assessing exposure effects of contaminant combinations in real-world conditions is an emerging research area that will call for reliance on observable adverse outcomes through monitoring.

Icing, Fogging, and Humidity: Increased localized fogging and relative humidity near cooling towers have not been reported to affect native vegetation (NRC 2013-TN2654). However increased fogging in combination with lighting could increase the incidence of bird collision with elevated structures. FPL modeling showed the most frequent visible cooling-tower plumes would occur in winter and the least frequent would occur in summer (FPL 2014-TN4058). Expected median plume heights in winter would be approximately 820 ft; they would be visible for 719 hours and would only exceed about 33,000 ft about 93 hours a year. The cooling-tower plume would also be visible mostly at night. Outdoor lighting would be necessary for worker safety. FPL would follow industry standards to the extent practicable to limit upward light when designing outdoor lighting (FPL 2014-TN4058). Increased collision potential would be minimal due to the limited extent of a visible plume and the application of industrial lighting standards. Ice-induced damage to native vegetation could theoretically result from ice buildup due to increased fogging during winter, but temperatures below freezing are very rare in South Florida.

Bird Collisions with Cooling Towers and Structures

Typically, the cooling tower and meteorological tower are the structures at nuclear power plants (other than transmission towers) that pose the greatest risk for bird collisions. Proposed Units 6 and 7 would each be supported by three mechanical draft cooling towers, each approximately 67 ft high and 246 ft in diameter. Each unit would also have a single cooling tower for the service-water system located near the turbine building. In a review of bird collisions with cooling towers at nuclear plants, the NRC (2013-TN2654) determined that avian mortality was negligible

Table 5-3. Comparison of Predicted Concentrations of Chemicals from Cooling-Tower Deposition during Reclaimed Water Use to Analytical Method Detection Limits and Toxicological Criteria or Benchmarks

Chemical Name	Description	Maximum Incremental Increases of Concentration in IWF (ug/L)	Method Detection Limit (ug/L)	Environmental Criteria or Benchmark (ug/L)[(a)]	Endpoint and Species
1,4-Dichlorobenzene	Insect repellant	0.00070	0.1	0.7	EC50[(b)] Immobilization *Daphnia magna*
3 beta-coprostanol	Human digestion marker	0.0011	0.52	0.04	Unspecified
4-Nonylphenol	Detergent metabolite	0.0022	0.64	0.01	LOEC[(c)] Gene expression *Danio rerio*
Acetyl-hexamethyl-tetrahydro-naphthalene (AHTN)	Musk compound	0.0022	0.08	7.2	EC10[(d)] Development *Acartia tonsa*
Hexahydrohexamethyl-cyclopentabenzopyran (HHCB)	Musk compound	0.00027	0.12	11.0	NOEC[(e)] Growth, survival *Daphnia magna*
Phenanthrene	Polycyclic aromatic hydrocarbon (PAH)	0.00032	0.08	0.125	NOEC Growth *Daphnia magna*
Warfarin	Pharmaceutical	0.000064	0.012	0.288	EC50 Immobilization *Daphnia magna*
17 beta-estradiol (E2)	Hormone	0.000019	2	0.0004	NOEC Morphology *Oryzias latipes*
Triclosan	Antibiotic	0.060	Unknown	0.2	NOEC Growth *Pseudokirch-neriella subcapitata*
Copper	Heavy metal	0.0052	6.0	4.8	EPA Aquatic Life Criteria, Saltwater

(a) Environmental benchmarks obtained from EPA ECOTOX (EPA 2012-TN1525); aquatic life criteria from EPA (2014-TN3295).
(b) EC50: effective concentration required to induce a 50% effect.
(c) LOEC: lowest-observed effect concentration.
(d) EC10: effective concentration required to induce a 10% effect.
(e) NOEC: no-observed effect concentration.

for mechanical draft cooling towers, which are typically not nearly as high as natural draft cooling towers. The NRC has previously concluded that avian collisions are unlikely to pose a biologically significant source of mortality because only a small fraction of total bird mortality has been attributed to collision with nuclear power plant structures (NRC 2013-TN2654). Tall structures exist elsewhere on the Turkey Point site as part of the power production from Units 1 through 5. Although peninsular Florida may serve as a funnel for neotropical migrant birds crossing the Gulf of Mexico, the operation of six additional cooling towers only 67 ft in height as well as the addition of the power block and associated buildings is not expected to result in substantial increased mortality of birds. Therefore, mortality from birds colliding with structures, including the cooling towers, containment buildings, and the meteorological tower, is expected but would be inconsequential at a population level for bird species.

Noise Impacts of Operation

Noise pollution in natural environments is recognized as a stressor that may disturb or displace wildlife, thus affecting habitat suitability and subsequent animal density in some environments. However species-specific responses to noise and the mechanisms that drive responses are poorly understood (Francis et al. 2009-TN4046). The NRC concluded operational noise would be of small significance to wildlife adapted to a landscaped and urbanized environment typically found around nuclear reactors (NRC 2013-TN2654). However, the proximity of the proposed units to Biscayne and Everglades National Parks may not represent the typical environment.

The dominant sources of noise likely to affect wildlife during normal operation of proposed Units 6 and 7 and associated facilities would be the mechanical draft cooling towers and cooling-water pumps. These features would be located on the Turkey Point site close to Biscayne National Park. Cooling-water pumps and other plant equipment capable of generating relatively high noise levels would be located within buildings (FPL 2014-TN4058). Expected cooling-tower noise levels would be approximately 73 dBA at a distance of 200 ft from the cooling towers and would be mitigated by the use of splash guards on air inlets and stacks on mechanical fans to direct noise vertically (FPL 2014-TN4058). Although much of the area around the cooling towers would be developed and offer limited wildlife habitat value, wildlife could still be present, and the 37 ac makeup-water reservoir could serve as an open-water refugium that could attract additional wildlife such as wading birds. Noise at these levels may displace wildlife very near the cooling towers or wildlife near the makeup-water reservoir. Cooling-tower noise would lessen to below the 65 dBA level at 400 ft from the source. Areas within 400 ft of the cooling towers would be outside of Biscayne National Park and other parkland.

It is not clear what effect chronic noise at these levels would have on wildlife at any distance from the noise source because some wildlife species adapt and some decrease in response to habitat degradation, and others may actually benefit from anthropogenic noise through decreased competition or predation (Barber et al. 2009-TN4045; Francis et al. 2009-TN4046). Local wildlife species may be displaced by operational noise from the immediate vicinity of the cooling towers, including the makeup-water reservoir, while others may adapt to these noise levels. Noise generated during operation of proposed Units 6 and 7 and the associated cooling towers is not expected to noticeably affect local wildlife beyond a limited distance and would not be expected to noticeably affect any wildlife species at a population level.

Impacts on Wetlands from Storm Water Runoff

Most undeveloped areas on the FPL Turkey Point site consist of various types of wetlands. After site preparation and development of proposed Units 6 and 7 are complete, extensive areas of wetlands would remain in undeveloped areas on and adjacent to the new facilities. Development would increase the amount of impervious surfaces, but the design calls for detention of stormwater runoff by the makeup-water reservoir and detention basins. Stormwater from the proposed Units 6 and 7 plant area (including the power block, Clear Sky substation, and associated parking), western laydown area, administration and training buildings, and parking areas would be directed to drain into the IWF rather than into surrounding wetlands (FPL 2014-TN4058). Detention basins would capture the first inch of runoff from the RWTF. However, the detention basins would discharge into surrounding wetlands. BMPs, including oil-water separation and discharge over riprap aprons, would be used to limit adverse impacts on wetlands (FPL 2014-TN4058; FPL 2011-TN303). Stormwater runoff during plant operation may cause localized areas of depressed salinity in mangrove forests directly adjacent to plant facilities for brief periods following heavy rainfall events but generally is not expected to adversely alter wetland biota or function on or in the vicinity of the Turkey Point site.

Biscayne Bay Shoreline Habitat

Water pumped from Biscayne Bay through the RCWs would sometimes be used as makeup water to replenish water lost to evaporation, blowdown, and drift. Because of the sheer volume of Biscayne Bay and its connectivity with the Atlantic Ocean full-time use of the RCWs to supply both units with cooling water would not result in noticeable changes in shoreline elevation. The operation of proposed Units 6 and 7 is therefore not expected to noticeably alter shoreline habitats on Biscayne Bay.

Impacts of Increased Vehicle Traffic

Increased traffic associated with operation of proposed Turkey Point site Units 6 and 7 may result in increased wildlife mortality from vehicle-wildlife collisions. FPL expects the operation workforce at proposed Units 6 and 7 to be 806 persons. This would result in an estimated increase in traffic of 86 percent over current levels. Refueling outages for each unit would occur every 1.5 years and would require a maximum of 1,000 temporary workers for 30 days. FPL assumed a conservative estimate of a maximum temporary outage workforce of 2,000 staff during its traffic analysis and concluded this level of staffing would increase traffic by 213 percent over current levels (FPL 2014-TN4058). Additional traffic would likely result in a proportional increase in animal mortalities on area roads. Although wildlife would experience some direct mortality, the review team does not expect that the levels expected would destabilize local wildlife populations (see Section 5.3.1.3 for increased traffic, the Florida panther, and other important species discussion). Roadways that were improved only to build proposed Units 6 and 7 could be removed (FPL 2014-TN4058). This would include a portion of SW 359th Street. Traffic volume on these roads would be reduced or eliminated as would the likelihood of potential road-killed animals, thereby reducing the overall impact of increased traffic (FPL 2014-TN4058). However, the removal, re-grading, and restoration of construction access roads have not yet been determined. The extent of the effects of road improvement on wildlife is contingent upon the decision to restore roads to the preexisting condition and traffic levels.

Consequently, the review team concludes that these impacts may not be detectable beyond the local vicinity and could not destabilize regional wildlife populations. However, if roads are not restored or traffic not restricted during operation to baseline levels, the uncertainty of risk and subsequent impact on wildlife from vehicle collisions would increase.

Light Pollution During Facility Operation

Light pollution during facility operation could affect wildlife residing on or migrating through the Turkey Point site and immediately adjoining areas of Biscayne National Park. Research has shown that artificial nighttime lighting can alter behaviors, foraging areas, and breeding cycles of a wide variety of wildlife, including insects, turtles, frogs, birds, and bats (Chepesiuk 2009-TN1326). Increased polarization of natural and artificial light from artificial surfaces such as buildings and parking lots could also affect wildlife that use naturally polarized light as a visual cue (Horvath et al. 2009-TN897). The behavior of night-migrating songbirds can be disrupted by nighttime lighting systems, particularly during inclement weather. FPL has proposed to incorporate Illuminating Engineering Society of North America guidelines (IES 2012-TN1044) when designing outdoor lighting systems. Design criteria could include minimization of upward lighting, turning off unnecessary lighting between 11 p.m. and sunrise, and luminary selection and mounting to provide light only where needed (FPL 2014-TN4058). If these actions are taken impacts from light pollution on wildlife would be minimal and would not be expected to noticeably affect wildlife populations at even a local scale.

5.3.1.2 Terrestrial Resources – Associated Offsite Facilities

Power generated by proposed Units 6 and 7 would be provided via new transmission lines installed within approximately 89 mi of new and existing transmission line corridors (FPL 2014-TN4058). Environmental impacts resulting from the development and installation of transmission lines are discussed in Section 4.3 of the EIS. Impacts related to maintenance and operation of the new transmission lines are discussed below.

Impacts from Transmission Line Operation and Maintenance

The primary transmission line corridor maintenance activity that may affect terrestrial resources is vegetation control. Transmission line rights-of-way must be kept clear of woody growth through maintenance practices that prevent outages and prevent the growth from becoming a safety hazard. FPL would maintain the transmission rights-of-way supporting proposed Units 6 and 7, including the application of herbicides, in compliance with applicable Federal, State, and local laws, regulations, and permit requirements (FPL 2014-TN4058).

FPL states that it uses a site-specific maintenance program that accounts for local factors including terrain and vegetation. The primary methods FPL would use to control vegetation include trimming, mowing, and chemical control using herbicides and/or plant growth regulators (FPL 2014-TN4058). Plant growth regulators are chemicals applied to plants to purposefully alter their growth rates or patterns. Plant species that could grow taller than 14 ft would be removed. Areas dominated by low-growing plants, including agriculture and sawgrass marsh, would require less maintenance than areas with taller vegetation. However, the use of chemical plant controls would change the plant composition within the corridors and reduce habitat available to native flora and fauna. Native plants could be displaced with planted grass cover within the corridor, further decreasing habitat value. The landscape in South Florida is dominated by wetlands, and most of the transmission lines not crossing agricultural land would traverse wetlands. In addition to Federal, State, and local laws, regulations, and permit requirements, restrictive clearing would be performed within sensitive areas, including wetlands, pine rocklands, and Miami-Dade County designated Natural Forest Communities (FPL 2015-TN4442). Restrictive clearing includes hand pulling and cutting with chain saws and rotary cutters with low ground pressure to minimize soil disturbance and compaction. Tree species that could exceed 14 ft in height would be pruned or cleared with restrictive cutting (State of Florida 2014-TN3637). Transmission rights-of-way would be managed to regenerate pine rockland plant species where appropriate and non-pine rockland species would be discouraged to the extent practicable (FPL 2015-TN4442).

The presence of the new transmission line corridors could affect small areas within adjoining remnant patches of pine rockland habitats in the southern Florida agricultural and urban landscapes. Pine rocklands are an arrested successional community that requires periodic disturbance to perpetuate. Fire was the periodic disturbance with which pine rocklands have evolved; without fire, pine rocklands tend to become dominated by upland hammock vegetation or (worse) by invasive upland species. Human habitation has required fire suppression in much of South Florida. Fire is also incompatible with overhead transmission conductors because the smoke can cause electricity to arc from the conductors to the ground. The inability to use controlled fire (or allow natural fires) to reverse conversion of pine rocklands to hammocks may ultimately contribute to the degradation of the few remaining pine rockland patches.

Vegetation-maintenance practices within the rights-of-way could result in mortality to less mobile animals, such as reptiles, amphibians, and small mammals that are unable to escape mowers, vehicles, spray rigs, and other equipment. If vegetation maintenance occurs during the spring and/or early summer nesting period, ground-nesting bird nests could be affected. Noise and human presence may temporarily displace wildlife from areas within or adjoining the corridors until maintenance activities are completed. In general, these impacts are expected to be minor. Maintenance of early-successional habitat and habitat edge (i.e., forest and/or clearing interface environments) within transmission line corridors could be beneficial to wildlife favoring these habitats while adverse to wildlife favoring larger contiguous areas of forest cover.

The NRC evaluated the impact of transmission line corridor maintenance on wildlife and habitats, including wetlands, and generally found it to be of small significance at operating nuclear power plants with associated transmission line corridors of variable widths (NRC 2013-TN2654). While conducting transmission line operation and maintenance in support of proposed Units 6 and 7, FPL would be required to comply with all Federal, State, and local laws, regulations, and permits. FPL would also use environmental BMPs, such as commonly used erosion and sediment control measures, while maintaining transmission rights-of-way. Co-location of proposed transmission lines within existing corridors would limit disturbance of natural communities and reduce the amount of new access roads needed. The use of site-specific measures to manage vegetation would serve to limit impacts on sensitive habitats such as wetlands and pine rocklands. Consequently, the review team concludes that potential effects on terrestrial ecology from maintenance practices within the new and existing transmission line corridors would be minor.

Avian Mortality Impacts from Power Transmission

At least 41 species of birds are known to have been killed by interaction with electrical utility structures in the State of Florida, 20 of which have been killed by FPL electrical utility structures (FPL 2011-TN1283). Transmission line structures, conductors, and guy wires all pose a potential avian collision hazard for all resident birds that live in the vicinity of the transmission lines and for migratory birds that may pass through these areas. The 230 kV transmission lines would be supported by single-pole concrete structures approximately 80 to 90 ft tall. The substation pulloff towers would be galvanized steel or concrete. The 500 kV transmission towers would be 140 to 160 ft tall, made of concrete, galvanized lattice steel, or tubular steel. Tower spans would vary between 900 and 1,000 ft, although FPL states that the distance might vary with site-specific conditions; e.g., to avoid and minimize impacts on wetlands or cultural resources. If tower structures are tubular steel, similar structures with larger gauge steel would be used where the transmission lines turn light angles (15 degrees or less), and three-pole structures with supports would be used where the lines turn heavy angles (55 to 90 degrees).

Transmission line strikes are one of many human-caused sources of avian mortality in the United States (FWS 2002-TN1327). Generally, collision mortality appears to represent only a small fraction of total avian mortality, and the NRC has concluded that bird collisions with transmission lines at existing U.S. nuclear power plants are of small significance, including transmission line corridors with variable numbers of transmission lines (NRC 2013-TN2654). Because some of the new transmission lines proposed for Units 6 and 7 would be collocated with existing transmission lines, either immediately adjacent to or within existing rights-of-way, the potential for bird collisions would be lower than if all of the new transmission lines followed new routes. However, even just increasing the number of lines within existing corridors may still increase the potential for strike mortality. The greatest risk for avian collision is likely to occur for larger-bodied birds, such as raptors, waterfowl, and wading birds (NRC 2013-TN2654). All of these bird types would be expected to occur near suitable habitats in South Florida including habitats traversed by the new transmission lines serving Units 6 and 7. Wading birds are mostly colonial nesting species identified as a biological indicator in South Florida. Eighteen species have been injured or killed by electric utility structures in Florida (FPL 2011-TN1283). Transmission lines for Units 6 and 7 are expected to kill birds as a result of collision mortality, and lines erected near nesting colonies could have a measurable effect on survival of adults and young at that colony.

FPL has provided a corporate Avian Protection Plan as part of its Threatened and Endangered Species Evaluation and Management Plan (FPL 2011-TN1283). This plan provides a decision hierarchy in the event a bird collision or electrocution is discovered; the hierarchy includes event reporting and cause determination. FPL construction and design standards include the use of bird discouragers, perch guards, and insulator shields to limit the potential for electrocution. FPL also uses risk assessment methodology when siting new lines to reduce avian interaction with transmission line systems. This methodology includes understanding bird size, habitat use, and bird behavior such as foraging behavior and flight characteristics.

The addition of new transmission lines and corridors may lead to an incremental increase in number of bird collisions during operation of proposed Units 6 and 7. However, considering the measures prescribed by FPL's Avian Protection Plan, the new lines would not be expected to cause a measurable reduction in robust bird populations (see Section 5.3.1.3 for important species and collision mortality discussion). Consequently, the review team concludes that the potential for impacts on birds due to collision with transmission lines for the proposed Turkey Point site project may noticeably affect some less than robust bird species populations but would not be severe enough to destabilize local bird populations, including local wading bird colonies.

Impacts of Electromagnetic Fields and Coronal Discharge on Flora and Fauna

EMFs are unlike many other agents that have an adverse impact (e.g., toxic chemicals, ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 2013-TN2654). As discussed in the Generic Environmental Impact Statement (GEIS) for license renewal (NRC 2013-TN2654), a careful review of biological and physical studies of EMFs did not reveal consistent evidence linking harmful effects with field exposures. Power transmission lines in the United States produce EMFs of nonionizing radiation at 60 Hz, which is considered to be an extremely low frequency (ELF) EMF. The transmission lines connected to the proposed reactors would be 500 kV and 230 kV. The EMFs produced by operating transmission lines up to 1,100 kV have not been reported to have any biologically or economically significant impacts on plants, wildlife, agricultural crops, or livestock (Miller 1983-TN1328). Minor damage to plant foliage and buds, caused by heating of the leaf tips and margins, can however occur near strong electric fields. Damage does not appear within the main stem and root systems of the plants and would not significantly affect growth (NRC 2013-TN2654).

The conclusion presented in the GEIS for license renewal (NRC 2013-TN2654) was that the impacts of EMFs on terrestrial flora and fauna were of minimal significance at operating nuclear power plants, including transmission systems with variable numbers of transmission lines. Since 1997, more than a dozen studies have been published examining cancer in animals exposed to EMFs for all or most of their lives (Moulder 2005-TN1329). These studies have found no evidence that EMFs cause any specific types of cancer in rats or mice (Moulder 2005-TN1329). Therefore, the review team concludes that the increased EMF impact on fauna posed by the operation of new 500 kV and 230 kV transmission lines proposed for the Turkey Point project would be negligible.

The phenomenon of corona discharge from energized transmission lines has been linked to effects on wildlife. Animals may be reluctant to travel under transmission lines and may be displaced from habitats near transmission lines during conditions of increased coronal discharge (Canfield 1984-TN4548). Mammals that are at least partially nocturnal have eye structures that transmit ultraviolet light, possibly enabling some species to see flashes of ultraviolet light during corona discharge (Douglas and Jeffery 2014-TN4547). It is not known how much sound or visible ultraviolet light from transmission lines supporting Units 6 and 7 might affect wildlife travel patterns and habitat use. The review team has accounted for the potential of the transmission lines to affect the movement of wildlife across the landscape in its conclusions regarding impacts of the project on terrestrial ecology.

5.3.1.3 Impacts on Important Terrestrial Species and Habitats

This section describes the potential impacts on important terrestrial species, as defined by the NRC in NUREG−1555 (NRC 2000-TN614), including Federally listed or proposed threatened and endangered species; State-listed species; and other ecologically important species and habitats resulting from operation of the proposed Units 6 and 7 and associated offsite facilities as well as transmission lines.

Turkey Point Site

The following sections address categories of important species and habitats on the 218 ac plant area and other affected areas on the Turkey Point site.

Federally Listed Species

None of the Federally listed endangered, threatened, and candidate plant species known to occur in the vicinity of FPL's Turkey Point site have been found on the site (see Section 4.3.1.3 for survey methods). Sand flax (*Linum arenicola*) has been found at Homestead Bayfront Park that is located about 1 mi north of Turkey Point site. However, the review team believes this plant is likely at a sufficient distance to preclude any impact from proposed Units 6 and 7 operations. None of the other species would be affected by the operation of proposed Units 6 and 7.

Five Federally listed terrestrial animal species—the eastern indigo snake (*Drymarchon corais couperi*), piping plover (*Charadrius melodus*), wood stork (*Mycteria americana*), rufa red knot (*Calidris canutus*), and Florida panther (*Puma concolor coryi*)—occur on or in the vicinity of the Turkey Point site and have the potential to be affected by operation of proposed Units 6 and 7. The Florida bonneted bat (*Eumops floridanus*) may also be present and potentially be affected. Cooling-tower drift, fogging, and icing are expected to have little impact on habitats and should not affect these listed species. Increased noise levels near the cooling towers, as well as increased human activity and traffic, may cause these wildlife species to avoid habitats immediately adjacent to the operating facilities. However, some level of habituation to ongoing operational disturbances (from proposed Units 6 and 7 as well as the older facilities on the site) would likely occur. If permanent displacement of listed wildlife into adjacent habitats occurred, competition for finite resources could result in small declines in the local populations.

Eastern indigo snakes rely on a matrix of habitats to survive, and movement among habitats that contain roads increases the potential for vehicle collision mortality. FPL expects the increased operations workforce on the Turkey Point site due to operation of proposed Units 6 and 7 to increase traffic levels by approximately 86 percent over current levels, and FPL expects that a maximum temporary outage would increase traffic by 213 percent over current levels (FPL 2014-TN4058). Snakes in general are prone to collision mortality, because they use road surfaces for thermoregulation and their shape, coloration, and low profile make them difficult for automobile drivers to see. Increased traffic would likely result in a proportional increase in road-killed indigo snakes on area roads. It is not known whether the increase in mortality attributable to increased traffic from the operation or refueling of proposed Units 6 and 7 would be measureable within the eastern indigo snake population.

Piping plovers and red knots are shorebirds that use open habitats, such as beaches and mudflats, during winter in South Florida. Both are small birds not known to be exceptionally prone to collision mortality, so the likelihood of collision with the mechanical draft cooling towers and other tall structures is expected to be minimal as is collision with vehicles. This species is therefore not likely to be affected by operation of proposed Units 6 and 7.

Wood storks occur in a variety of wetlands and have been observed foraging in shallow portions of the IWF. Stormwater runoff into the IWF is expected to increase. Water within the system is hypersaline, and the prey items wood storks consume are adapted to this environment. Conversely, salt deposition from cooling-tower drift would also occur on portions of the wastewater system near the cooling towers. The effect of increased runoff and salt deposition on wood stork prey populations within the IWF is unknown. However, wood storks have not been observed in great numbers within the IWF and it is not believed to be a major foraging area (FPL 2014-TN4058). Although juvenile wood storks are not particularly adept at flying, the likelihood of avian collision with the mechanical draft cooling towers and other tall structures is expected to be minimal. Therefore, the operation of proposed Units 6 and 7 is not expected to noticeably affect the wood stork population growth in the region.

The U.S. Fish and Wildlife Service (FWS) recognizes much of Miami-Dade County and South Florida as a Florida Panther Focus Area. Although the focus area excludes the Turkey Point site, lands immediately adjacent the Turkey Point site to the south and west are contained within the focus area and are also considered to be within the panther's primary zone (FWS 2007-TN230). Florida panthers are susceptible to vehicle collisions; one in five deaths of or major injuries to radio-collared panthers resulted from a collision with a vehicle (Schwab and Zandbergen 2011-TN4047). An incremental increase in traffic from operation of proposed Units 6 and 7 may increase the risk of vehicle collisions for local panthers. It is not known whether the increase in collision risk attributable to increased traffic from the operation or refueling of proposed Units 6 and 7 would result in a vehicle-panther collision event.

State-Listed Species

At least 111 plant species listed by the State of Florida are known to occur within the vicinity of the Turkey Point site (Table 2-14). Many occur in habitats not found on the Turkey Point site. Some of these plants, such as Small's flax (*Linum carteri var. smallii*) and the Bahama ladder brake (*Pteris bahamaensis*) are known to occur in disturbed habitat, and the banded wild-pine (*Tillandsia flexuosa*) is an epiphyte that grows on a variety of other plants that occur in a wide range of habitats. The range of habitats the State-listed plants represent indicates that some of the species could occur within the proposed plant area on the Turkey Point site, but the extent of their occurrence is undetermined. Species that occur very near the cooling towers could be exposed to elevated levels of salt from cooling-tower drift. However, as noted above in Section 5.3.1.1, the highest salt-deposition rate expected to affect naturally vegetated areas off of the island containing the plant area is 4 kg/ha/mo, too low to potentially injure vegetation, including State-listed plant species.

An additional 23 State-listed animal species can also be found on or near the Turkey Point site. This list includes 1 amphibian, 3 reptile, 16 bird, and 3 mammal species. Survey information indicates that many of these species have been observed using habitats within the proposed project area, and life histories as well as habitat preferences indicate that many of them would be expected to occur there. The Florida Fish and Wildlife Conservation Commission (FFWCC) determined that only the limpkin (*Aramus guarauna*), Florida burrowing owl (*Athene cunicularia floridana*), little blue heron (*Egretta caerulea*), reddish egret (*E. refescens*), snowy egret (*E. thula*), tricolored heron (*E. tricolor*), white ibis (*Eudocimus albus*), roseate spoonbill (*Platalea ajaja*), American oystercatcher (*Haematopus palliatus*), white-crowned pigeon (*Pagagioenas* *leucocephala*), brown pelican (*Pelecanus occidentalis*), black skimmer (*Rynchops niger*), least tern (*Sterna antillarum*), and Everglades mink (*Neovison vison evergladensis*) have the potential to be affected by the proposed project activities because only these species are known or suspected to occur in the Turkey Point site vicinity.

The limpkin is a resident wading bird found in a variety of wetland types throughout southern Florida. Operational noise could displace individual limpkins that may occur on the site and in the vicinity. However, wetlands near the proposed Units 6 and 7 plant area are not habitat favored by limpkins in South Florida and any effects from the operation of Units 6 and 7 would therefore be negligible.

One Florida burrowing owl was observed one time within the Turkey Point site IWF (FPL 2014-TN4058). Florida burrowing owls are found in open upland habitat and cleared areas (FFWCC 2014-TN3570). Although berms among the canals of the IWF could be considered to be potential habitat because they are mostly non-vegetated and the deposition of fill raised them to upland elevations, the occurrence of a single burrowing owl does not necessarily indicate habitat suitable for Florida burrowing owls is present within the IWF. If these berms were in fact suitable for burrowing owls, one would expect more than a single observation. Therefore, lands that would be affected by proposed Units 6 and 7 operations are not considered burrowing owl habitat and the likelihood that this species would be affected is very low.

Little blue herons, reddish egrets, snowy egrets, tricolored herons, and roseate spoonbills are all piscivorous wading birds. They all have been observed on the Turkey Point site in shallow wetland habitats. Increased runoff and salt deposition may alter habitat within the IWF, but would not be expected to noticeably change the suitability of this facility as habitat for these four species. Operational noise could displace some individuals, but their occurrence within suitable habitats despite the current operation of existing plants indicates most would be expected to adapt to increased noise, activity, and artificial light levels. Operation of proposed Units 6 and 7 is not expected to noticeably affect populations of these species.

The white ibis is also a wading bird that uses a variety of wetlands on the Turkey Point site. This species is known for nomadic behavior and will move seasonally and annually to take advantage of locally abundant resources. Although noise could exclude birds from some wetlands, the predisposition of this species to relocate would likely preclude any measurable impacts from proposed Units 6 and 7 operations on the white ibis population.

The American oystercatcher occurs on large open expanses and forages in shellfish beds. No known shellfish beds would be affected by the operation of proposed Units 6 and 7. Other operational effects including noise, salt deposition, and artificial lighting are not expected to affect American oystercatchers.

White-crowned pigeons forage on fruit-bearing trees especially poisonwood (*Metopium toxiferum*). Salt deposition could affect poisonwood trees growing near the cooling towers. Poisonwood is known to occur near saltwater, which indicates some level of salt tolerance. Regardless of the tolerance of poisonwood to salt, the limited extent of salt deposition from proposed Units 6 and 7 cooling-tower drift would limit any impacts on poisonwood trees and thus any impact on white-crowned pigeons.

The brown pelican is a coastal species that may roost or loaf within Turkey Point site wetlands. Operational noise may displace local brown pelicans, but pelicans may also adapt to any new noise levels as indicated by their continued presence on the site despite operation of the existing units. Roosting and loafing habitats are not known to be limited and thus operation of proposed Units 6 and 7 would not be expected to noticeably affect brown pelican populations.

Black skimmers and least terns forage over open water. Least terns have been observed on the Turkey Point site and dredge spoil may provide suitable nesting habitat for both species. Operational noise may displace skimmers and terns from dredge spoil within the IWF that is near the cooling towers. Skimmers and terns are not currently known to nest near the proposed cooling-tower locations, and it is likely impacts from noise would be negligible to both black skimmers and least terns.

The Everglades mink would be expected to use wetlands within the Turkey Point site. Little is known about the Everglades mink, but as with other species operational noise may deter mink from using parts of the site nearby the proposed facilities. Mink are primarily active at night. The effects of artificial lighting on mink are not known. However, the effects of proposed Units 6 and 7 operations on wetlands would be extremely limited in scope and would not be expected to alter availability or suitability of wetland habitats for the Everglades mink.

FPL would be required to comply with all applicable Federal, State, and local laws, regulations, and permitting requirements to minimize potential impacts on listed species. If operational impacts on State-listed wildlife cannot be avoided, FPL would be required to coordinate with the FWS and the FFWCC on the need for appropriate mitigation. A biological assessment currently is being prepared by the review team to address impacts on Federally listed species that may be affected by the operation of proposed Units 6 and 7. FPL would be obligated to implement any mitigation required through this process.

Other Important Species and Habitats

In addition to Federally and State-listed species and those proposed for listing, the NRC (2000-TN614) identifies important species as those that are commercially valuable, recreationally valuable, essential to the maintenance or survival of commercially or recreationally valuable species, critical to the structure and function of local terrestrial ecosystems, and those that serve as biological indicators. Important habitats include wildlife refuges, sanctuaries, preserves, FWS-designated critical habitat, other State or Federally protected habitats, wetlands, and floodplains.

Mangrove forests are an integral part of South Florida ecology and occur within the area expected to be affected by salt deposition from cooling-tower drift. Mangroves represent the link between upland and marine environments and are adapted to survive in a saline environment. They must be salt-tolerant to thrive in this environment. However, it is not known whether the levels of salt deposition very near the cooling towers could exceed the tolerance level for the three mangrove species found here. The limited extent to which elevated salt levels are expected to be deposited around the proposed Units 6 and 7 cooling towers would limit any impact on local mangrove stands.

Everglades National Park is several miles west of the Turkey Point site. Salt deposition from cooling-tower drift is expected to extend onto offsite areas west of the cooling towers and may reach lands within the park. However, levels are expected to be far below levels known to affect sensitive plant species. Operational noise may displace some individual animals from the Turkey Point site to the park thereby increasing competition for resources. Displacement would likely be very low if detectable and would not destabilize local wildlife populations that may occur in the Everglades National Park adjacent to the Turkey Point site.

Terrestrial resources within Biscayne National Park are not expected to be affected by operation of proposed Units 6 and 7. See Section 5.3.2 for impacts on aquatic resources within Biscayne Bay.

Commercially and recreationally valuable species, including white-tailed deer (*Odocoileus virginianus*), mourning dove (*Zenaida macroura*), and cottontail rabbit (*Sylvilagus floridanus*), are present within the Turkey Point site. Waterfowl are also likely present. Increased traffic from proposed Units 6 and 7 operations would likely result in a proportional increase in road-killed deer and rabbits but is not expected to substantially affect regional populations of these locally common species. Increased activity and noise may displace some deer and waterfowl offsite where they may be exposed to increased hunting mortality. However, displacement and increased mortality are not expected to noticeably change local deer and waterfowl populations.

Disease vectors and pest species in this region include insects, mammals, reptiles, and invasive plant species. Like other animals, increased vehicle traffic during operation and refueling of proposed Units 6 and 7 would likely cause increased collision mortality of raccoons (*Procyon lotor*), skunks (*Mephitidae*), and Burmese pythons (*Python molurus bivittatus*). Raccoons and skunks are native wildlife species that are known disease vectors. Increased mortality is not expected to noticeably alter populations of these two animals or the frequency of diseases they may carry. The Burmese python is non-native, and any road-killed pythons would ultimately help ongoing control efforts, albeit likely an immeasurable amount. Changes in the salinity of wetlands in the vicinity of the cooling towers would not likely change population levels of waterborne insect vectors.

<u>Associated Offsite Facilities Including Transmission Facilities</u>

The primary transmission line corridor maintenance activity that may affect terrestrial resources is vegetation control. Transmission line rights-of-way must be kept clear of woody growth through maintenance practices that prevent it from either affecting the distribution of power or becoming a safety hazard. FPL uses a site-specific maintenance program and accounts for local factors including terrain and vegetation. The primary methods FPL would use to control vegetation include trimming, mowing, and chemical control including herbicides and plant growth regulators (FPL 2014-TN4058). Plant species that could grow taller than 14 ft would be removed. Areas dominated by low-growing plants, including agriculture and sawgrass marsh, would require less maintenance than areas with taller vegetation.

Federally Listed Species

FPL estimated up to 14 Federally listed plant species may occur within the entire project area (FPL 2011-TN1283). The FWS lists many endangered, threatened, or candidate plant species in Miami-Dade County (FWS 2014-TN2918) and still others are proposed for listing. One Federally endangered plant species has been observed within the proposed or existing transmission line corridors that would support proposed Units 6 and 7, and two other species listed or proposed for listing were also found (FPL 2014-TN4058). The endangered Florida brickell-bush (*Brickellia mosieri*), proposed endangered sand flax (*Linum arenicola*), and the candidate pineland sandmat (*Chamaesyce deltoidea ssp. pinetorum*) were all observed within a 9 ac fire-maintained pine rockland area within the first leg of the proposed West corridor known as the King's Highway Pineland (FPL 2009-TN657). Other State-listed plant species were also observed in the same location (FPL 2014-TN4058). The King's Highway Pineland has been proposed as critical habitat for the Florida brickell-bush and Carter's small-flowered flax (*Linum carteri* var. *carteri*) (78 FR 61293) (TN2912). The following paragraph describes the potential impacts from operation and maintenance of proposed Units 6 and 7 associated offsite facilities, including transmission lines, on these species.

The maintenance of transmission line corridors would negatively affect both Federal and State-listed plant species and would negatively affect proposed critical habitat for the endangered Florida brickell-bush and the listed endangered Carter's small-flowered flax. Because none of the listed plant species are trees, they would not be the direct targets of trimming or spraying but could experience indirect exposure and drift from spraying of adjoining vegetation and could be inadvertently trampled by maintenance vehicles and spray rigs. Pine rockland and marl prairie are early-successional habitats that were historically maintained by periodic fire. The presence of transmission infrastructure would likely preclude the use of fire to maintain vegetation because FPL does not list fire as a tool for vegetation management within its transmission line corridors. Periodic mowing has replaced fire as the primary management tool for early-successional habitats within FPL's transmission corridors, including pine rocklands and marl prairie, and may in part simulate fire disturbance. Periodic mowing is also a management technique FPL uses for vegetation control within transmission line corridors. The continued occurrence of early-successional fire-dependent plant species within existing transmission line corridors would indicate that current management of the corridor could preserve fire-dependent habitats and species present. However, the abundance of fire-dependent plants managed with mowing is unknown and many other listed plant species that would be expected to occur within pine rocklands and marl prairies have not been observed during previous plant surveys of the corridors. This may indicate that either these plants had not previously occurred within the corridors or that current management using periodic mowing is not an adequate fire surrogate to maintain these species over the long term. The effects of herbicides to control vegetation within transmission line corridors on listed plants is unknown but would not be expected to be beneficial. Overspray of herbicides could affect adjacent habitats, but the use of restrictive clearing and cutting near or within wetlands and pine rocklands should limit this impact to the extent practicable (FPL 2015-TN4442). Also, the use of vehicles on transmission access roads creates a means by which non-native plants may be spread into sensitive habitats. Non-native plants can outcompete native species, thereby reducing or eliminating listed plant populations as well as decreasing habitat value. Impacts on Federally or State-listed plants would occur as a result of the maintenance of transmission line corridors, but their extent would be difficult to quantify without more information describing plant populations throughout the proposed transmission line corridors and proposed management techniques that would be used where listed plants occur. Transmission line rights-of-way supporting proposed Units 6 and 7 would be maintained by FPL in compliance with applicable Federal, State, and local laws, regulations, and permit requirements (FPL 2014-TN4058). It is not known whether the FWS would place restrictions on vegetation-management protocols in locations known to support Federally listed plants.

The FFWCC identified 29 Federally and/or State-listed terrestrial wildlife species that at times may occur on or near the associated offsite facilities (reclaimed water-supply system, potable-water supply system), including transmission lines (Table 2-16). This list includes 6 Federally and 23 State-listed species. Each of these species could potentially be affected by operation and maintenance activities. The following discussion describes the potential impacts from operation and maintenance of offsite facilities associated with proposed Units 6 and 7, including transmission lines, on these species.

The worldwide population of the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) is limited to fewer than 3,000 individuals (FWS 2010-TN256). This species thrives in marl prairie habitat and is limited to six subpopulations located south and west of the proposed transmission lines (FWS 2010-TN256). Impacts on this species are therefore not expected to occur from operation or maintenance any offsite facilities or the proposed transmission system.

Eastern indigo snakes occur in a wide variety of habitats and thrive in a mosaic of different habitat types. This species has been observed at two locations within the eastern transmission line corridor and suitable habitat is present at many locations within both the eastern and western transmission line corridors. Eastern indigo snakes use burrows and other underground refugia and are vulnerable to mortality while underground during ground-clearing and infrastructure installation activities that require off-road use of vehicles. Mechanical vegetation control within the transmission line rights-of-way could affect this species by causing direct mortality. The FWS has required FPL to adhere to standardized protection measures for the eastern indigo snake. These measures include a snake protection plan that would include education of construction personnel to limit impacts and provide a reporting protocol for indigo snake observations and take (FWS 2004-TN779). Institution of these measures will not eliminate impacts on the eastern indigo snake, but should minimize the potential impacts to the extent practical.

The Florida panther has been observed within the proposed West Preferred and West Consensus corridors (FPL 2014-TN4058). Vegetation-control measures would have negative effects on local panthers by maintaining habitat fragmentation that occurred when transmission line corridors were developed and by not allowing natural succession to reclaim previously disturbed areas. Operation of the potable and reclaimed water-supply systems could also serve to maintain habitat fragmentation that occurred when the pipeline was built.

The piping plover is a migratory shorebird species that occurs in Florida during winter in beach-like habitats. No suitable piping plover habitat exists within, at, or along offsite facilities associated with proposed Units 6 and 7. Any potentially suitable habitat present before facilities were built would be eliminated and no impacts on this species are therefore anticipated.

The Everglade snail kite (*Rostrhamus sociabilis plumbeus*) is susceptible to collision or electrocution mortality (FPL 2011-TN1283) and the operation of transmission lines within the

West corridor could pose a risk of electrocution or collision mortality. Transmission lines within the Preferred corridor border suitable habitat where the FFWCC has observed numerous snail kites and documented successful nesting. Snail kites spend the majority of time perching, fly about 25 percent of daylight hours to forage for snails, and travel to and from the nest location as well as between perch locations (Beissinger 1983-TN2383). They also spend a minor amount of time flying to defend territory. Most of the flight time is spent foraging. To forage, they fly over suitable marsh habitat at an elevation of 10−16 ft above the vegetation (Beissinger 1983-TN2383). They also forage by perching at elevated locations within suitable habitat to look for snails, rest on perches to consume captured snails, and perform various maintenance activities while perched (Beissinger 1983-TN2383). Forage flights would occur well below the expected transmission line heights of 80–90 ft (230 kV) and 140–160 ft (500 kV) (FPL 2014-TN4058) but would not preclude collision with guy wires. Collision mortality related to transmission lines and guy wires could also occur during non-foraging flight. Raptors generally must be very agile in flight to enable them to capture prey. Snail kites may not necessarily have to be as agile as other raptors because they prey on slow-moving snails, but the review team still regards them as agile enough to generally avoid collision with transmission wires. The fact that no known snail kites have been reported as injured or killed from interaction with utility structures in Florida lends limited support to this conclusion (FPL 2011-TN1283). The wing span of snail kites is approximately 42 in. and could not span the minimum of 120 in. for typical single-circuit 230 wires as indicated by FPL (FPL 2011-TN94). Distances for 500 kV circuits would be even greater. Thus electrocution of snail kites by new transmission lines supporting proposed Units 6 and 7 would not be expected to occur. The occurrence of snail kites along the West corridors coincides with the location of wood stork nesting colonies. Use of non-guyed transmission poles in suitable foraging habitat near snail kite nesting areas could also reduce risk of collision mortality. Transmission line poles could also pose a risk to snail kites as perch locations for snail kite nest predators. Snail kite eggs are predated by fish crows (*Corvus ossifagus*) and boat-tailed grackles (*Quiscalus major*) (FWS 1999-TN136), and these species could use transmission line poles as elevated hunting perches in otherwise open marsh habitat. Transmission line poles could also serve as perches for large hawks and eagles that may prey on adult Everglade snail kites (PNNL 2013-TN2466). Increased predation on breeding adults and nests would likely decrease productivity on an already depressed snail kite population and could result in decreased habitat suitability if the kites move elsewhere to nest where elevated perches do not exist. Use of perch discouragers could reduce predation and may be required as mitigation by either the FFWCC or FWS. Maintenance of vegetation within sawgrass habitat would be minimal because this vegetation does not exceed 14 ft in height. Any negative impact on a depressed population such as the Everglade snail kite from operation and maintenance of the proposed transmission line corridors could be noticeable. Increased predation on kites and their nests in an area that is important to snail kite production in the southern portion of its range in Florida could be detrimental to snail kite recovery efforts. Operation of the potable and reclaimed water-supply systems would not be expected to affect snail kites because they are not known to occur within pipeline corridors or in adjacent habitats and the nature of pipeline operation and maintenance would not be would not be expected to affect to snail kites.

Bird attributes that contribute to avian collision with transmission lines include size, behavior, abundance, and habitat use. Birds with relatively large wing spans, including wood storks, are more likely to be electrocuted because their wing length can bridge larger gaps between live circuits. Birds including wood storks that routinely perch or nest on utility structures also increase the risk of collision or electrocution. Large wading birds, such as wood storks, have wings that are relatively small compared to their large body size. This results in less agility while flying and a higher likelihood of collision with structures. Juvenile wood storks may be particularly vulnerable due to their flying at low altitudes, low agility, and little or no experience with transmission structures. Two wood stork nesting colonies exist within approximately 0.5 mi of the West Preferred corridor and one about 0.8 mi of the West Consensus corridor. This distance puts these corridors within the FWS-recommended maximum secondary protection zone for wood stork colonies. Two additional colonies are within 3 mi of the West Preferred corridor and three to the West Consensus corridor. Wood storks have been killed by collision with and electrocution by FPL electrical utility structures (FPL 2011-TN1283) and are at risk to collide with both proposed West transmission corridors. However, wood stork use of particular colonies varies annually and the colony farthest from the proposed West transmission corridors (Tamiami West approximately 2.8 mi away) is also the most commonly used. Wood storks were documented to use the three nearest colonies 4 or 5 years out of 20 (Table 2-13). FPL would conduct a detailed study along transmission line corridors to determine flight behaviors of storks nesting near the corridors. FPL would also investigate options and effectiveness of making smaller-diameter overhead ground wires that are strung higher than other wires visible to flying wood storks. Investigations to minimize impacts of transmission line operation on wood storks would be detailed within the biological assessment being prepared by the USACE as part of formal consultation with the FWS with respect to the Endangered Species Act (16 U.S.C. § 1531 et seq.-TN1010). Use of un-guyed poles could also reduce risk of collision. Mortality and impacts on the wood stork may not be totally avoidable. The review team anticipates that involvement of the FWS with respect to the effect of proposed Units 6 and 7 transmission line operation and maintenance would minimize any direct or indirect impacts on the wood stork to the extent practicable and may include the use of both flight diverters and perch discouragers. Operation of the potable and reclaimed water-supply systems would not be expected to affect wood storks.

Other Federally listed or migratory bird species may nest within low-growing vegetation within transmission line corridors and could be affected by vegetation maintenance. FPL would coordinate with the FWS to obtain necessary permits and guidance for direct impacts on State-listed species nesting within the proposed Units 6 and 7 transmission infrastructure. Electrocution would cause direct mortality. FPL would coordinate with the FWS to obtain necessary permits and guidance for direct impacts on Federally listed species found within the proposed Units 6 and 7 transmission infrastructure. Inactive nest removal would not be expected to noticeably affect healthy bird populations.

Although neither Bartram's scrub-hairstreak nor the Florida leafwing butterflies are known to be present within the proposed transmission line corridors, proposed critical habitat for both species lies within both West corridors and adjacent to the East corridor. Both of these species depend on the pineland croton (*Croton linearis*) as their sole host plant. The pineland croton depends on periodic fire for its continued existence, and the elimination of fire as a management tool within pine rockland habitat located in transmission corridors could decrease habitat value for these two butterflies. The control of vegetation with chemicals on rocklands within and adjacent to transmission corridors could also have negative consequences on the pineland croton and ultimately Bartram's scrub-hairstreak and the Florida leafwing.

State-Listed Species

FPL estimated up to 174 listed plant species may occur within the entire project area (FPL 2011-TN1283). Impacts on valuable habitats including wetlands and pine rocklands resulting from the operation of associated offsite facilities including the proposed Units 6 and 7 transmission system would also affect many State-listed species. Vegetation maintenance within transmission line corridors would affect listed plant species that are present. Periodic mowing could simulate natural fire disturbance that maintains many listed plants, and may be beneficial. However, the timing and nature of mowing may not benefit all State-listed plant species. Use of herbicides within the corridors could also simulate disturbance, but would likely be equally detrimental to desirable plant species as it would to undesirable plant species. Transmission line rights-of-way supporting proposed Units 6 and 7 would be maintained by FPL in compliance with applicable Federal, State, and local laws, regulations, and permit requirements (FPL 2014-TN4058). It is not known whether the State of Florida would place restrictions on vegetation-management protocols in locations known to support State-listed plants.

Ospreys (*Pandion haliaeetus*), American kestrels (*Falco sparverius*), little blue herons, snowy egrets, and white ibis have been killed by interaction with FPL electrical utility structures (FPL 2011-TN1283). Osprey routinely nest and perch on FPL power transmission structures located near open water where fish are present. The FFWCC regulates osprey nest removal, and FPL would have to possess a permit to remove inactive osprey nests from transmission structures. The FFWCC permits require a replacement nest structure be erected by the permittee (FPL 2011-TN1283). Removal of inactive osprey nests and subsequent replacement of a suitable nest structure nearby would not have a substantial detrimental effect on osprey populations. Kestrels nest within cavities excavated by woodpeckers within wooden power poles. Cavities threaten the integrity of wooden power poles and would mandate replacement. FPL has proposed to install non-wood poles within transmission line corridors supporting proposed Units 6 and 7. Even if wood poles were used the number of replacement of poles containing cavities would not be expected to noticeably affect kestrel populations. Other State-listed birds may nest within low-growing vegetation within transmission line corridors. FPL would coordinate with the FFWCC to obtain necessary permits and guidance for direct impacts on State-listed species nesting within the proposed Units 6 and 7 transmission infrastructure. Electrocutions and inactive nest removal would not be expected to noticeably affect healthy bird populations.

Other Important Species and Habitats

Transmission-system operation would serve to maintain edge habitats that could benefit game species such as the white-tailed deer and cottontail rabbit, but could also predispose such species to increased hunting mortality by providing cleared areas for hunters. Regardless, operations would not be expected to noticeably affect populations of game species. Wading birds and other species considered biological indicators in South Florida that have been killed or injured from interaction with electrical utility structures in Florida include the double-crested cormorant (*Phalacrocorax auritus*), great egret (*Ardea alba*), green heron (*Butorides virescens*), great blue heron (*A. herodias*), and both black- and yellow-crowned night herons (*Nicticorax nicticorax* and *Nictanassa violacea*) (FPL 2011-TN1283). Adding more transmission lines would likely result in increased collision risk and mortality. Populations of most wading bird species monitored in Florida have trended upward recently (SFWMD 2013-TN4034) and the incremental change in collision risk and mortality from the operation of a transmission system to support Units 6 and 7 would not be expected to noticeably affect populations of these species.

5.3.1.4 Terrestrial Monitoring

The FFWCC requires FPL to fund a Mitigation Effectiveness Study to evaluate mitigation measures to reduce the potential impacts of power transmission on wood storks. FPL's proposed evaluation effort would include mortality monitoring surveys and observation of wood stork flight behavior along transmission line corridors. These studies would be conducted prior to transmission line installation and during operation as required. These efforts may not constitute monitoring *per se*, but would account for wetland condition post-restoration and the estimated loss of prey biomass on an annual basis. Additional monitoring could be required by regulatory agencies.

5.3.1.5 Potential Mitigation Measures for Terrestrial Impacts

FPL would investigate the options for and effectiveness of making overhead ground wires visible to flying wood storks. FPL has not proposed other specific mitigation measures for terrestrial ecology impacts attributable to plant operations. Additional mitigation measures could be required by local, State, or Federal regulatory agencies and may include the installation of flight diverters and perch discouragers to lessen impact of transmission system operation on listed bird species.

5.3.1.6 Summary of Impacts on Terrestrial Resources

The review team evaluated the potential effects on terrestrial ecological resources of operating proposed Turkey Point Units 6 and 7, including onsite and associated offsite facilities. As described above, most potential impacts of operations on terrestrial resources would be minimal. Salt deposition from cooling-tower drift exceeding levels known to affect sensitive plant species would occur immediately around the cooling towers and into the existing IWF and nearshore areas of Biscayne Bay. However, the areas predicted to receive the potentially harmful salt deposition would lie within new or existing developed areas. Mangroves are the dominant vegetation in those areas and are highly salt-tolerant. Salinity within the IWF or other area wetlands would not change enough to alter prey populations consumed by wading birds. The climate of South Florida would preclude localized icing impacts. The addition of cooling towers and other tall structures is not expected to noticeably affect healthy bird populations in the local area. Cooling-tower noise would be limited using engineering controls and is not expected to measurably affect local wildlife. Water levels within Biscayne Bay would not be affected by water withdrawal for cooling.

Although building the proposed Units 6 and 7 facilities would increase the amount of impervious surfaces on the Turkey Point site, the new makeup-water reservoir and detention basins would adequately manage the resulting runoff. Reduced runoff and use of BMPs would limit impacts from stormwater runoff to adjoining terrestrial habitats. Increased traffic during plant operation and refueling is expected to result in a proportional increase in wildlife mortality on local roadways. Although wildlife would experience some increased direct mortality, the levels expected would not destabilize healthy wildlife populations. Uncertainty exists however regarding potential increased mortality for the eastern indigo snake and Florida panther.

Deposition of emerging pollutants of concern from use of reclaimed water for cooling would be below levels expected to affect the terrestrial ecosystem. However, as explained above, the toxicological and bioaccumulative properties of these contaminants are not well understood. The review team therefore acknowledges uncertainty with respect to the potential impacts to terrestrial biota present in habitats subject to the highest levels of cooling tower drift.

The primary transmission line corridor maintenance activity that may affect terrestrial resources is vegetation control. As many as 174 listed plant species (14 Federally listed, 160 State-listed) could be present within the associated transmission line corridors. FPL would use mechanical and chemical methods of controlling vegetation within a site-specific maintenance program to limit adverse impacts to the extent practical. Periodic mowing of rights-of-way crossing pine rocklands may serve to maintain some level of ecological diversity. FPL's use of site-specific vegetation-control plans limits the uncertainty regarding impacts resulting from the use of herbicides on listed plants. Impacts would likely still result from transmission line vegetation maintenance. Vegetation control within the western transmission line corridor where it crosses the King's Highway pine rockland could directly harm the Florida brickell-bush and Carter's small-flowered flax, indirectly harm Bartram's scrub-hairstreak and Florida leafwing butterflies, and could decrease the value of proposed critical habitat for these species.

The presence of transmission lines poses a noticeable risk of collision injury or electrocution of birds, especially large birds with wide wing spans. Individuals of at least 41 bird species have perished as a result of transmission line operation in Florida either by trauma from collision or electrocution. Waterfowl, raptors, and wading birds including the wood stork are particularly vulnerable. Operation of the transmission lines serving Units 6 and 7 could result in further bird mortalities. Uncertainty exists regarding the possible effects of coronal discharges from high-voltage transmission lines on the ability of certain wildlife to cross transmission line rights-of-way. However, mortality caused by transmission lines is generally a small fraction of total avian mortality. Furthermore, FPL would use engineering controls to limit transmission line-related bird mortality and fund research and monitoring to determine impacts on wood storks. FPL's corporate Avian Protection Plan provides guidance and engineering controls to reduce and report avian mortalities.

Based on the review team's independent evaluation of the Turkey Point site project, including the ER, the SCA, FPL's responses to the review team's RAIs, interactions with State and Federal agencies, the public scoping process, and the identified mitigation measures and BMPs, the review team concludes that operational impacts on terrestrial ecological resources (including wetlands and listed species) would be MODERATE. This conclusion accounts for the potential effects of increased collision mortality on wood storks, Everglade snail kites, and other important wildlife, and impacts of vegetation control on listed plants, proposed critical habitats, and other important terrestrial resources. It also reflects the proximity of many of these impacts to the natural areas and wildlife contained within Biscayne and Everglades National Parks.

Additionally, the conclusion reflects uncertainties inherent in the review team's evaluation of potential toxicological effects on terrestrial biota from CECs present in drift originating from use of city wastewater in cooling towers.

5.3.2 Aquatic Impacts Related to Operation

This section discusses the potential impacts of the operation of proposed Turkey Point Units 6 and 7 on onsite and offsite aquatic resources. The NRC Environmental Standard Review Plan guidance for aquatic ecosystems (ESRP 5.3.1.2) (NRC 2000-TN614) directs the review team to conduct an independent analysis of the effects of the proposed plant intake system on aquatic ecosystems. As previously described, FPL would have access to two sources of cooling water: reclaimed water provided by Miami-Dade County and water obtained from four RCWs that would be installed on the Turkey Point peninsula. The primary water source for the proposed Turkey Point Units 6 and 7 cooling system would be reclaimed water from Miami-Dade County. RCW operation is limited by the State of Florida to not exceed 60 days per year during the operating license period (State of Florida 2014-TN3637). Water obtained from the RCW system is expected to be similar in salinity and chemical composition to the waters of Biscayne Bay near the Turkey Point site; reclaimed water from Miami-Dade County would require additional onsite treatment, including chlorination, to remove suspended solids prior to use in the cooling system but may still retain some contaminants that are not removed during the treatment process. Although the thermal and chemical effects of blowdown water on aquatic communities in surface waters are eliminated by deep-aquifer injection, such effects on potential aquatic communities that may exist in the receiving aquifer are unknown because no information on the presence of deep-aquifer biota is available.

5.3.2.1 Aquatic Resources – Site and Vicinity

Aquatic resources on the Turkey Point site include the IWF and numerous surface-water habitats consisting of small streams and ponds. Aquatic resources in the vicinity of the Turkey Point site include nearby canals and water-diversion systems, Biscayne Bay, Biscayne National Park and Aquatic Preserve, Card Sound, Florida Keys National Marine Sanctuary, Everglades National Park, and other areas, as shown in Figure 2-26. The ensuing sections provide a general discussion of how each proposed cooling-water source could affect onsite and offsite aquatic resources, followed by a detailed discussion of impacts on the important species and habitats identified and described in Section 2.4.2.

Onsite Surface-Water Habitats and Industrial Wastewater Facility

Potential impacts on onsite surface-water habitats and the IWF from operation of proposed Turkey Point Units 6 and 7 could include the following:

- deposition of conventional chemicals and CECs from cooling-tower drift into the IWF or other surface-water habitats when reclaimed water is used for cooling;
- hydrological alterations associated with the operation of the RCW that affect the IWF aquatic community structure or function;
- discharges from the stormwater system into the IWF; and

- salt deposition from cooling towers during the use of the RCW system that increases salinity within the IWF or other onsite surface-water habitats.

Use of Reclaimed Water

As described in the ER (FPL 2014-TN4058), the primary source of cooling water would be reclaimed water from the MDWASD. Approximately 60 Mgd would be needed to support the operation of proposed Units 6 and 7. Because FPL would rely on piped reclaimed water, no intake would be required, and cooling-tower blowdown would not be discharged into surface-water habitats, so entrapment, entrainment, impingement, and thermal impacts on onsite and nearby aquatic resources in surface waters primarily associated with thermoelectric power stations would not occur. There is, however, the potential for priority pollutants (e.g., metals and organic compounds) and CECs present in reclaimed water after treatment to disperse over the IWF and adjacent waterbodies as cooling-tower drift deposition. Because the threatened American crocodile (*Crocodylus acutus)* is present in the IWF, which is Federally designated critical habitat, the review team evaluated the potential for chemical deposition from cooling-tower operation to directly affect sensitive life stages of the crocodile, or indirectly affect this species by altering existing food webs in the IWF. As described in Section 5.2, to evaluate the potential effects of cooling-tower deposition on aquatic resources, the review team conducted a screening-level assessment that estimated likely chemical concentrations in influent reclaimed water and compared the concentrations to water-quality criteria or other environmental benchmarks to determine whether the chemicals pose a potential risk to aquatic environments. For chemicals with established water-quality criteria, those present in reclaimed water above limits considered protective of aquatic resources were retained in the screen and evaluated for fate and effects, as discussed in Section 5.2 and presented in Table 5-1. For chemicals without established water-quality criteria, including most CECs, those present at >1/10 of a toxicological benchmark were included in fate and effects evaluations (Table 5-1). These evaluations included the use of atmospheric and hydrodynamic models to predict chemical concentrations in the IWF, Biscayne Bay, Card Sound, and other surface-water environments adjacent to the Turkey Point site. The analysis was considered conservative in that the review team assumed no additional treatment of water would occur prior to its use in the cooling system even though the applicant plans to conduct additional treatment using the RWTF.

Use of Radial Collector Wells

FPL proposed to install four RCWs beneath Biscayne Bay to provide a secondary source of cooling water. This system would not use a surface-water intake structure and would be used when reclaimed water from MDWASD is not available (see EIS Section 3.2.2.2). FPL has proposed, and FDEP has permitted, that RCW use would be limited to a maximum of 60 days per year (FPL 2012-TN2688; State of Florida 2014-TN3637). Given that the RCW laterals (horizontal collector lines) would be 25 to 40 ft beneath Biscayne Bay, and the decision to discharge cooling-tower blowdown into a deep-aquifer formation, adverse effects on onsite surface-water habitats related to impingement and entrainment of organisms; or thermal discharges would be highly unlikely. Entrainment of water designated as essential fish habitat (EFH) could occur but as stated above would be limited to 60 days per year. Because the majority of the RCW water source is expected to be Biscayne Bay seawater, there is a potential for adverse effects on IWF communities related to salt drift and deposition from cooling-tower operation while using the RCWs to supply cooling water. Because the threatened American crocodile inhabits the IWF, this species and the food web it depends on are the primary focus of the review team's assessment.

Aquatic Resources near the Turkey Point Site

Aquatic resources near the Turkey Point site include nearshore areas adjacent to the Turkey Point peninsula and the eastern boundary of the site property (including Biscayne Bay and Card Sound, which are portions of Biscayne National Park and Florida Keys National Marine Sanctuary, respectively) and Everglades National Park, which is southwest of the facility. Potential impacts on aquatic resources from the operation of proposed Turkey Point Units 6 and 7 could include the following:

- chemical deposition into nearshore waters and terrestrial areas adjacent to the Turkey Point site from cooling-tower drift;
- salt deposition into nearshore waters and terrestrial areas adjacent to the Turkey Point site from cooling-tower drift;
- entrainment, or impingement of aquatic organisms during operation of the RCW if limestone fracturing occurs above the well laterals (extending from the Turkey Point peninsula beneath Biscayne Bay);
- changes in nutrient or salinity levels in interstitial water in Biscayne Bay sediment that affect existing aquatic resources above RCW laterals; and
- potential hydrological changes related to RCW operation that could change local species composition or food web dynamics.

<u>Use of Reclaimed Water</u>

Under normal operations the use of reclaimed water from Miami-Dade County would eliminate the potential for intake-related effects on marine and estuarine species occurring near the Turkey Point site, and the use of deep-aquifer injection of cooling-tower blowdown would eliminate potential thermal impacts on biota in surface waters. Chemicals associated with cooling-tower drift are also unlikely to affect Biscayne Bay, Card Sound, Biscayne National Park or Everglades National Park because expected deposition patterns are generally to the southwest over the IWF, and any chemicals associated with cooling-tower deposition would likely be rapidly diluted and undetectable. Thus, the potential effects of reclaimed water use on the aquatic species described in Section 2.4.2 as living in Biscayne Bay, Card Sound, and other surface-water habitats near the Turkey Point site are expected to be minimal.

<u>Use of Radial Collector Wells</u>

The review team examined the operation of the RCW system to assess the potential for salinity alterations to affect aquatic resources near the Turkey Point site. To evaluate potential salinity impacts, the review team reviewed available historical information about salinity trends in Biscayne Bay from FPL, the NPS, available reports and peer-reviewed journal articles, and the numerical model developed by USGS to assess the effects of RCW operation on Biscayne Bay. Because of the system design, impingement and entrainment effects associated with RCW operation are unlikely, but could occur in a limited manner if the limestone above the RCW laterals fractures, creating preferred flow pathways that increase downwelling velocities sufficient to impinge or entrain small fish and larvae. The review team also assessed the potential for impingement, entrainment, or detectable changes to sediment pore-water characteristics to occur under both normal and limestone fracture scenarios. The results of these evaluations formed the basis for the impact discussion provided below for recreationally, commercially, or ecological important species; species listed by Federal or State resource agencies; and species with designated EFH or habitat areas of particular concern (HAPCs).

5.3.2.2 Aquatic Resources – Transmission Line and Pipeline Corridors

Impacts on aquatic resources from transmission line and pipeline maintenance are expected to be minimal during the licensing period because most of the transmission lines and pipelines follow existing linear facilities or rights-of-way, or they traverse areas that have been previously disturbed. The exceptions to this are the proposed transmission lines near Everglades National Park, where maintenance of the transmission line rights-of-way has the potential to affect aquatic species inhabiting nearby drainage canals. In these areas, FPL has committed to following BMPs and would conduct threatened and endangered species monitoring consistent with State and Federal resource agency guidance.

5.3.2.3 Aquatic Species and Habitats

Commercially, Recreationally, or Ecologically Important Species

Commercially, recreationally, and ecologically important species that are likely to occur on or near the Turkey Point site are discussed in Section 2.4.2. Given the proposed cooling-system design, the review team evaluated the potential for impacts on these species from cooling-tower drift and radial collector well operation. When reclaimed water is used, cooling-tower deposition may contain chemicals not removed during treatment; use of the RCW system could also result in salt deposition that increases the salinity in bodies of surface water beneath the plume. It is also possible that fractures in limestone overlying the RCW laterals could open preferred flow pathways, resulting in limited impingement or entrainment of aquatic organisms during intermittent RCW operation. The review team also evaluated the potential for radial well operation to affect surface-water salinities in Biscayne Bay and changes in the benthic community environment above the radial well laterals. Potential impacts related to each proposed cooling-water source are described below.

<u>Use of Reclaimed Water</u>

As described above, the use of reclaimed water minimizes intake-related effects, and deep-well injection eliminates thermal impacts on commercially, recreationally, or ecologically important aquatic biota in Biscayne Bay and Card Sound. There is a potential, however, for cooling-tower drift containing priority pollutants and CECs to affect both onsite and offsite aquatic resources. The cooling-tower drift rate under normal two unit operation is expected to be 8 gpm. As described in Section 5.2 (Table 5-1), deposition rates for the chemicals and constituents included in the fate and transport screening assessment are generally low, ranging from 1.5×10^{-9} to 8.4×10^{-7} g/m^2/mo. Calculations for TP deposition were also estimated from reclaimed water and RCW water using the same information (FPL 2012-TN263) given in

Table 5-1. The annual deposition rates to the cooling canals were 1.5×10^{-3} g/m^2-yr and 1.6×10^{-4} g/m^2-yr, respectively. Annual deposition of TP to Biscayne Bay was estimated as 3.7×10^{-4} g/m^2-yr from reclaimed water and 4.0×10^{-5} g/m^2-yr from RCW water. The highest depositional rates for chemicals and constituents associated with the drift were predicted for the IWF cooling canals; lower depositional rates were expected in surface-water habitats near the site (e.g., Western Areas/Model Lands) and nearshore areas of Biscayne Bay. The low depositional rates are unlikely to adversely affect commercially, recreationally, or ecologically important species present at offsite locations because deposited chemicals, including TP, would be rapidly diluted and essentially undetectable. Because the highest depositional rates are expected to occur in the IWF cooling canals, which are Federally designated critical habitat for the threatened American crocodile, this potential adverse impact is discussed below.

Use of Radial Collector Wells

Based on the analysis described in Sections 5.2.1.4 and 5.2.1.5, salt drift from cooling towers during the use of the RCW system is expected to be extremely low, and the decision to use the RCWs primarily as a cooling-water backup that is limited to 60 days per year further reduces the impacts. Thus, salt deposition in the IWF, surface-water habitats within or adjacent to the Turkey Point site, or in nearshore areas of Biscayne Bay National Park, Biscayne Bay and Card Sound is expected to be undetectable. Effects on red mangroves (*Rhizophora mangle*) are unlikely because they are found in water with salinities ranging from 0 to 90 ppt (Hill 2001-TN1015). In contrast, turtle grass (*Thalassia testudinum*) requires water salinity of 20 ppt or higher, so hydrological changes that decrease bay salinities could affect this species (Dineer 2001-TN1013). Likewise, hydrological changes that increase nearshore water salinity could affect seagrasses requiring lower salinities. For instance, the salinity range for manatee grass (*Syringodium filiforme*) is 20 to 26 ppt; shoal grass (*Halodule wrightii*) is generally found in coastal waters with salinities ranging from 20 to 36 ppt (FMNH 2012-TN1014). A 2013 study (FPL 2015-TN4442) simulated the potential for RCW operations on seagrasses. Nutrient flux and salinity in the pore water was measured under simulated RCW operation, and even at a 95 percent reduction in nutrient concentrations, and a 4 ppt increase in salinity through pore-water migration, turtle grass growth and development was not affected. This 2013 study supports the assessment that operation of the RCW system would have minimal effects on seagrass beds near the Turkey Point site.

Although minimal, there is a potential for impingement or entrainment of juvenile or larval forms during RCW operation if the limestone above the well laterals fractures, creating preferential flow pathways sufficient to impinge or entrain aquatic biota. Species susceptible to impingement and entrainment include individual fish and invertebrate larvae, and eggs from various species. Use of the RCW system could also affect benthic organisms in the immediate vicinity of the well field by changing salinity. Examples of commercial, recreational, and ecologically important species that could be influenced by changes in nearshore salinity include juvenile Spotted Seatrout (*Cynoscion nebulosus*), mojarras (*Eucinostomus* spp.), juvenile Silver Perch (*Bairdiella chrysoura*), juvenile pink shrimp (*Farfantepenaeus duorarum*), and eastern oyster (*Crassostrea virginica*). The NPS identified these species as ecosystem indicators, and they generally have an optimum salinity range of 10 to 25 ppt (NPS 2006-TN183). Other benthic species that may be susceptible to salinity changes include polychaetes, amphipods, mollusks, and other benthic macroinvertebrates present in nearshore locations above the RCW laterals. These species are described in Section 2.4.2.

To assess the potential for RCW operation to noticeably change nearshore salinity patterns and adversely affect sensitive species, the review team evaluated historical salinity data provided by the NPS and others to understand the inherent spatial and temporal variability at nearshore and offshore locations in Biscayne Bay near Turkey Point. The team also reviewed assessments of salinity impacts provided by FPL and the NPS, and a numerical model developed by the USGS that compared existing (base-case) salinity conditions to predicted conditions under three RCW operational scenarios: 1) continuous RCW pumping throughout the year (Scenarios A, B, and C), 2) repeated annual periods of pumping of 3 months duration during the dry season followed by 9 months with no pumping (Scenario D), and 3) repeated pumping periods of 30 days followed by 90 days of no pumping (Scenarios E, F, and G). The review team evaluated the base case and Scenarios A (continuous pumping) and D (3 months pumping followed by 9 months without pumping). A description of the USGS model results and updated variable density modeling is presented in Section 5.2.1.1; additional information is provided in Appendix G and in NRC 2014 (TN3078).

The review team's examination of time series indicated that variations in salinity from continuous pumping were mostly within ±1 psu, with only transient increases to near 2 psu (Appendix G, Figure G-9). When the review team examined the spatial distribution results at the time when salinity time-series differences had an increase (10/3/2003), the increase (which was less than +2 psu) was found to occur in a relatively small area north of Turkey Point (Appendix G, Figure G-10). When the review team examined the spatial distribution results at the time when salinity time-series differences had a decrease (10/25/2004), the decrease (which was greater than -2 psu) was also found to occur in a relatively small area north of Turkey Point (Appendix G, Figure G-11). Figure G-11 shows the relative saltwater balance and flow changes for Biscayne Bay and the Turkey Point site during RCW operations. These results show that the variation in salinity was minimal with continuous RCW pumping. The review team noted that the actual duration of pumping would not be continuous because the FDEP permit conditions require that pumping be limited to 60 days or less per year (State of Florida 2014-TN3637). A shorter duration would allow time for the groundwater system to recover following RCW pumping and limit the entrainment of saltwater from Biscayne Bay. Any drift deposition during RCW operation would not noticeably affect salinity in Biscayne Bay as described in Section 5.2.1 (Table 5-1). Therefore, the effect on Biscayne Bay salinity from any permitted pumping would be much reduced from the already minimal salinity change predicted by the USGS modeling analyses.

Using the same operational scenarios evaluated by USGS and described in Section 5.3.2, the review team assessed the potential for impingement and entrainment of larval fish and invertebrates from RCW operation. Based on the assumption that the RCW laterals would be located 25 to 40 ft beneath Biscayne Bay, the team estimated the average vertical velocity of saltwater approaching the bay bottom to be 0.0003 ft/min (0.000152 cm/sec) if all the pumped water flowed into the bay bed within a polygon encircling the RCW laterals. A worst-case approach velocity was estimated to be 0.3 ft/min (0.0152 cm/sec or 0.005 fps) using assumptions similar to those described above and substrate permeability 1,000 times greater than the average permeability (EIS Section 5.2.1.2). This is significantly less than EPA's 0.5 fps intake through screen velocity limit for new facilities under 316 (b) Phase I requirements specified in 40 CFR 125.84 (TN254). Because these estimated vertical velocities are orders of magnitude smaller than the near-bottom current speeds measured by McAdory et al. (2002-TN1155) during ebb and flood events at nearshore locations in Biscayne Bay, tidal and wind-driven currents would provide a much greater influence at the sediment-water interface, and impingement and entrainment impacts would be negligible during RCW operation. If, however, the limestone above the RCW laterals were to fracture, preferential flow patterns associated with RCW operation could noticeably alter flow dynamics at some locations surrounding the Turkey Point site, and the potential for impingement and entrainment is possible. Required monitoring of water quality, benthic organisms, and submerged aquatic vegetation during operation of the RCWs should detect any adverse effects that would require mitigation (State of Florida 2014-TN3637), and is discussed in greater detail in Section 5.3.2.4. Any operational effects would likely be confined to a small portion of Biscayne Bay above the RCW laterals, which would be operated no more than 60 days per year (State of Florida 2014-TN3637). Thus, the effects of RCW operation on impingement and entrainment are expected to be minimal during the licensing period.

A study of benthic communities in Biscayne Bay and Card Sound conducted by Ecological Associates, Inc. in 2008-2009 (EAI 2009-TN97) found assemblages of crustaceans, echinoderms, mollusks, polychaetes, and other taxa consistent with previous studies (Table 2-20 in Section 2.4.2.1 [EAI 2009-TN97]). The horizontal and vertical distributions of these taxa are influenced by a variety of factors, including sediment grain size, salinity, oxygen, light intensity, and nutrients (Gray and Elliot 2009-TN1007). In general, the bulk of meiofauna and microfauna are found in the upper few centimeters of the sediment near the sediment-water interface (Gray and Elliot 2009-TN1007; Hines and Comtois 1985-TN1004; Flint and Kalke 1986-TN1003). A 2013 mesocosm study (FPL 2015-TN4442) supports the unlikelihood of noticeable pore-water changes that could affect benthic communities. Thus, the any adverse impacts on benthic communities from RCW operation are expected to be undetectable during the licensing period. As described above, monitoring of benthic communities during operation of the RCWs will be required by FDEP to detect any adverse effects, and determine additional measures to mitigate any impacts if any are detected (State of Florida 2014-TN3637).

Radial collector well operation is also unlikely to affect currently Federally listed corals or those proposed for listing or reclassification by the National Oceanic and Atmospheric Administration (NOAA 2014-TN3712). The nearshore (western) regions of Biscayne Bay near Turkey Point provide only marginal habitat for these species in comparison to mid-bay, eastern, and offshore locations (Lirman et al. 2003-TN1519).

Based on the above analyses, the review team concludes that operation of the RCW is unlikely to noticeably alter or destabilize commercially, recreationally, or ecologically important species inhabiting Biscayne Bay. USGS modeling results suggest that although episodic increases in salinity are possible under continuous RCW operation, the effects would be localized and of short duration. Further, the continuous pumping scenario is the least likely to occur, based on FPL statements that the RCW is to be used as a backup system only and no more than 60 days per year. Impingement, entrainment, and changes in sediment pore-water characteristics are also unlikely, given comparisons of the estimated downwelling water velocity during RCW operation to the sweeping currents at near-bottom locations in Biscayne Bay during ebb and flood tide events. Thus, the review team concludes that any adverse effects on the aquatic resources of Biscayne Bay are expected to be minor.

Federally or State-Listed Species, Species of Concern, and Designated Critical Habitat

Federally or State-listed aquatic species likely to occur at or near the Turkey Point site include the Florida manatee (*Trichechus manatus latirostris*), Hawksbill sea turtle (*Eretmochelys imbricata*), Leatherback sea turtle (*Dermochelys coriacea*), Green sea turtle (*Chelonia mydas*), Loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), American crocodile (*Crocodylus acutus*), American alligator (*Alligator mississippiensis*; because of its similarity in appearance to the crocodile), Smalltooth Sawfish (*Pristis pectinata*), and Johnson's seagrass (*Halophila johnsonii*). Species likely to be affected by operation of the proposed Turkey Point Units 6 and 7 cooling system include the American crocodile, which resides in the IWF and has designated critical habitat within the Turkey Point site, and potentially the Smalltooth Sawfish, which has been reported in nearshore areas of Biscayne Bay and Card Sound but does not have designated critical habitat near the Turkey Point site. Sawfish would only potentially be affected during the operation of the RCW system, and then only if they occurred in areas that may be susceptible to short-term salinity fluctuations. Because suitable habitat for this species exists elsewhere in Biscayne Bay, effects are not expected to be noticeable. Because manatees are generally found near the barge-unloading area and in warm-water canal areas to the north of the facility, they would not interact with the closed-cycle cooling system. Sea turtles would also likely be unaffected by operation of the proposed Turkey Point Units 6 and 7 cooling system, given their infrequent visits to nearshore areas adjacent to the Turkey Point site based on stranding data from FFWCC (2012-TN4120) and NOAA. Johnson's seagrass, while present in Biscayne Bay, has not been reported in nearshore areas near the Turkey Point site and, thus, would be unlikely to be affected by operation of the cooling system.

Federal and State of Florida Species of Concern likely to occur at or near the Turkey Point site include the Mangrove Rivulus (*Rivulus marmoratus*), Dusky and Sand Tiger Sharks (*Carcharhinus obscurus* and *Carcharias taurus*, respectively), Opossum Pipefish (*Microphis brachyurus lineatus*), and Speckled Hind (*Epinephelus drummondhayi*) (Section 2.4.2). With the exception of the Mangrove Rivulus, none of the Federally and State-listed Species of Concern is expected to be affected by the operation of the proposed Units 6 and 7 RCW cooling system because, although they are present in Biscayne Bay, they have not been reported in the vicinity of the Turkey Point facility or captured in recent collections. Although the Mangrove Rivulus is able to tolerate a salinity range of 0 to 68 ppt (FMNH 2010-TN165), noticeable hydrological alterations resulting from RCW operation could affect the coastal marsh and mangrove habitat necessary to support the fish in the immediate vicinity of the wells. A discussion of the potential effects of the proposed Units 6 and 7 cooling system on susceptible species follows.

<u>Use of Reclaimed Water</u>

The use of reclaimed water as a cooling source eliminates the potential for changes in Biscayne Bay salinity values and impingement or entrainment of protected aquatic species but may result in adverse effects from cooling-tower drift deposition of chemicals present in Miami-Dade reclaimed water after final treatment. Because cooling-tower drift deposition is expected to be confined primarily to the IWF, potential effects on the threatened American crocodile could occur if chemical loading is sufficient to directly affect adults or juveniles, or indirectly affect this species through alteration of the food web present in the IWF. The reclaimed water used for cooling would receive high-level disinfection at the SDWWTP prior to entering the Turkey Point reclaimed water-treatment facility. This level of disinfection is greater than the secondary treatment required for reclaimed water used for irrigation for public and private use (Fla. Admin. Code 62-610-TN1269). Additional treatment of the reclaimed water would occur at the RWTF, to include additional filtration, prior to being used as cooling water (FPL 2014-TN4058). While the combined treatment of reclaimed water may remove or reduce concentrations of many CECs, the NRC staff performed a conservative screening-level assessment that compared the expected concentrations of priority pollutants and CECs in reclaimed water to appropriate toxicological data if numerical criteria were unavailable. The screening-level assessment included organic compounds, metals, and CECs. A number of sources of information were used to determine the potential concentrations in reclaimed water (FPL 2012-TN263; Lietz and Meyer 2006-TN1005; Miami-Dade County 2011-TN1006). Expected chemical concentrations derived from these sources of information were compared to Federal water-quality criteria (EPA 2014-TN3295) or to toxicological effects available from EPA Ecotoxicology (ECOTOX) (EPA 2012-TN1525). Recent work by Brausch and Rand (2011-TN1002) was also used to assess the toxicological effects of CECs, because water-quality criteria have not been established for many of these chemicals. When toxicological benchmarks were used, no-observed effect concentration (NOEC) levels were chosen for sensitive, representative aquatic species to provide a conservative assessment. When possible, the NOECs for mortality of the water flea (*Daphnia magna*) were used as a toxicological benchmark because this species has been used extensively to support water-quality studies, and is commonly used as a sensitive surrogate for toxicity studies. As described above, for chemicals with established water-quality criteria, those present in reclaimed water above limits considered protective of aquatic resources were retained in the screen and evaluated for fate and effects, as discussed in Section 5.2 and presented in Table 5-1. For chemicals without established water-quality criteria, including most CECs, those present at >1/10 of a toxicological benchmark chosen by the review team to be protective of aquatic resources were included in fate and effects evaluations (Table 5-1). Based on fate and effects modeling results summarized in Table 5-1, adverse effects on IWF species (including the threatened American crocodile) are highly unlikely because many predicted contaminant concentrations in IWF water are orders of magnitude (less than one in several hundred to several thousand) below current analytical method detection limits, and they are much lower (4 to 40,000 times) than the toxicological benchmarks used in the screening assessment. Cooling-tower deposition during reclaimed water use is also not expected to adversely affect Smalltooth Sawfish and Johnson' seagrass—listed species that may occur in Biscayne Bay—because the cooling-tower deposition occurs predominantly west and south of the Turkey Point site, and any chemicals entering Biscayne Bay and Card Sound from cooling-tower deposition would be rapidly diluted due to the tidal exchange of water over a day. The NRC staff acknowledge that the list of CECs assessed is not exhaustive, but is a representative list of different chemical classes, and are known to occur in the reclaimed water from SDWWTP (FPL 2012-TN263; Lietz and Meyer 2006-TN1005; Miami-Dade County 2011-TN1006). In addition, the toxicological benchmarks described here are assessed for single chemical exposures, often under laboratory controlled conditions where they do not combine with other organic or inorganic substances or may become less bioavailable through sedimentation. There is a growing research area in assessing combinatorial exposure effects of contaminants by measuring adverse outcome pathways (Knapen et al. 2015-TN4449), or effects-directed analysis (Brack et al. 2016-TN4448), but a general acknowledgement that real-world conditions where exposures occur under varying water-quality conditions to hundreds of natural and anthropogenic compounds, even in known contaminated areas, will require reliance on observable adverse outcomes through monitoring.

Use of Radial Collector Wells

Because RCW laterals are located 25 to 40 ft below Biscayne Bay, impingement and entrainment of listed species is highly unlikely. Salt-drift deposition from cooling-tower operation, however, could affect resident American crocodile, their prey residing in the IWF, and the critical habitat. To assess these potential impacts, the review team used a fate and effects modeling approach similar to the one described for reclaimed water chemicals to estimate the salt-drift deposition likely to occur within the IWF or freshwater refugia on IWF berms. A complete discussion of the modeling approach, assumptions, and results is found in Section 5.2 and Appendix G.

Based on the modeling results presented in Appendix G and discussed in Section 5.2.1.1, salt-drift deposition would not noticeably change the existing salinity in the IWF or freshwater refugia ponds. Deposition of trace chemicals present in Biscayne Bay water also would pose no threat to species inhabiting the IWF because predicted concentrations are orders of magnitude lower than analytical method detection limits (Table 5-3), and those entering Biscayne Bay and Card Sound would be rapidly diluted.

As described above, continuous RCW operation would not noticeably alter salinity patterns in nearshore areas. Moreover, the 60-day limitation (State of Florida 2014-TN3637) on operation of the RCW would result in less impact than continuous operation. Short-term salinity changes of ±2 psu for a short period of time are not expected to adversely affect aquatic biota, such as the Mangrove Rivulus, that spend some of their time in nearshore areas of Biscayne Bay near Turkey Point.

Storage of Excavated Muck on IWF Berms

Excavated muck from the construction of the nuclear island would be placed on IWF berms as described in Section 4.3.2.1. FPL plans to stabilize the addition of material to the berms by using control measures such as silt fences and/or gravel filters to prevent muck and runoff from entering the canals (FPL 2015-TN4442). The location of the muck additions also would not be in preferred crocodile nesting areas, as determined from historic nesting locations (Figure 2-31). Therefore, the permanent storage of excavated muck on the IWF berms is expected to have a negligible effect on aquatic resources within the canal system, including the American crocodile. Rainfall and runoff from the site could cause leaching of nutrients such as nitrogen and phosphorus from the stored muck into the IWF. As described in Sections 5.2.1.4 and 5.2.3.1, a conservative analysis was used to determine the maximum incremental increase to the IWF (i.e., if all the muck was washed into the cooling canals from a storm) in concentration for TKN as 32 μg/L and for TP as 16 μg/L, even though phosphorus was not detected in muck leachate samples. Nutrients from the muck leachate that may reach Card Sound were estimated as 1.11×10^{-6} mg/L for TKN and 7.67×10^{-7} mg/L for TP, which is almost 4 orders of magnitude less than TP observed in water samples from Card Sound between 2006 and 2008. Given this conservative estimate and the additional dilution of tidal exchange in Card Sound and Biscayne Bay, the addition of TKN and TP to the environment from muck leachate would be negligible.

Species with Designated Essential Fish Habitat

The effects of the operation of the proposed Turkey Point Units 6 and 7 cooling system on designated EFH or HAPC would likely be similar to those described above for recreationally, commercially, or ecological important species, except that by definition, any Biscayne Bay seawater entering the RCW system would affect EFH. A complete description of potential impacts on EFH and HAPCs is provided in Appendix F-3 (EFH Assessment).

Deep-Aquifer Communities

Because there is no available information about biological communities that may be present in deep-aquifer formations near Turkey Point, it is not possible to determine whether a complete exposure pathway is present or assess potential impacts. Thus, the potential risk of chemical exposure resulting from deep-aquifer injection of cooling-tower blowdown cannot be determined.

5.3.2.4 Aquatic Monitoring During Operation

It is assumed the existing aquatic resources monitoring programs conducted by FPL at the Turkey Point site would continue during the operation of proposed Units 6 and 7, including the comprehensive program that protects the American crocodile populations in the IWF and the monitoring procedures used during barge deliveries to reduce the potential for barge/tug collisions with manatees or sea turtles. FDEP also requires additional monitoring during the operation of proposed Units 6 and 7 to ensure the proposed facilities and systems operate as permitted. This includes 2 years of post-installation monitoring including the first two RCW operational events for seagrass and benthic communities in areas adjacent to the RCWs, and a mitigation plan in the event adverse impacts are detected (State of Florida 2014-TN3637), as described in the applicant's Radial Collector Well System Monitoring Plan (see Section 4.3.2.4).

A monitoring program could be developed to assess the condition and ecological resources associated with proposed transmission line and pipeline corridors, and to guide maintenance procedures. Federal or State regulatory agencies may require additional monitoring that confirms the predicted effects of the cooling system described in the applicant's ER, the SCA submission, and this EIS. In addition, monitoring of the condition of channel markers in the private entrance channel to the Turkey Point site is already required by the U.S. Coast Guard, and is expected to continue during operation of proposed Units 6 and 7. Although this is not considered ecological monitoring, the maintenance of the markers would protect seagrass and benthic resources from vessel groundings near the Turkey Point site.

5.3.2.5 Summary of Operational Impacts on Aquatic Resources

The independent assessment conducted by the review team included evaluation of information provided by FPL, review of relevant technical reports and scientific journal articles, consultation with State and Federal resource agencies, and incorporation of scoping comments into the review process, when applicable. In addition, the team reviewed the salinity models and results provided by FPL, the NPS, and USGS, and performed a screening-level assessment and fate and effects modeling to better understand the potential for adverse impacts from cooling-tower deposition for both cooling-water options. Based on these assessments, the review team concludes the use of reclaimed water from Miami-Dade County to operate the cooling system, operation of RCWs compliant with State of Florida requirements (State of Florida 2014-TN3637), and permanent storage of muck on IWF berms would result in SMALL impacts on onsite and offsite aquatic resources, including commercially, recreationally, and ecologically important species; those listed by State or Federal resource agencies; and those with designated as EFH or HAPC in Biscayne Bay or Card Sound.

5.4 Socioeconomic Impacts

Operations activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of operations-related activities and the operations workforce on the region.

Although the review team considered the entire region within a 50 mi radius of the Turkey Point site when assessing socioeconomic impacts, the primary socioeconomic impact area is Miami-Dade County. Based on commuter patterns, populations, and the distribution of residential communities in the area, the review team anticipates minimal impacts on other counties within the 50 mi radius in Florida.

5.4.1 Physical Impacts

This section identifies and assesses the direct physical impacts of operations-related activities on the community, including the disturbances from noise, odors, exhausts, visual intrusions, and thermal emissions. It includes consideration of impacts resulting from plant operations, transmission line corridors and access roads, other offsite facilities, and project-related transportation of goods and materials in sufficient detail to predict and assess potential impacts and to show how these impacts may be mitigated.

The following sections assess the potential operations-related physical impacts of two new units on specific segments of the population, the plant, and nearby communities.

5.4.1.1 Noise Impacts on Workers and the Local Public

The main sources of noise from plant operations are from the cooling towers of the circulating-water system (CWS) (NRC 2000-TN614). Also, noise would be generated by the operation of the Units 6 and 7 transmission system, substation operations, and increased traffic of the operations workforce on access roadways and onsite roads. Noise from transmission system and substation operations would be in accordance with State and local code requirements.

FPL must meet all applicable Occupational Safety and Health Administration (OSHA) noise requirements. Workers would use noise protection as required by OSHA when engaging in work subject to noise hazards. There are no residential areas or public roads on the Turkey Point site.

Offsite, one residence is approximately 3.9 mi from proposed Units 6 and 7 and the transient population includes Turkey Point Units 1–5 workers and visitors to nearby recreational facilities such as Biscayne National Park, Homestead Bayfront Park, and Homestead Miami Speedway. The Homestead Air Reserve Base lies within the 6 mi vicinity of the site. The closest public access points to the site are 1.6 mi northwest and 2 mi north of the existing units (FPL 2014-TN4058). FPL conducted an ambient noise survey and an operations noise analysis for the operations of Units 6 and 7 (for details, see Section 5.8.2). These analyses showed that there would be no noticeable alteration in noise in the current environment surrounding the proposed site, and that noise levels at the boundary of the site would be lower than 60 dBA, a level at which noise impacts would be of small significance.

Based on the above analysis, the review team concluded that the operations-related impact from noise would be minor and mitigation would not be warranted.

5.4.1.2 Air-Quality Impacts on Workers and the Local Public

In Section 5.7, the review team assessed the impacts on air quality from operations at the Turkey Point Units 6 and 7. The new units would have standby diesel generators that would be operated periodically on a limited short-term basis accompanied by intermittent related emissions. The emissions would be mostly due to periodic testing of diesel generators and normal plant operations; the rest would be mostly due to workforce transportation. In Section 5.7, the review team determined there would be minor air-quality impacts and mitigation would not be warranted.

5.4.1.3 Buildings

Operations activities would not affect offsite buildings. Onsite safety-related buildings have been constructed to safely withstand any possible impact, including shock and vibration, from operations activities associated with the proposed activity (10 CFR Part 50) (TN249), Appendix A). The closest structures are those of the Homestead Bayfront Park marina, approximately 2 mi north of the proposed site for Units 6 and 7. Except for Turkey Point site structures, no other industrial, commercial, or residential structures would be affected. Consequently, the review team determined there would be no operations-related impacts on onsite and offsite buildings.

5.4.1.4 Roads

Roads within the vicinity of the Turkey Point site would experience an increase in traffic at the beginning and the end of each operational shift and the beginning and end of each outage support shift. The increase in traffic volume would have negligible impacts on road conditions. No road improvements other than those already proposed for construction would be warranted.

After completion of construction, FPL would remove a portion of the roadway improvements on SW 359th Street that was used during construction and return it to its status as a transmission line patrol road (FPL 2014-TN4058). All other road improvements made for the construction period would remain in place. From a socioeconomic perspective, the review team considers the remaining road improvements derived from increasing lanes, signalization, and police control to represent noticeable beneficial changes. However, these changes would continue to have the potential for impacts on land use and terrestrial ecology. For an analysis of those impacts, see Sections 5.4.1, 5.4.3, and Chapter 7.

Traffic impacts are analyzed in Section 5.4.4.1.

5.4.1.5 Waterways

During operations, large components necessary for maintenance or uprates would arrive by barge. These shipments would be infrequent and therefore have minor impacts on waterways from these activities.

5.4.1.6 Aesthetics

Parts of the two proposed reactors would be visible from surrounding roadways and recreational areas, but existing vegetation would often screen Units 6 and 7 from public view. Commercial and recreational boating traffic on the eastern side of the property would have a broad view of proposed Units 6 and 7. Because Units 6 and 7 would be built adjacent to existing units, the contrast with the existing landscape would be reduced. Units 6 and 7 would be built with materials that are architecturally similar to Units 1 through 4 to provide an aesthetically comparable effect (FPL 2014-TN4058).

The plumes from the cooling towers would be seen during the early morning in cool weather, generally during the winter months, and would extend only a short distance from the site during most days. Results from the CALPUFF (EPA 2007-TN1474) modeling analysis showed that during a little over 1 percent of daylight hours the plumes would have lengths exceeding 10,000 m downwind from the cooling towers. This would occur with high relative humidity and a nearly saturated atmosphere (see Section 5.7 for details).

Guidelines from the Illuminating Engineering Society of North America would be incorporated into the outdoor lighting design while meeting NRC and OSHA requirements for security and worker and plant safety. Typical practices to be incorporated include minimizing upward light from lighting fixtures, minimizing upward light in general so that light reaches its intended target, turning off lighting not needed for safety and security between 11:00 p.m. and sunrise, and containing light within its intended target area (by the suitable choice of fixtures for light distribution, by selection of mounting height and physical location, and by minimization of glare in the horizontal or vertical directions) (FPL 2014-TN4058). Light from current Turkey Point site units is visible from several locations surrounding the site, so sky glow from them is visible from urban areas as far as Miami (Section 2.5.2.4). Based on the mitigating factors listed above, the review team concluded that the visual impact of the operations of proposed Units 6 and 7 would be minor.

Transmission lines in established transmission line corridors would have little visual contrast with the existing environment. The transmission line from Clear Sky to Turkey Point would be fully contained on the Turkey Point site and the view would be similar to the existing lines between the Turkey Point switchyard and the McGregor switchyard (FPL 2014-TN4058). The segments of the western transmission line corridor between Everglades National Park and the Levee substation would be adjacent to the Everglades National Park. These transmission lines would be visible to recreational users of the park up to a distance of 20 mi (FPL 2014-TN4058). The transmission line along the borders of the Everglades National Park would follow SW 187th Avenue and the presence of the road would attenuate any visual contrast with the national environment.

5.4.1.7 Summary of Physical Impacts

Based on the information provided by FPL (2014-TN4058) and the review team's independent analysis, the review team concludes that the overall physical impacts of operations on workers and the local public, buildings, and aesthetics near the Turkey Point site would be SMALL and adverse, although there would be MODERATE and beneficial socioeconomic impacts on roads near the existing Turkey Point site.

5.4.2 Demography

For analytical purposes, Unit 6 is scheduled to start operation by 2025 and Unit 7 by 2026. Operations staffing would begin 2 years before fuel loading of Unit 6, increasing to its full size by November 2025[(1)].

FPL determined the total number of operations workers for the proposed project would be 806, and that the in-migrating workforce for operations would be 50 percent of all operations workers, or 403 workers (FPL 2014-TN4058). Also, FPL assumed that in-migrating workers would settle into the socioeconomic impact area in the same pattern as the current FPL employees and all of the in-migrating operations workers would bring families. Using an average family size for the workforce of 3.25 people (Malhotra and Manninen 1981-TN1430), this would bring the total in-migrating project-related population to 1,310 (403 workers and 907 additional family members).

The review team believes that the above assumptions are plausible and incorporated them into the current analysis. The estimated size of the operations workforce for each unit and the average family size of the in-migrating workers are based on existing studies (FPL 2014-TN4058). The assumption that 50 percent of the workforce would migrate into the 50 mi region may be an upper-bound estimate given that the total number of operational workers employed (806) is less than one-tenth of 1 percent of the workforce available in Miami-Dade County (see Section 2.5.2.1). If the in-migrating population follows the same pattern as the existing workforce, then 42.78 percent of the in-migrating population (560) would live in the socioeconomic impact area of Homestead and Florida City and 83.3 percent (1091) in Miami-Dade County as a whole. With these assumptions, there would be a net population increase of

(1) From the time of this analysis, commercial operation dates have been moved to 2027 and 2028, respectively (FPL 2015 TN4502). The review team does not expect this change to affect the results of the current analysis.

less than one-tenth of 1 percent in the projected population for Miami-Dade County in 2020 and less than 1 percent increase in the current population of the Homestead and Florida City area.[(2)]

The operation of Turkey Point Units 6 and 7 would also require support of 600 to 1000 temporary workers every 18 months for each unit. In other words, there would be an outage for either Unit 6 or Unit 7 about every 9 months. Each outage would last approximately 30 days. This would more than double the number of in-migrating workers to the 50 mi area for short periods of time, but it would still represent a small fraction of the population in the area.

Based on its independent analysis, the review team concludes that the demographic impacts of operation in Miami-Dade County would be SMALL. Although the impacts may be larger in the Homestead and Florida City area than in the county as a whole, the impacts would still be SMALL for the demographics of the Homestead and Florida City area.

5.4.3 Economic Impacts on the Community

The impacts of station operation on the local and regional economy are dependent on the region's current and projected economy and population. The review team obtained insight into the projected economy and population by reviewing FPL's ER (FPL 2014-TN4058) and through its own independent study of the affected area through consultation with local authorities and analysis of publicly available data. The economic impacts over a 40-year period of station operation are qualitatively discussed. The primary economic impacts from employing 806 new workers to operate Units 6 and 7 at the Turkey Point site would be related to taxes, housing, and increased demand for goods and services; the largest impact would be associated with plant property tax revenues (discussed in Section 5.4.3.2).

5.4.3.1 Economy

The review team estimated the potential social and economic impacts on the surrounding region as a result of operating the proposed two new reactors at the Turkey Point site over a 40-year operating license. Social and economic impacts would occur from additional operation workforce jobs, tax revenue impacts, and the increased population of in-migrating workers and their families.

The 806-person operations workforce would support new indirect jobs in the area through an employment multiplier effect, by which each dollar spent on goods and services by an in-migrant becomes income to the recipient, who saves a portion but re-spends the rest. In turn, this re-spending becomes income to someone else, who, in turn, saves part and re-spends the rest. This iterated increase in local expenditures creates demand for new jobs. The U.S. Department of Commerce's Bureau of Economic Analysis (BEA) provides estimates for regional multipliers for industry jobs and earnings. For each new job created in the power generation and supply industry in Miami-Dade County an estimated 2.1696 indirect jobs would be created (FPL 2014-TN4058).[(3)] The review team determined all workers who would be employed in the operation of Turkey Point Units 6 and 7 would constitute "new employment" because workers already

(2) Based on a 59,866 population estimate for Homestead and 11,313 population estimate for Florida City (Section 2.5.1).
(3) RIMS II (Regional Input-Output Modeling System) direct effect employment multipliers for Miami-Dade County: 3.1696 for the power generation and supply industry.

residing and working in Miami-Dade County who left their jobs to work at Turkey Point Units 6 and 7 would leave a vacant position that would need to be filled by other workers.(4) Therefore, the review team applied the BEA employment multiplier to all direct operations workers residing in Miami-Dade County (83.3 percent of all operations workers) to estimate indirect employment.

Using the BEA employment multiplier, the review team estimated the 671 operation workers residing in Miami-Dade County (806 × 0.833) would support 1,456 indirect jobs in Miami-Dade County. Because most indirect jobs would be service or retail-related and not highly specialized, and because 1,456 indirect jobs represent approximately 1.3 percent of the number of unemployed workers in Miami-Dade County in 2013, the review team expects these jobs would likely be filled by local residents and any additional in-migration would be negligible.

The new operations workforce would have positive economic impacts in the region. If each new operations worker earned $116,579(5) a year, each year of salaries paid to operations workers would inject $78,224,509 (671 × $116,579) into the local economy. BEA estimates that for each dollar paid in the power generation and supply industry in Miami-Dade County, an additional 0.7880 dollars of earnings are generated in all industries (FPL 2014-TN4058). Therefore, the $78,224,509 of annual earnings of operation workers would generate an additional $61,640,913 in annual indirect earnings ($78,224,509 × 0.7880). The total annual earnings injected into the regional economy would be $78,224,509 plus $61,640,913 of indirect earnings, equaling $139,865,422 in total annual earnings.

The review team concludes that beneficial economic impacts could be experienced throughout the 50 mi region surrounding the site as a result of operational activities at the Turkey Point site. Because annual earnings would be less than three-tenths of 1 percent of total wage earnings in Miami-Dade County,(6) these beneficial impacts would not noticeably alter local earnings. Operations jobs and the jobs indirectly created by the workforce would total 671 + 1,456 = 2,127 new jobs. Because these new jobs would be less than two-tenths of 1 percent of the jobs in the Miami-Dade County (see Section 2.5.2-1), these beneficial impacts would be minor on local employment. The review team concluded that the beneficial economic impacts on the economic impact area and the 50 mi region would be minor.

5.4.3.2 Taxes

Several tax revenue categories would be affected by the operation of proposed Units 6 and 7. These include corporate income taxes, sales and use tax and other taxes on sales and services, and property taxes.

Personal and Corporate Income Taxes

As stated in Section 2.5.2.2, the State of Florida does not levy a personal income tax on individuals. Florida does levy a corporate income tax and in fiscal year (FY) 2010-2011, the State of Florida received $1.87 billion (6.3 percent of its total tax revenue of $29.7 billion) from corporate income and excise taxes (Table 2-42). The tax base is based on the Federal taxable

(4) For more information on BEA RIMS II regional economic multipliers, see BEA 2012-TN1569.
(5) BLS 2012-TN4083. Average Annual Pay in Nuclear Electric Power, all United States, 2012 (no data available for Miami-Dade County).
(6) BLS 2012-TN4084. $46,667 million annual estimate in 2012.

income with specific adjustments for the State of Florida and a $25,000 exemption (FDOR 2012-TN450). Many factors are involved in computing the amount of tax liability. However, the review team used the following analysis to determine the taxes paid on FPL's income from the operation of Units 6 and 7 would be a small fraction of the total corporate income taxes received by the State of Florida in 2010-2011:

- Each nuclear reactor would have a net output power of 1,100 MW(e).
- The units are expected to operate at a maximum capacity of 93 percent (FPL 2014-TN4058).
- If each reactor operated 8,148 hours a year (8,760 hours × 0.93), the amount of power generated would be 8,961,480,000 kWh/yr (1,100 × 93 percent × 8,760 × 1,000).
- As of January 2012, the average electricity price in the Miami area was $0.114 (11.4 cents) per kWh (BLS 2012-TN447). These are retail prices and the average wholesale price would be lower, which establishes this process as an upper-bound analysis.
- At these prices, the revenue generated by proposed Units 6 and 7 would be no higher than $2,043 million per year (8,961,480,000 × $0.114 × 2).
- Based on MIT 2009 (TN448), the review team estimates that the operating costs per kWh would be between 8.3 cents and 11.1 cents, assuming fuel costs at about seven-tenths of 1 cent per kWh. With an estimated 8,961,480,000 kWh/yr of power generated by each reactor, this would correspond to $743.8 million to $994.7 million per year in operating costs for each reactor or $1,488 million to $1,989 million per year for both Units 6 and 7.
- Annual corporate income from the operations of Units 6 and 7 would be no higher than $555 million per year ($2,043 million − $1,488 million).
- Annual corporate income taxes would be no higher than $31 million ($555 million × 5.5 percent).

Because corporate income taxes would account for less than 1.7 percent of the total corporate income taxes received by the State of Florida, the review team determined the corporate income tax impact on the State of Florida would be minor.

Sales and Use Taxes

The region would experience an increase in the sales and use taxes collected from purchases made for the operation of proposed Units 6 and 7. The area around the proposed site would also experience an increase in sales and use taxes generated by retail expenditures (e.g., restaurants, hotels, merchant sales, food) by the operations and outage workforces.

FPL does not currently have an estimate for its Units 6 and 7 annual operations expenses. Based on MIT 2009 (TN448), the review team estimates that the operating costs would be between 8.3 cents and 11.1 cents per kWh. With an estimated 8,961,480,000 kWh/yr of power generated by each reactor, this would correspond to $743.8 million to $994.7 million per year in operating costs for each reactor or $1,488 million to $1,989 million per year for both Units 6 and 7. The review team's experience indicates that about 10 percent of annual operations expenditures are spent locally (NRC 2011-TN3675). A State sales tax of 6 percent would generate between \$8.9 million (\$1,488 million × 10 percent × 6 percent) and \$11.9 million (\$1,989 million × 10 percent × 6 percent). This would represent less than one-tenth of 1 percent of FY 2011 State sales and use tax revenues (Table 2-42). Similarly, a County sales tax of 1 percent would generate between \$1.5 million and \$2.0 million. This would represent less than 1 percent of FY 2012 County sales tax revenues (Table 2-41). Therefore, the review team expects the tax revenues generated by sales and use taxes from operations at Units 6 and 7 would be minor but beneficial to the State and Miami-Dade County.

Property Taxes

County and school district governments in Florida may levy taxes up to 10 mills each (1 percent of assessed value) (FDOR 2012-TN459). In 2014, Miami-Dade property appraiser proposed property taxes for FPL's two existing nuclear units were \$37.9 million. Approximately 40 percent to be paid to the Miami-Dade School District (\$15 million), 40 percent to Miami-Dade County (\$15 million), and the remaining paid to unincorporated municipalities and other accounts (Miami-Dade County 2014-TN4079).

If property taxes paid by Turkey Point Units 6 and 7 were proportional to their net generating capacity, property taxes paid by Units 6 and 7 would be 1.33 times that paid by Units 3 and 4 (2,184 MW(e)/1,632 MW(e) = 1.33). Property taxes for Units 6 and 7 would be estimated at approximately \$50.4 million (1.33 × \$37.9 million). Of these property taxes, approximately \$20 million would be paid to the Miami-Dade School District and \$20 million would be paid to Miami-Dade County. These payments would correspond to up to 1.3 percent of the Miami-Dade School District 2011-2012 property tax revenues (\$20 million out of \$1,556 million), and up to 1.6 percent of Miami-Dade County 2011-2012 property tax revenues (\$20 million out of \$1,243 million) (Section 2.5.2.2). Property taxes paid by Turkey Point Units 6 and 7 would, therefore, be less than 10 percent of the total revenues of the collecting jurisdiction and would have a minor but beneficial impact.

Another source of revenue from property taxes would be housing purchased by some operations workers. However, there is such a large housing stock available in Miami-Dade County the review team does not expect upward pressure on housing prices. See Section 5.4.4.3 for the review team's discussion of housing. If incoming workers' families were to reside in Miami-Dade County, they would represent an increase of less than one-tenth of 1 percent over Miami-Dade County's projected 2020 population. If 43 percent of the in-migrants choose to reside in the Homestead and Florida City area, they and their families would represent a less than a 1 percent increase in the population of the Homestead and Florida City area (Section 5.4.2). However, some in-migrating workers could choose to have new homes built, which would add to the county's taxable property base. Therefore, the property tax impacts from new residents would be minor and beneficial to property tax revenues.

Summary of Tax Impacts

The review team expects tax revenue increases in the form of sales, corporate, and property taxes, because of the operation of the proposed Units 6 and 7 and the influx of operations workforce into the region. Because of the large Florida State, Miami-Dade County, and the Homestead and Florida City tax bases, relative to the estimated increases in revenues from operations-related activities, the review team expects the tax-related impact on these governments would likely be minor and beneficial.

5.4.3.3 Summary of Economic Impacts on the Community

Based on its independent analysis, the review team concludes that the economic impacts of operating Turkey Point Units 6 and 7 would be SMALL and beneficial in the State of Florida, Miami-Dade County, as well as in Homestead and Florida City.

5.4.4 Infrastructure and Community Services

Infrastructure and community services include transportation, recreation, housing, public services, and education. The operation of two new units at the Turkey Point site would affect the transportation network because the additional workforce would use local roads to commute to and from work and additional truck deliveries would be made to support operation of the new units. These same commuters could also affect recreation in the area. As the workforce migrates into and settles in the region, there may be impacts on housing, education, and public sector services.

5.4.4.1 Traffic

After completion of construction, SW 359th Street would be returned to its status as a transmission line patrol road, but would remain paved and all worker access to the site would occur through SW 344th/Palm Drive (FPL 2014-TN4058). To assess the impact on traffic of the increase in operations workers at the site, a traffic study was conducted in 2009. The study assumed the following improvements at two key intersections made to accommodate construction traffic would be maintained during operations (Traf Tech 2009-TN1266):

- SW 328th Street/North Canal Drive and SW 117th Avenue:
  - All-way stopped control (no need for signalization or police control);
  - One separate northbound left-turn lane (no need for dual lefts).
- Construction of one eastbound right-turn lane.
- SW 344th Street/Palm Drive and SW 117th Avenue:
  - All-way stopped control (no need for signalization or police control);
  - Construction of one eastbound left-turn lane;
  - Construction of one westbound right-turn lane; and
  - Construction of one southbound left-turn lane.

With the above improvements maintained, the two most affected intersections would continue to operate adequately with the increase in operations traffic. This would remain true even during outages. Table 5-4 shows the expected level of service (LOS) of those two intersections with the estimated increase in traffic.

Table 5-4. Level of Service of Key Intersections during Normal Operations of Turkey Point Units 6 and 7 with Selected Intersection Improvements[(a)]

Intersection	AM Peak Hour	PM Peak Hour
SW 328th St. & SW 117th Ave	B (C)	B (B)
SW 344th St. & SW 117th Ave	A (B)	B (B)

(a) LOS in brackets indicates level of service during outages.

Source: Traf Tech 2009-TN1266

Based on the information provided by FPL (2014-TN4058) and the review team's independent analysis, the review team concludes that traffic on the roads surrounding the proposed site would noticeably increase relative to the current baseline during operations, particularly during outages. However, with the proposed mitigation measures described above, it would not destabilize traffic in the affected area and therefore, the review team expects the traffic-related impact during normal operations would be noticeable.

In addition to congestion impacts, operations-related traffic would result in an increase in the number of accidents, injuries, and fatalities. The costs associated with these incidents include workers' compensation premiums, lost productivity, environmental remediation, property damage, fines and penalties, insurance premiums, and medical costs. Section 5.8.6 presents an estimate of construction-related vehicular impacts on accidents, injuries, and fatalities. Because the review team expects the impacts on accidents, injuries, and fatalities to be low, the associated socioeconomic impacts would be minor.

5.4.4.2 Recreation

Several recreational facilities exist in the vicinity of the proposed site: Biscayne National Park, Homestead Bayfront Park, Homestead Miami Speedway, and Mangrove Preserve. In addition, the segments of the western transmission line corridor between Everglades National Park and the Levee substation would be adjacent to the park. To the extent that traffic, noise, air emissions, and the visual landscape are affected by the operation of Units 6 and 7, recreational activities in these facilities could be affected. Traffic impacts of operations are analyzed in Section 5.4.4.1. Traffic impacts would be unevenly distributed during the day and, based upon three shifts of operations workers per day (FPL 2014-TN4058), traffic would be greatest during peak commuting hours of 6:00 a.m. to 7:00 a.m. (Traf Tech 2009-TN1266). The use of the above recreational facilities would not generate substantial competing traffic during those hours and the impact from operations on recreation-related traffic would be minor.

Noise and air emissions impacts of operational activities are analyzed in Section 5.4.1.1. Visual impacts of operational activities are analyzed in Section 5.4.1.4. Transmission lines would be visible to recreational users of Everglades National Park up to a distance of 20 mi. The new units would be fully visible by recreational users of the Biscayne National Park, but would not contrast with the existing landscape because of the presence of existing Units 1–5.

The influx of operations-related population to Miami-Dade County, and to the Homestead and Florida City areas in particular, would increase the number of local users of recreational facilities. The review team assumes that the in-migrating workers would have recreational preferences similar to the current population in Miami-Dade County. Because the in-migrating population would be less than one-tenth of 1 percent of the projected population for Miami-Dade County in 2020 and less than 1 percent of the current population of the Homestead and Florida City area, the review team expects the impact on the current recreational infrastructure to be negligible.

5.4.4.3 Housing

Section 5.4.2 of this chapter presents the assumptions behind the review team's estimated in-migration of workers. The review team assumed that 336 (403 × 0.833) workers would migrate to Miami-Dade County. All of these workers would bring families and would need housing. The operations workforce would typically require permanent housing, while a higher proportion of construction workers would prefer temporary housing (FPL 2014-TN4058).

As described in Section 2.5.2.5, the U.S. Census Bureau, in 2008–2012, estimated Miami-Dade County had 163,185 vacant housing units, 35,884 of which were for rent. Although these numbers may not be fully indicative of the housing market during the decades of operations, they suggest the demand from in-migrating operations workers would likely be a small share of the available housing (in 2008–2012 it would be three-tenths of 1 percent) and that the housing market in the county would be able to absorb the influx of operations workers with little to no perceptible impact on housing prices.

In Homestead and Florida City there were 26,215 housing units in the area in 2008–2012, 4,928 of which were vacant. If the distribution of residences of Units 6 and 7 operations workers were the same as that of present Turkey Point site employees, 173 workers (42.8 percent of the in-migrating workforce) would reside in the area. Because the demand from in-migrating operations workers would be for 3.5 percent of the available housing, the review team expects the housing market in the Homestead and Florida City area has a sufficient inventory of houses with the right amenities that it would be able to absorb the influx of operations workers and rental rates and housing prices to not suffer a perceptible increase because of this influx.

The operation of proposed Turkey Point Units 6 and 7 would also require the support of 600 to 1,000 temporary workers every 9 months, lasting approximately 30 days each time, during refueling outages. The group of workers would need temporary housing. Because of the short duration of the stay of these workers the review team expects the hotels/motels in Miami-Dade County would be sufficient to accommodate this influx. In the South Dade region alone, which includes the Homestead and Florida City area, 25 hotels/motels with approximately 1,683 rooms were available in 2007 and the average occupancy percentage for the area was 63.9 percent (FPL 2014-TN4058).

Based on its independent analysis, the review team concludes that the impacts of the operation of Units 6 and 7 on housing in Miami-Dade County would not be noticeable. Although the impacts may be larger in the Homestead and Florida City area than in the county as a whole, the impacts would still be minor for the local housing markets.

5.4.4.4 Public Services

Water Supply and Wastewater-Treatment Facilities

A detailed description of operations-related water requirements and their impacts is presented in Section 5.2 of this EIS.

Operations could bring as many as 1,091 new workers and family members to Miami-Dade County (1,310 total in-migrating operations workers and families × 0.833 residing in Miami-Dade County). According to the EPA, U.S. residents use about 100 gpd of water (EPA 2012-TN1267), which would result in an increase in the demand for potable water of approximately 0.11 Mgd for Miami-Dade County. This would represent a three-hundredths of 1 percent increase over the current demands of 347.81 Mgd on the MDWASD, which is currently operating at 71.92 percent of its capacity with 135.8 Mgd of available capacity (see Section 2.5.2.6 for a discussion of current demands). Therefore, review team concludes that increases in the demand for potable water due to operations of the proposed Turkey Point Units 6 and 7 would be negligible.

FPL plans include a packaged sanitary waste-treatment plant located on the Units 6 and 7 plant area for use by its operations workforce that would process waste from Units 1 through 7 (FPL 2014-TN4058). For analytical purposes, the review team assumed that 100 percent of the water consumed by individuals would be subject to wastewater treatment. If 2,082 people migrated into Miami-Dade County outside of Homestead and Florida City, their wastewater treatment would be handled by either the Northern or Southern District MDWASD facilities. An increase of about 109,100 gpd for the wastewater-treatment system would constitute an increase in capacity use of about five hundredths of 1 percent for the total capacity of the two district's systems. Florida City does not have its own sewage-treatment facility and relies upon the Southern District of the MDWASD to manage its waste. If all 2,201 people migrated into Homestead (and none to Florida City) the increase in demand of 0.1 Mgd would increase use from 102.2 percent of current capacity to 103.8 percent of current capacity. As explained in Section 2.5.2.6, the city's proposed 10-Year Water Supply Facilities Work Plan identifies and details the construction of a 3.45 Mgd high-level disinfectant wastewater-treatment plant upgrade, which would accommodate this increase in demand. In addition, Homestead uses the MDWASD system as a backup. The review team concludes that, with the proposed wastewater-treatment plant, or current use of MDWASD's system as a backup for Homestead, the increase in demand for wastewater treatment during operations of Turkey Point Units 6 and 7 would be negligible.

FPL plans to use up to 72.7 Mgd (50,481 gpm) of reclaimed water for the condenser cooling system of Turkey Point Units 6 and 7 (Section 3.4.2.2). As noted in Section 2.5.2.6, a study conducted for Miami-Dade County projected 374 Mgd of wastewater to be generated in Miami-Dade County by 2025 (Miami-Dade County 2007-TN1496). FPL could, therefore, be expected to use up to 19.4 percent of the wastewater generated. Because the 2007 study identified technically feasible projects to use somewhere between 25 percent and 33 percent of the total wastewater projected to be generated by 2025, and because FPL included the use of saltwater as an option when reclaimed water cannot be obtained in sufficient quantity or quality (FPL 2014-TN4058), the review team expects the demand of reclaimed water to not compete with other existing or projected uses of reclaimed water and to not adversely affect the use of reclaimed water by other projects in Miami-Dade County.

Based on the information provided by FPL (2014-TN4058) and the review team's independent analysis, the review team concludes that the overall impacts of the operation of Units 6 and 7 on the water supply and wastewater-treatment facilities in the 50 mi region would not be noticeable with implementation of Homestead's 10-Year Water Supply Facilities Work Plan.

Police, Fire Protection, and Medical Services

For onsite security, FPL would employ its own security force. Offsite, residents-to-law enforcement officer ratios for Miami-Dade County are presented in Table 5-5. In 2012, the ratio of residents-to-law enforcement officers in Miami-Dade County was 575.8 to 1. If 1,091 workers and their families (1,310 × 83.3 percent) migrate into the county during operations, the population in-migration would increase that ratio to 576.1, a one-tenth of 1 percent increase. In the Homestead and Florida City area, the increase in residents-to-law enforcement ratio would be slightly less than 1 percent. These increases would not noticeably alter police protection services in Miami-Dade County or the Homestead and Florida City.

Table 5-5. Building Impact on Police Protection in Miami-Dade County and the Homestead and Florida City Area

	Miami-Dade County	Homestead and Florida City
Population (2012)[a]	2,512,219	71,179
Sworn law enforcement officers (2010)[b]	4,363	135
Ratio of residents per law enforcement officer	575.8	527.3
Population with operating related In-migration	2,513,310	71,739
Ratio of residents per law enforcement officer with operating related in-migration	576.1	531.4
Percent increase in residents-to-law enforcement ratio	0.1%	0.8%
Additional sworn law enforcement officers needed	5	2

(a) USCB 2012-TN4098
(b) FPL 2014-TN4058

Source: Review team calculations

Residents-to-firefighter ratios for Miami-Dade County are presented in Table 5-6. In 2012, the ratio of residents to firefighters in Miami-Dade County was 717.8 to 1. If 1,091 workers and their families migrate into the county during operation, the population in-migration would increase that ratio to 718.1, a 0.1 percent increase. In the Homestead and Florida City area, the increase in residents-to-firefighter ratio would be 0.8 percent. These increases would not noticeably alter fire protection in Miami-Dade County or the Homestead and Florida City.

The population increase in Miami-Dade County from operations-related in-migration would be less than six-tenths of 1 percent of the population. A two-tenths of 1 percent increase in the average daily census in Miami-Dade hospitals would be negligible compared to the current occupancy rate of 77.5 percent (for those hospitals for which a census is available). In addition, the increase in the annual admissions and the annual outpatient visits would not be noticeable or burden the existing medical service capacity.

Table 5-6. Operations Impact on Fire Protection in Miami-Dade County and the Homestead and Florida City Area

	Miami-Dade County	Homestead and Florida City
Population (2012)[(a)]	2,519,219	71,179
Active firefighters (2010)[(b)]	3,500	69
Ratio of residents per active firefighter	717.8	1,031.6
Population with operations-related in-migration	2,513,310	71,739
Ratio of residents per active firefighter with operations-related in-migration	718.1	1,039.7
Percent increase in residents-to-firefighter ratio	0.1%	0.8%
Additional active firefighters needed	4	1

(a) USCB 2012-TN4098
(b) FPL 2014-TN4058

Source: Review team calculations

Comments received from the Village of Pinecrest express concern about the electromagnetic interference of transmission lines along the East transmission line corridor interfering with emergency communications of the Pinecrest Police Department. NRC's *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NRC 1996-TN288) concluded that the corona discharges occurring along transmission lines can result in radio and television interference, but that it is generally not a problem at voltages below 345 kV. Because the proposed transmission lines that cross the most urbanized areas are of lower voltages, the review team concludes that interference with communication systems should not be a problem. The West transmission line corridor does propose transmission lines with higher voltages but the lines are generally located at greater distances from urban populations. Potential interference of transmission lines with radio communications decreases rapidly with distance. In addition, FPL proposed to design transmission lines with hardware and conductors that minimize corona discharge (FPL 2014-TN4058). The review team concludes that interference of transmission lines with emergency communication systems would be minor.

The review team concludes that the impacts of construction on police and fire services and medical facilities would be minor.

5.4.4.5 Education

Based on a 1981 study of the migration of workers at nuclear power plant construction sites (Malhotra and Manninen 1981-TN1430), the review team assumed that if each in-migrating operations worker has eight-tenths of 1 school-age child, approximately 269 school-aged children would be part of the operations-related in-migration. If all of these children attended public schools, the additional 269 students would represent less than one-tenth of 1 percent of the 2011-2012 enrollment in Miami-Dade County Public School District. Because this amount is considerably less than the 1 percent average annual variation in public school enrollment in Miami-Dade County in past years and because Miami-Dade County public schools generally meet current mandated class sizes (see Section 2.5), the review team expects the education system in the county to be able to accommodate students that would accompany the operations workers.

The student population in the Homestead and Florida City area could increase by 138 students (403 in-migrating workers × 0.428 to Homestead and Florida City × 0.8 children per worker). This represents an increase of six-tenths of one percent of the 2011-2012 enrollment in the Homestead and Florida City area traditional public and charter schools. For this reason, and because Homestead and Florida City area public schools generally meet current mandated class sizes (see Section 2.5), the review team expects the education system in the Homestead and Florida City area to be able to accommodate students that would accompany the operations workers.

Approximately 15 percent of students in Miami-Dade County currently attend private schools (FPL 2014-TN4058). If the same share of in-migrating school-aged children were enrolled in private schools, this would further reduce the use of the expected public school capacity.

5.4.4.6 Summary of Infrastructure and Community Services

Based on information supplied by FPL, review team interviews and information solicited from public officials in Miami-Dade County, and review team review of data concerning the current availability of services and current State and community planning efforts, the review team concludes that the operational impacts on the regional infrastructure and community services would be SMALL with the exception of impacts on traffic that would be MODERATE.

5.4.4.7 Summary of Socioeconomic Impacts

Based on information supplied by FPL, review team interviews conducted with public officials in the socioeconomic impact area concerning the current availability of services, and additional taxes that would likely compensate the need for additional services, the review team concludes physical impacts and impacts on demographics, transportation, recreation, housing, public services, and education for Miami-Dade County and the Homestead and Florida City area would be SMALL, with the exception of MODERATE and adverse impacts on traffic, but MODERATE and beneficial socioeconomic impacts on road quality near the existing Turkey Point site.

5.5 Environmental Justice

Environmental justice (EJ) refers to a Federal policy under which each Federal agency identifies and addresses, as appropriate, any disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. The NRC has a policy for the treatment of EJ matters in licensing actions (69 FR 52040) (TN1009). Section 2.6 discusses the locations of EJ populations of interest (as defined in Section 2.6.1) around the Turkey Point site, vicinity, and region.

The scope of the review, as defined in the NRC guidance, should include an analysis of the impacts on EJ populations of interest, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation. The descriptions to be provided by this review should state whether the impacts are likely to be disproportionately high and adverse. The review also should evaluate the significance of such impacts.

The review team evaluated whether the health or welfare of EJ populations of interest in the census blocks identified in Section 2.6 of this EIS could be disproportionately affected by the potential impacts of operating two new reactors at the proposed site. To perform this assessment, the review team used the same process applied in Section 4.5. Figure 2-31 identifies minority populations within the 50 mi region surrounding the Turkey Point site, and indicates that several minority and low-income census block groups reside near the Turkey Point site. Therefore, the review team concluded that additional research on these populations, communities, and pathways was warranted.

5.5.1 Physical and Socioeconomic Impacts

Physical impacts of operations related to soil, water, air, and noise and socioeconomic impacts are described below.

5.5.1.1 Soil-Related Impacts

Operations activities would not affect soils at proposed Units 6 and 7, nor along proposed transmission and pipelines rights-of-way. There would be no impacts on nearby residents, and, therefore, no disproportionately high and adverse impacts on EJ populations of interest.

5.5.1.2 Water-Related Impacts

Water-related impacts are discussed in Section 5.2. The primary source of cooling water for proposed Units 6 and 7 would be reclaimed wastewater supplied by the MDWASD. A secondary source of water would be saltwater extracted from Biscayne Bay through RCWs. Other activities with potential water-related impacts would include stormwater runoff, deposition of drift from the Units 6 and 7 cooling towers, reduction of hydraulic head in the vicinity of the RCWs, and injection of blowdown water in the Boulder Zone. Section 5.2 does not identify any high and adverse impacts on water use and quality from the above activities. Because no special pathways for water-related impacts on EJ populations of interest were identified, the review team concludes that no disproportionately high and adverse water-related impacts would exist.

5.5.1.3 Air-Related Impacts

Section 5.7 discusses the potential impacts of the operations of Units 6 and 7 on air quality associated with criteria pollutants and greenhouse gas (GHG) emissions, as well as potential impacts from cooling-system emissions and transmission lines. Section 5.7 concludes that air-quality−related impacts would be minimal and identified no high and adverse air-quality−related impacts. Migrant agricultural workers were identified as being particularly vulnerable to air-quality impacts because of their outdoor presence. However, the closest agricultural areas to the proposed site would be located several miles away, and most agricultural areas within the 50 mi region would be located more than 10 mi away west of US-1. The review team concludes that no disproportionately high and adverse air-quality−related impacts would exist.

5.5.1.4 Noise Impacts

The highest noise levels during operation of proposed Units 6 and 7 would be caused by the operation of the mechanical draft cooling towers (FPL 2014-TN4058). At the plant property boundary the estimated noise level generated would be below current ambient noise. Migrant agricultural workers were identified as being particularly vulnerable to noise impacts because of their outdoor presence. However, the closest agricultural areas to the proposed site would be located several miles away, and most agricultural areas within the 50 mi region would be located more than 10 mi away west of US-1. The review team concludes that no disproportionately high and adverse noise-related impacts would exist.

5.5.1.5 Socioeconomic Impacts

Socioeconomic impacts are discussed in Section 5.4. The review team concluded that all socioeconomic impacts identified were small with the exception of moderate impacts on roads and traffic in the vicinity of the plant. The review team did not identify any special pathways through which any socioeconomic impacts would affect EJ populations of interest. Therefore, the review team concluded there would be no disproportionately high and adverse impacts on any EJ populations of interest.

5.5.2 Health Impacts

The review team determined through literature searches and consultations with NRC staff health experts that the expected operations-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations and would not impose a disproportionately high and adverse effect on EJ populations of interest. The results of the normal operation dose assessments (Section 5.9) indicate that the maximum individual dose for these pathways would be insignificant, well below the regulatory guidelines in Appendix I of 10 CFR Part 50 (TN249) and the regulatory standards of 10 CFR Part 20 (TN283). Furthermore, the review team did not identify special pathways through which any EJ populations of interest would be more exposed to these minimal impacts. Therefore, the review team concluded that there would be no disproportionately high and adverse health impacts on minority and low-income members of the public from the release of radiological material from operations or from design basis accidents.

5.5.3 Subsistence and Special Conditions

5.5.3.1 Subsistence and Unique Pathways of Exposure to Environmental Effects

The NRC's EJ methodology includes an assessment of affected populations of particular interest or with unusual circumstances, such as minority communities that are exceptionally dependent on subsistence resources or identifiable in compact locations such as American Indian settlements. As discussed in Section 2.6.1, the review team concluded that subsistence activities such as subsistence fishing are typically not conducted by any identified minority or low-income group. However, the review team identified migrant agricultural workers as a low-income and mostly minority (Hispanic) group with potentially unique pathways for exposure to environmental effects because of their potential for greater exposure to outdoor air and noise pollution. Because the farming areas closest to the site are located mostly west of the

Homestead and Florida City urban area, migrant agricultural workers would be unlikely to be affected by noise and air pollution and no disproportionate human health or environmental effects on migrant agricultural workers would be expected.

5.5.3.2 High-Density Communities

Based on the analysis in Section 2.6, most of the 50 mi radius around the proposed site is an area of concentrated presence of minorities. Because of its proximity to the proposed site, the area surrounding the Homestead airbase, home to a low-income and African-American population, is of particular interest. Another area of particular importance is the Miccosukee area on the corner of Krome Avenue and Tamiami Trail, which is bordered by the preferred alignment for the western transmission line corridor (Western Preferred corridor). Areas crossed by the eastern transmission line corridor in the proximity of the Miami area also are often home to low-income and African-American populations. Because the review team did not find any special pathways through which health, physical, or socioeconomic impacts would disproportionately affect these high-density communities, the review team concluded there would be no disproportionately high and adverse impacts on EJ populations of interest.

5.5.4 Summary of Environmental Justice Impacts

The review team evaluated the extent to which potential adverse environmental and socioeconomic impacts would disproportionately affect EJ populations of interest. After reviewing the evidence presented in the various sections of this chapter, and after considering any special pathways through which EJ populations of interest could be more affected than other population groups, the review team did not identify any high and adverse human health or environmental impacts and concluded that there would be no disproportionately high and adverse impacts on EJ populations of interest.

5.6 Historic and Cultural Resources Impacts

The National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4321 et seq.) (TN661), requires Federal agencies to take into account the potential impacts of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to local populations. The National Historic Preservation Act of 1966 (NHPA) (54 U.S.C. § 300101 et seq.) (TN4157) also requires Federal agencies to consider the impacts on those resources if they are eligible for listing in the National Register of Historic Places (NRHP) (54 U.S.C. § 300101 et seq.) (TN4157) (such resources are referred to as "Historic Properties" in the NHPA). The USACE is the lead Federal agency for compliance with Section 106 of the NHPA. The USACE's NHPA Section 106 consultation for this project has been completed with the exception of the transmission line consultation with the SHPO and the THPOs for STOF and the Miccosukee Tribe which is ongoing.

Operating new nuclear power plants may affect either known or previously unidentified historic properties located within the site. In accordance with the USACE Regulatory Program's Procedures for Protection of Historic Properties at 33 CFR Part 325, Appendix C, the USACE is required to make a reasonable and good faith effort to identify historic properties in the Area of Potential Effect (APE) and, if such properties are present, determine whether significant impacts are likely to occur. If there are potentially adverse impacts, the USACE shall consult with the SHPO, and Federally recognized tribes as necessary, to address mitigation and/or avoidance measures. Even if no historic properties (i.e., places eligible for listing in the NRHP) are present or affected, the USACE is still required to notify the SHPO before proceeding. If it is determined that historic properties are present, the USACE and SHPO are required to assess and resolve any adverse effects of the undertaking.

For a description of the historic and cultural resources at the Turkey Point site, see Section 2.7. In 2009, FPL conducted an archaeological and architectural resources survey of the direct- and indirect-effects APEs on the Units 6 and 7 project site (FPL 2011-TN95). FPL concluded that there are no NRHP-eligible archaeological sites, above-ground resources, or traditional cultural properties located within the onsite direct-effects APE and the indirect-effects APE. As a result of cultural resources studies conducted for the Turkey Point Units 6 and 7 project area, FPL concluded that no known cultural resources exist within the onsite direct or indirect APEs. The Florida SHPO concurred with FPL's informal determination of "no historic properties affected" (FPL 2014-TN4058, Appendix 2.5A). During the site visit in June 2010 (NRC 2010-TN1457), the review team reviewed the documentation used by FPL to prepare the cultural resources section of the ER. The NRC staff did not identify any important cultural resources that would be affected directly or indirectly by construction and preconstruction of proposed Turkey Point Units 6 and 7.

For transmission lines and other offsite facilities, FPL has provided desktop cultural resources investigations, including a search of the Florida Master Site file (Janus Research 2009) (FPL 2011-TN95). The archaeological sites and historic structures within the direct and indirect-effects APEs for the transmission line corridors are listed in Section 2.7. The desktop investigation concluded that no known resources were found in the APE for the non-transmission lines offsite facilities, including water pipelines from the MDWASD SDWWTP and various access roads and bridges. However, resources do occur within the transmission line corridors. The USACE will use this information during the ongoing consultation process for the transmission lines.

In work plans describing future studies for both the Units 6 and 7 project area (FPL 2009-TN1514; FPL 2011-TN95) and the offsite facilities (FPL 2009-TN1515; FPL 2011-TN95), such as the transmission lines, FPL has agreed that it would develop plans for addressing unanticipated discoveries (FPL 2014-TN4058). FPL reiterated this commitment in a letter to the USACE dated March 31, 2016 (FPL 2016-TN4581). These plans would include, at a minimum, a worker training program and procedures for informing managers and workers to stop work if cultural materials or human remains are inadvertently discovered during operations or maintenance activities and to notify staff within the appropriate organization (FPL 2014-TN4058). Details of the unanticipated discoveries plans will be developed in consultation with the USACE and Florida SHPO the Tribes and if a DA permit is issued it would likely be a condition of the permit. The USACE will continue to consult with the Seminole Tribe of Florida and the Miccosukee Tribe of Indians of Florida on the development of the work plan. Included in the plan will be protocols for work stoppage for any ground-disturbing activity that could affect a historic property that is potentially eligible or, eligible for listing in the NRHP, or contains human remains, and notification procedures for the USACE, Florida SHPO, and appropriate Tribes. The special conditions that the USACE typically uses for permitting actions dictate that all work and ground-disturbing activities shall halt within a 100 m radius of any unanticipated discovery of cultural resources or human remains. Work shall not commence without written notice from the USACE, and the SHPO.

For the purposes of the review team's NEPA analysis, the review team concludes that the impacts from operation would be SMALL. This conclusion is based on (1) no known significant cultural resources within the Units 6 and 7 onsite APEs, (2) the review team's cultural resource analysis, (3) FPL's commitment to develop procedures that would be in place if ground-disturbing operations or maintenance activities reveal historic or cultural resources, (4) consultation with the Florida SHPO that concluded with a finding of no historic properties affected for the Units 6 and 7 onsite area (FDHR 2010-TN1455; FPL 2014-TN4058, Appendix 2.5A) and ongoing consultation efforts for transmission lines and offsite locations, and (5) the assessment that the operation and maintenance of transmission lines would not contribute additional visual impacts beyond those generated during construction. Mitigative actions may be warranted if an unanticipated discovery is made during any ground-disturbing activities associated with the project; these actions would be determined by the USACE, SHPO, and the Miami-Dade County Office of Historic and Archaeological Resources. FPL would have cultural resource management procedures in place prior to construction and operation (FPL 2014-TN4058).

5.7 Meteorological and Air-Quality Impacts

The primary impacts of operating proposed Units 6 and 7 at the Turkey Point site on local meteorological conditions and air quality would be associated with emissions from the routine operation of auxiliary equipment and cooling systems and from emissions from worker's vehicles. The potential impacts on air quality are addressed in Section 5.7.1, and the potential impacts of operating the cooling system are addressed in Section 5.7.2.

5.7.1 Air-Quality Impacts

Section 2.9 describes the meteorological characteristics and air quality at the Turkey Point site. Sources of air emissions include stationary combustion sources (diesel generators and auxiliary boilers), cooling towers, and mobile sources (worker vehicles, onsite heavy equipment and support vehicles, and delivery of materials and disposal of wastes). Proposed Units 6 and 7 at the Turkey Point site would have two standby diesel generators for each unit, two ancillary diesel generators, and a single diesel-fired fire pump as described in the site ER (FPL 2014-TN4058, Chapter 3.5). These generators and fire pump would each be operated about 8 hours per month. In addition, various general-purpose diesel engines (all rated less than 450 kW) would be used continuously in equipment such as cranes and compressors.

5.7.1.1 Criteria Pollutants

The principal emissions associated with the new units at the Turkey Point site are emissions of particulate matter that have an aerodynamic diameter of 10 microns or less (PM_{10}) from the cooling towers. Table 5-7 lists the expected annual emissions from all sources used in operating proposed Units 6 and 7. These emissions include particulate matter, sulfur oxides (SO_x), carbon monoxide (CO), hydrocarbons in the form of VOCs, and nitrogen oxides (NO_x).

New or modified sources of air pollution are considered to be a major source and need to undergo a new source review before construction and obtain a Title V operating permit from the FDEP if emissions exceed threshold amounts. Stationary equipment such as diesel generators and auxiliary boilers would be required to comply with the requirements of the "National Emission Standards for Hazardous Air Pollutants" given in 40 CFR Part 63 (TN1403). These regulations specify emission limits and, for nonemergency diesel engines, performance tests, limitations on fuel sulfur content, and operating limitations. In addition, depending on when the engines are built and installed, there may be additional requirements under the "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines" (40 CFR 60, Subpart IIII [TN1020]). These Federal requirements would be administered by the State of Florida and included in the Title V operating permit. Given the small size and infrequent operation of combustion equipment, their impact on offsite air quality is expected to be minimal.

Table 5-7. Anticipated Atmospheric Emissions Associated with Operation of Proposed Units 6 and 7

	Four 4,100 kW Diesel Generators (lb/yr)[a,b]	Four 36 kW Ancillary Diesel Generators (lb/yr)[a,b]	Two 243 kW Diesel Fire Pump Engines (lb/yr)[a,b]	General-Purpose Engines (lb/yr)[a,b]	Maximum Mechanical Drift from All Six Cooling Towers (lb/yr)[c]
PM_{10}	2,000	19	56	2,520	42,400
$PM_{2.5}$	1,700	19	56	2,520	220
Sulfur oxides	23	0.25	0.69	12	---
Carbon monoxide	42,000	370	370	7,700	---
Hydrocarbons	5,000	44	140	2,900	---
Nitrogen oxides	34,000	300	950	35,700	---

(a) Assumes ultra-low sulfur diesel (15 ppm S) and operates 8 hours per month.
(b) Based on Manufacturer Certification and 40 CFR Part 60 (TN1020), Subpart III, for diesel generators and fire pump except for particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) based on the EPA's *Compilation of Air Pollutant Emission Factors* (AP-42). For the general-purpose engines, see AP-42 Chapter 3.3, Gasoline and Industrial Engines, Table 3.3-1 (EPA 2011-TN1088).
(c) Maximum escape of dissolved salts that could be emitted from cooling-tower outflow as drift based on peak in PM_{10}, which occurs at 4000 ppm TDS (Reisman and Frisbie 2002-TN1022).

Source: FPL 2009-TN1023

The Turkey Point site is in Miami-Dade County, which is in attainment for all criteria pollutants defined in the National Ambient Air Quality Standards (NAAQSs) (FPL 2014-TN4058). Because the generating system and fire pumps would be used infrequently (i.e., typically a few hours per month) and the general diesel engine emissions and the cooling towers would be operated in accordance with relevant State and Federal air permit regulations, the review team concludes that the combined air-quality impact of pollutants from these sources would be minor.

Other emissions generated as a result of the operation of proposed Units 6 and 7 would come from workforce commuting. A total of 806 personnel are needed to support operations of the two units. Emissions associated with the workforce commute have been estimated (see Section 4.7). The operational workforce is much smaller than the combined preconstruction and construction workforce of up to 3,950 workers that were concluded to have a minor impact; therefore, the impact from transportation of operational workers on air quality would be minimal.

5.7.1.2 Greenhouse Gases

Finally, the operation of a nuclear power plant involves the emission of some GHGs, primarily CO_2. The review team has estimated that the total GHG footprint for actual plant operations of Units 6 and 7 for 40 years is on the order of 634,000 MT of CO_2 equivalent (the sum of about 181,000 MT per unit from plant operation and about 136,000 MT per unit from operations workforce transportation) of CO_2 equivalent (an emission rate of about 15,850 MT CO_2e annually, averaged over the period of operation). This is about 0.005 percent of the 290 million MT CO_2e total GHG emissions for the State of Florida in 2007 (FDEP 2010-TN2997). This also equates to about 0.0002 percent of the total United States annual CO_2 emissions rate of 6.7 billion MT CO_2e (EPA 2013-TN2815). The value of 634,000 MT CO_2e includes the emissions from two nuclear power plants operating (362,000 MT CO_2e) and the associated emissions from the operations workforce (272,000 MT CO_2e). These estimates are based on GHG footprint estimates in Appendix J of this EIS.

The EPA promulgated the Prevention of Significant Deterioration (PSD) requirements and the Title V GHG Tailoring Rule on June 3, 2010 (75 FR 31514) (TN1404). As of January 2, 2011, operating permits issued to major sources of GHGs under the PSD or Title V Federal permit programs must contain provisions requiring the use of Best Available Control Technology to limit the emissions of GHGs if those sources would be subject to PSD or Title V permitting requirements because of their non-GHG pollutant emission potentials and their estimated GHG emissions are at least 75,000 T/yr of CO_2e. Based on the review team's estimate of 15,850 MT CO_2e emitted annually from operation of two new units at the Turkey Point site, the power plant could be exempted from GHG emission limits in a PSD permit or a Title V permit (EPA 2014-TN4116).

Based on this assessment of the plant operations' GHG footprint in comparison to the Florida and United States annual GHG emissions, the review team concludes that the atmospheric impacts of GHGs from plant operations would not be noticeable and additional mitigation measures would not be warranted.

5.7.2 Cooling-System Impacts

As described in Section 3.2.2.2, the operation of the cooling system for proposed Units 6 and 7 would remove waste heat generated as a byproduct of each unit's electrical power generation to the environment. Proposed Units 6 and 7 would each be equipped with a CWS that includes three mechanical draft cooling towers that provide cooling during normal operations. In addition, a single mechanical draft cooling tower would be used to remove heat from the service-water system for each unit, but the proposed system is much smaller than the CWS and the analysis therefore focuses on the CWS. The cooling-tower emissions would be required to adhere to the New Source Performance Standards (40 CFR 60.40Da [TN1020]) and demonstrate compliance with ambient air-quality standards by acquiring a PSD permit before the cooling towers could be operated.

Potential atmospheric impacts from cooling-system operation include fogging and subsequent icing downwind of the mechanical cooling towers, and potential impacts from plume blight (formation of a visible plume) and drift emissions from the cooling towers.

FPL used EPA's CALPUFF (EPA 2007-TN1474) modeling system in conjunction with the *cooling-tower* emissions processor (CTEMISS) to estimate the fogging impacts from the operation of the cooling towers. The CALPUFF model is the FDEP's preferred model for assessing fogging and plume blight from cooling towers. Inputs to the model included important physical and mechanical performance characteristics of the mechanical cooling towers (e.g., location, base heat rejection rate, dry heat input, stack height, stack diameter, exit velocity, temperature, and building dimension data). This information was used in conjunction with 5 years of meteorological data (2001–2005) from the Miami International Airport to determine plume visibility. FPL used the Miami International Airport data for this analysis because the data covered a longer period of record (5 versus 3 years for the onsite data) and were shown to be regionally representative of the Turkey Point site as described in Section 2.3 of the Final Safety Analysis Report (FPL 2015-TN4502).

Results from the CALPUFF (EPA 2007-TN1474) modeling analysis (Version 5.8) showed that the most frequent visible plumes would occur in the winter months (719 hours) and the least frequent during the summer months (230 hours). The median summer length of the plume was 200 m and the median winter length of the plume was slightly longer—250 m. The median height of the plume across all four seasons ranged from 175 to 200 m. During daylight hours the plume would only be visible an average of 584 hr/yr or 7 percent of the daylight hours. The plumes are predicted to have lengths exceeding 10,000 m on average 93 hr/yr. However, of these hours only 7 would be during daylight hours.

Fogging from mechanical draft cooling towers occurs when the visible plume intersects with the ground. CALPUFF modeling shows that plume-induced fogging does not occur during the summer and autumn months. Offsite areas on the eastern and southeastern perimeter of the Turkey Point site experience induced fogging during the winter season for an average of 7 days, but only for a few hours. During the spring season an average of 1 day experiences plume-induced fogging. No cases of icing were found in the simulations. On the basis of this analysis, the NRC staff concludes that the impacts of Turkey Point Units 6 and 7 on fogging would be minimal and not warrant mitigation. The staff further concludes that because the temperatures in the area are almost always above freezing the impacts on icing would also be minimal and not warrant mitigation.

The AERMOD (07026) modeling system was used to evaluate the amount and location of cooling-tower salt-drift deposition (EPA 2009-TN1501). The AERMOD air-dispersion model uses the state-of-the-science algorithms for simulating plume behavior in all types of terrain. While not specifically developed for cooling towers it does have the state-of-the-science recognized deposition algorithms that have been tested and documented in a number of studies and would be applicable for salt deposition from the operation of cooling towers. FPL proposes to control particulate matter with high-efficiency mist eliminators designed for a droplet drift rate of 0.0005 percent of the circulating-water flow rate of the cooling towers. Although use of the reclaimed wastewater is the primary water source, FPL modeled the cooling-tower drifts assuming the use of saltwater to demonstrate the maximum possible salt deposition. For saltwater, the expected TDS concentration is approximately 34,000 ppm, which represents the average TDS concentration of water in Biscayne Bay near the Turkey Point site. At 1.5 cycles of concentration the expected average TDS concentration is 50,000 ppm. The particle diameter size and mass fraction distribution used in the modeling were based on test data for the distributions of water droplet size for a drift eliminator that achieved a tested drift rate of 0.0003 percent (Reisman and Frisbie 2002-TN1022). Because FPL is proposing to use a 0.0005 percent drift rate, it is reasonable to expect that a 0.0003 percent drift rate would produce smaller droplets and therefore be conservative for predicting the fraction of PM_{10} from the total cooling-tower particulate matter emissions.

To more accurately represent the physical model of the CWS cooling-tower emissions, the modeling approach considered the cooling-tower emission as saltwater droplets. The emission rate of saltwater droplets at 50,000 ppm TDS concentration is 69.6 g/s from each cooling tower. The density of the saltwater droplets is 1.05 g/cm^3. The emission rates, particulate size distribution, and density were all used as input to the model and the final deposition was determined by multiplying the saltwater droplet deposition amount by 0.05 to reflect the 50,000 ppm salt concentration in the cooling-water vapor.

The Turkey Point salt-deposition analysis indicated that the annual salt-deposition rate from cooling-tower drift using saltwater from the RCWs as a primary cooling-water source could result in depositions as high as 105 kg/ha/mo near the makeup-water reservoir, decreasing to 1 to 70 kg/ha/mo in the cooling canals; salt-deposition rates greater than 10 kg/ha/mo generally would be confined to the Turkey Point site except for areas adjacent to the southeastern portion of the site.

On the basis of the analysis presented in the ER and the review team's independent evaluation of that analysis, the review team concludes that atmospheric impacts of Turkey Point Units 6 and 7 cooling towers would be minimal.

5.7.3 Transmission Line Impacts

The NRC addresses the impacts of existing transmission lines on air quality in NUREG–1437, Revision 1 (NRC 2013-TN2654). Small amounts of ozone and smaller amounts of nitrogen oxides are produced by transmission lines. The production of these gases was found to be insignificant for 745 kV transmission lines (the largest lines in operation) and for a prototype 1,200 kV transmission line. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted.

The components needed to complete an interface between proposed Units 6 and 7 and Turkey Point Units 1 and 2, and ties to the regional power grid, would be well within the range of transmission lines evaluated in NUREG–1437, Revision 1 (NRC 2013-TN2654). The largest line planned for the site is 500 kV. Therefore, the review team concludes that the air-quality impacts from transmission lines would not be noticeable and mitigation would not be warranted.

5.7.4 Summary of Meteorological and Air-Quality Impacts

The review team evaluated the potential impacts on air quality associated with criteria pollutants and GHG emissions from operating proposed Turkey Point Units 6 and 7. The review team also evaluated the potential impacts of cooling-system emissions and transmission lines. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operating proposed Units 6 and 7 on air quality from emissions of criteria pollutants, GHG emissions, cooling-system emissions, and transmission line impacts would be SMALL and warrant no further mitigation.

5.8 Nonradiological Health Impacts

This section addresses the nonradiological human health impacts on the public from operating the proposed new nuclear Units 6 and 7 at the Turkey Point site. Nonradiological public health and worker impacts are considered from operation of the cooling system, noise generated by operations, EMFs, and transporting materials and personnel to and from the site. Nonradiological health impacts from the same sources are also evaluated for workers during the operation of proposed Units 6 and 7. Section 2.10 provides background information about the affected environment and nonradiological health at and within the vicinity of the Turkey Point site. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Etiological and Chemical Agents

This section first describes the operational components of the proposed Units 6 and 7 that could have an impact on public health due to etiological (disease-causing) and chemical agents. Next, it describes the potential exposure pathways and risks (impacts) for each of these components.

5.8.1.1 Operational Components

Operation of proposed Units 6 and 7 would result in the use of reclaimed wastewater received from the Miami-Dade SDWWTP as the primary source of water for the cooling system. According to FPL's response to NRC RAI L-2011-158 (FPL 2011-TN55), the reclaimed wastewater proposed for use at Turkey Point site would have already undergone secondary treatment, as defined in Fla. Admin. Code 600.420(1), and high-level disinfection as defined in Fla. Admin. Code 62-600.440(5) (TN1268).

The Fla. Admin. Code regulations specify three alternative sets of requirements for allowing the use of reclaimed wastewater in open cooling towers, e.g., Fla. Admin. Code 62-610.668(2) (b), (c), or (d) (TN1269). The SDWWTP is complying with option (b), which includes high-level disinfection and secondary treatment, as well as "All requirements of Part III of Chapter 62-610…." Part III (titled "Slow-Rate Land Application Systems; Public Access Areas, Residential Irrigation, and Edible Crops") also includes reliability and operator staffing, monitoring, operating protocol, and other requirements. According to Fla. Admin. Code 62-610.460 (TN1269), in Part III the reclaimed wastewater shall have no more than 5.0 mg/L of suspended solids before the disinfectant is applied, and, as specified in Fla. Admin. Code 62-600.440(5) (TN1268), the high-level disinfection will result in reclaimed wastewater in which fecal coliform values (per 100 mL of sample) are below detectable limits. The SDWWTP also has recently added enhanced treatment of the final treated effluent to the treatment plan (FPL 2012-TN1270). This enhanced treatment includes additional sand filtration and additional disinfection. These treatments are expected to eliminate or minimize etiological agents from the SDWWTP makeup-water source, and might have some effect on chemical agents. FPL has stated (FPL 2011-TN55) that its RWTF would provide additional treatment beyond the requirements of Part III of Fla. Admin. Code 62-610 (TN1269).

When reclaimed wastewater cannot supply the quantity and/or quality of water needed for the CWS, a second source for makeup water would be available from the RCWs that would withdraw saltwater from under Biscayne Bay. Because most of the etiological agents of concern are primarily found in freshwater, as described in Section 2.10, etiological agents likely would not be present in the makeup water from the RCWs. Two possible exceptions are *Vibrio* spp., which are thermophilic bacteria commonly found in coastal marine waters such as those at the Turkey Point site, and a toxin-producing dinoflagellate such as *Karenia brevis*, which can cause red tide when present in high concentrations.

Blowdown water from the cooling towers and other plant discharge effluents would be collected in a sump and injected to the Boulder Zone, a cavernous, high-permeability geologic horizon within the Lower Floridan aquifer system. The Boulder Zone contains water similar to seawater in salinity. As described in EIS Section 2.3.1.2, a greater than 1000 ft thick sequence of mostly low-permeability limestone and dolomite overlies the Boulder Zone and separates it from the overlying Upper Floridan aquifer, which is a potential source of drinking water. Details from the drilling and testing of the EW-1 exploratory well and a discussion of upward migration of wastewater that has occurred at other Florida wastewater injection sites is presented in Section 2.3.1.2. The potential for upward migration of injectate from the planned UIC wells is presented in Section 5.2.1.3. The Boulder Zone UIC wells would be permitted by FDEP and would be required to implement institutional controls and monitoring programs to detect upward migration of injected wastewater.

5.8.1.2 Potential Impacts

In general, Fla. Admin. Code 62-610, under which exposure of reclaimed wastewater to the public is controlled, is designed to "assure that all waters of the State shall be free from components of wastewater discharges which, alone or in combination with other substances, are acutely toxic; are present in concentrations which are carcinogenic, mutagenic, or teratogenic to humans, animals, or aquatic species; or otherwise pose a serious threat to the public health, safety, and welfare" (Fla. Admin. Code 62-610.100(5) [TN1269]). The review team concludes that compliance with Florida requirements for the treatment and use of reclaimed wastewater by FPL for Units 6 and 7 would be protective of public health. Furthermore, FPL has stated they would comply with Florida requirements for reclaimed wastewater (FPL 2014-TN4058).

The review team identified several possible pathways for human exposure to etiological and chemical agents attributable to the operation of proposed Units 6 and 7 at the Turkey Point site. The potential sources and/or pathways of exposure include the onsite RWTF, makeup-water reservoir, open channel flume, cooling-tower drift (i.e., deposition of particulates from aerosolized cooling water), blowdown sump, UIC well site, migration of the injected water in the subsurface, and sanitary-waste and solid-waste management. The review team recognizes that human health risks might be increased because of the use of improperly treated or handled reclaimed wastewater, both before and especially after it is heated during reactor cooling. Thermal discharges have the potential to increase the growth of thermophilic microorganisms (including those that can cause diseases, i.e., etiological agents). The types of organisms of concern in the reclaimed water include enteric pathogens (such as *Salmonella* spp. and *Pseudomonas aeruginosa*), thermophilic fungi, bacteria (such as *Legionella* spp.), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.), and noroviruses. Any of these microorganisms could result in potentially serious human health effects, particularly at high exposure levels (NRC 2013-TN2654). Section 2.10.1.2 discusses etiological agents in more detail and present incidence data of waterborne diseases in Florida. However, extensive treatment of the reclaimed water before use, the harsh environment of the cooling-water system, the very low drift rates from the cooling towers, the disposal of blowdown through deep-well injection, and the isolation of the site from the public would likely eliminate any public health risk from thermophilic microorganisms associated with the operation of Units 6 and 7.

The review team also evaluated the potential for human health risk from the category of compounds and chemicals referred to as "contaminants of emerging concern" (CECs) or alternatively "microconstituents," "emerging substances of concern," or "emerging pollutants of concern" (EPOCs). CECs is the term used by the EPA and the NRC review team to identify these compounds and chemicals. The potential impacts from exposure to CECs are addressed below for public health and in Section 5.8.5 for worker health.

As mentioned above, the RWTF treatment would exceed the requirements of Part III of Fla. Admin. Code 62-610 (TN1269) (FPL 2011-TN55). In addition, "…the conceptual RWTF treatment system incorporates de-chlorination, nutrient removal, hardness removal (if necessary), pH adjustment, filtration and disinfection processes (FPL 2012-TN1270)." These additional treatments are expected to eliminate or sufficiently minimize etiological and chemical agents from this makeup-water source such that public health would be protected. Furthermore, regarding etiological and chemical agents from cooling-tower drift, the majority of any potential human exposure is onsite, as indicated by the salt-deposition rates shown in Figure 5-3. Therefore, the review team concludes that because public access to the site is limited, and there are no residences in the vicinity of the site where inhalation from operation of the proposed units would be likely to occur, only potential worker exposure is a potential concern for human health (Section 5.8.5).

Regarding UIC wells and the potential for contamination of the Upper Floridan aquifer, which is a source of drinking water, the low-permeability layer separating the Upper and Lower Floridan aquifers is expected to prevent transport of any etiological agents that might be present in the injected wastes from migrating into drinking water supplies (see Section 2.8). Furthermore, an investigation of the geology within a 25 mi radius of the site revealed no features or lineaments associated with faulting within the plant property and determined that a continuous horizontal stratigraphy is present with no faults or folds related to tectonic deformation. Thus, the review team concludes that cooling-tower blowdown would not be discharged to waters that have the potential for any contact by members of the public. Also, as noted in Section 5.2, monitoring is planned for the groundwater to identify any changes in water quality related to deep-well injection.

5.8.2 Noise

In NUREG–1437 (NRC 2013-TN2654), the NRC discusses the environmental impacts of noise from operations at existing nuclear power plants. Common sources of noise from plant operation include cooling towers, transformers, turbines, and the operation of pumps along with intermittent contributions from loud speakers and auxiliary equipment such as diesel generators.

In addition, there may be corona discharge noise—the electrical breakdown of air into charged particles—associated with high-voltage transmission lines. The common sources and impacts of noise are addressed in this section.

As described in Section 2.10.2, the impact of noise upon humans is difficult to determine because of the varying responses of humans to the same or similar noise patterns. For the Turkey Point site, both an ambient noise survey and an operations noise prediction analysis were conducted. The ambient noise survey is described in Section 2.10.2. The noise prediction analysis for the operation of proposed Units 6 and 7 is fully described in Section 6.7 of the SCA and is the focus of this section. These predictions were developed using the CadnaA computer model, a computerized software program for calculation, presentation, assessment, and prediction of environmental noise, and results are described in the following section (FPL 2010-TN272).

The noise impacts of proposed Units 6 and 7 were evaluated using the equipment associated with normal operation of the facility. The noise level generated by each cooling tower would be on the order of 88 dBA at 3 ft from the towers, 73 dBA at 200 ft from the towers, and 65 dBA at 400 ft from the towers, which is within the Units 6 and 7 plant area. Therefore, levels of noise at the site boundary from Units 6 and 7 are expected to be lower than 65 dBA, and even lower at the nearest permanent, residence approximately 3.9 mi away. To confirm this, the day-night average sound levels (L_{dn}) were examined. The L_{dn} is a single dBA value calculated from hourly noise level equivalent (L_{eq}) over a 24-hour period, with the addition of 10 dBA to nighttime sound levels to account for the greater sensitivity of most people to nighttime noise. The nearest likely future resident, located just outside the nearest northern boundary 1.6 mi away, as shown in Figure 2-41 (the S5 noise monitoring location), would experience average noise levels during operation of about 45.7 dBA during the daytime and 48.7 dBA during the nighttime, which would be close to the measured background noise levels of 44.1 dBA during the daytime and 47.9 dBA during the nighttime. The L_{dn} at this location during operation thus would be about 55.9 dBA, while the background L_{dn} would about 55.1 dBA, which indicates that the operation of Units 6 and 7 would have minimal impact at this location.

Furthermore, according to NUREG–1437 (NRC 2013-TN2654), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities* (NUREG–0586, Supplement 1) (NRC 2002-TN665). The criterion for assessing the level of significance was not expressed in terms of sound levels, but was based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG–0586, Supplement 1, is stated as follows:

> The noise impacts... are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts... are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Regarding the corona discharge noise associated with high-voltage transmission lines, the occurrences are infrequent and weather-related, when the public is likely to be indoors. Corona noise is composed of both broadband noise, characterized as a crackling noise, and pure tones, characterized as a humming noise. Corona noise, which is greater with increased voltage, is also affected by the weather. During dry weather, the noise level is low and often indistinguishable off the transmission line corridor from background noise. In wet conditions, water drops collecting on conductors can cause louder corona discharges. However, background noise (e.g., falling rain, traffic, or blowing leaves) can easily mask this noise. For 500 kV transmission lines, corona noise, when present, is typically below ambient outdoor levels. During rain showers, the corona noise likely would not be readily distinguishable from background noise. Residents also are more likely to be indoors at such times. During very moist but not rainy conditions, such as heavy fog, the resulting small increase in the background noise levels would not be expected to result in annoyance to adjacent residents. Periodic maintenance activities, particularly vegetation management, would produce noise from mowing, bush-hogging, and tree and limb trimming and grinding.

Based on the relatively low levels of noise associated with the operation of proposed Units 6 and 7 and the significant attenuation of that noise, the review team concludes that potential noise impacts associated with the operation of the new units on the public would be minor and would not require mitigation.

5.8.3 Acute Effects of Electromagnetic Fields

In its ER (FPL 2014-TN4058), FPL states that the proposed transmission system for Units 6 and 7 would consist of one onsite 230 kV line, three offsite 230 kV lines, and two offsite 500 kV lines. Electric shock related to transmissions lines is an acute effect that results from either direct access to energized conductors or induced charges in metallic structures. Such acute effects are controlled and minimized by conformance with National Electrical Safety Code (NESC) (IEEE 2007-TN1087; 10 CFR 51, Subpart B, Appendix A [TN250]). NESC describes how to establish minimum vertical clearances to the ground for electric lines having voltages exceeding 98 kV. The clearance must limit the induced current as a result of electrostatic effects to 5 mA if the largest anticipated truck, vehicle, or equipment were short-circuited to ground (IEEE 2007-TN1087). By way of comparison, the short-circuit setting of ground-fault circuit interrupters (used in residential wiring of special breakers for outside circuits or those with outlets in kitchens and bathrooms) is 4 to 6 mA.

FPL states in its ER that the proposed transmission lines would be built in compliance with the NESC (FPL 2014-TN4058). In addition, all transmission lines constructed by FPL would conform to standards established by American National Standards Institute, NESC, and other applicable codes and standards that are generally accepted by the industry, except as modified by Florida statutes. Also, during construction of the transmission lines, FPL would ground existing fences and gates that cross or parallel the right-of-way to mitigate shock hazards.

The transmission lines would also be designed to comply with FDEP regulations limiting maximum electrical and magnetic field strength (Fla. Admin. Code 62-814-TN644):

- The maximum electric field at the edge of the transmission line corridor and at the new substation property boundary shall not exceed 2 kV/m.
- The maximum electric field on the transmission line corridor shall not exceed 10 kV/m.

- The maximum magnetic field at the edge of the transmission line right-of-way and at the new substation property boundary shall not exceed 200 milliGauss (mG).

FPL notes that during the license renewal process for Units 3 and 4 at Turkey Point site, the existing eight 230 kV circuits that extend from Turkey Point site to the Davis and Florida City substations were analyzed (FPL 2014-TN4058). The maximum induced current for these circuits was determined to be 4.3 mA, which is below the allowable 5 mA. This compliance demonstrates the capability of FPL to meet the 5 mA limit for the 500 kV lines also, such as through tower design (e.g., increased height) as described in SCA Section W9.2 (FPL 2010-TN272). The proposed transmission lines for Units 6 and 7 would display similar induced current results because the proposed lines would be built in compliance with the NESC limit.

Based on the regulations related to the design and installation of new transmission lines, and the fact that transmission lines constructed and upgraded to serve proposed Units 6 and 7 would meet NESC standards in effect at the time of installation, the review team concludes that the potential impact on the public from acute effects of EMFs would be minor and further mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Operating power transmission lines in the United States produce EMFs of nonionizing radiation at 60 Hz, which is considered to be an ELF-EMF. Research on the potential for chronic effects of EMF from energized transmission lines was reviewed and addressed by the NRC in NUREG–1437 (NRC 1996-TN288). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. An NIEHS report (NIEHS 1999-TN78; HPA 2006-TN1273) contains the following conclusion:

> The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

The review team reviewed available scientific literature on the chronic effects of ELF-EMF on human health published since the NIEHS report and found that several other organizations reached the same conclusions (HPA 2006-TN1273; WHO 2007-TN1272). Additional work under the auspices of the World Health Organization (WHO) updated the assessments of a number of scientific groups reflecting the potential for transmission line EMF to cause adverse health effects in humans. In the report by WHO, the authors summarized the potential for ELF-EMF to cause disease such as cancers in children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications, and neurological disease. The results of the review by WHO found that the extent of scientific evidence linking these diseases to EMF exposure is not conclusive (WHO 2007-TN1272).

The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts.

5.8.5 Occupational Health

As discussed in Section 2.10, human health risks for personnel engaged in activities such as maintenance, testing, and plant modifications for proposed Units 6 and 7 are expected to be dominated by occupational accidents (e.g., falls, electric shock, and burns) or occupational illnesses due to noise exposure, exposure to toxic or oxygen-replacing gases, and other hazards. Data shown in that section indicate that the average incidence rate for the Turkey Point Units 3 and 4 workforce for 2004 through 2008 was 0.4 cases per 100 workers. Using this rate for Units 6 and 7, the annual estimate for injuries and illnesses at Units 6 and 7 is 3.1, which is well under the numbers that would be expected at an electric power-generation facility based on national and State incident rates, i.e., 23 and 22, respectively. Also, note that as was the case for construction injury estimates in Section 4.8, these are gross estimates that do not take into account injury risks that workers would face if they were employed somewhere other than at the Turkey Point site. The net effect of Turkey Point operation on total occupational injuries in Miami-Dade County could be considerably lower, or even negative, if alternative employment is associated with higher risks.

Possible key pathways of concern for worker exposure to etiological agents are via the onsite RWTF, makeup-water reservoir, open channel flume, cooling-tower drift, blowdown sump, underground injection well site, and sanitary-waste and solid-waste management. These locations would be located within the Turkey Point site, which would preclude access by members of the public. Furthermore, site personnel access would be strictly controlled by administrative controls and security patrols. Personnel protective measures (i.e., personal protective equipment, personnel monitoring) related to work activities requiring personnel contact with reservoir and flume systems would be controlled by the facility's worker protection plan, as described below. In addition, the planned disinfection for the cooling water is expected to eliminate or minimize health risks to workers (DOL 2012-TN1274; HDR 2009-TN1073). In its ER, FPL addresses management of occupational injury and fatality risks through safety and health programs, and personnel to promote safe work practices and respond to occupational injuries and illnesses (FPL 2014-TN4058). Procedures have been developed and implemented for the existing units that would be applied to the proposed new units that have the objective of providing personnel who work at Turkey Point site with an effective means of preventing accidents due to unsafe conditions and unsafe acts. These safe work practices address a number of occupational health issues (e.g., hearing protection, confined space entry, personal protective equipment, heat stress, electrical safety, the safe use of ladders, microbial hazards, chemical handling, storage, and use, and other industrial hazards). These procedures ensure that FPL adheres to NRC and OSHA safety standards (29 CFR 1910) (TN654), practices, and procedures. Furthermore, health impacts on workers from nonradiological emissions during operations at the proposed Units 6 and 7 would be monitored and controlled in accordance with the applicable OSHA regulations. Appropriate State and local statutes and procedures, including those for new nuclear unit operations (State of Florida 2014-TN3637), would also be considered when assessing and controlling occupational hazards and health risks at the Turkey Point site.

Similar to the discussion in Section 5.8.1.2 regarding public health, even with regulatory and voluntary controls in place to protect worker health, technical or other failures could occur, or rules and guidelines could be deemed to be out of date at some point (e.g., because of newer information about health effects). In addition, several public comments have addressed concern for worker health risks from reclaimed wastewater in cooling-tower drift (Appendix D). NUREG–1555 (NRC 2000-TN614) also requires that the human health impacts associated with a plant's cooling system be evaluated. Furthermore, as indicated by the salt-deposition graphs in ER Figure 5.3-1 (FPL 2014-TN4058), the majority of any potential exposure to etiological and chemical agents from cooling-tower drift would be onsite. Therefore, additional analysis of cooling-tower drift was conducted by the review team, as described below.

Regarding etiological agents, as discussed above in Section 5.8.1.2 for public health, FPL has stated that its RWTF would exceed the requirements of Part III of Fla. Admin. Code 62-610 (TN1269), and, according to its response to RAI L 2012-225 (FPL 2012-TN1270), "…the conceptual RWTF treatment system incorporates de-chlorination, nutrient removal, hardness removal (if necessary), pH adjustment, filtration and disinfection processes." These additional treatments are expected to eliminate etiological agents as a concern for worker health.

Regarding chemical agents from the use of reclaimed water, a screening-level confirmatory analysis was conducted on selected agents in cooling-water drift from cooling towers. Sections 5.2.1.3 and 5.7.2 describe air modeling conducted by NRC staff to estimate drift impacts on surface water and air quality, respectively. Similar modeling was used here to estimate the air concentrations of chemicals in the centerline of the drift plume as it leaves the cooling towers. Specifically, the AERMOD model (EPA 2003-TN1310) was run using a 5-year period to predict the particle phase concentrations in the air emissions. The maximum annual average concentration for a 1 g/s (or 1×10^6 ug/s) chemical emission rate was estimated as 0.05 ug/m^3. This relationship then was used to scale the maximum concentration of selected chemicals. This concentration was assumed to be the concentration in the blowdown effluent as it is injected underground. A cooling-water emission rate of 1,824 L/s was used, based on Table 3.3-1 (Stream Number 42) of the ER (FPL 2014-TN4058). Thus, for example, if the concentration of a chemical in the cooling water is 1 ug/L, then its maximum annual average concentration in the air would be 1 ug/L × 1824 L/s × (0.05 ug/m^3 per 1×10^6 ug/s), or 9.1×10^{05} ug/m^3 (or 9.1×10^{-08} mg/m^3). The estimated air concentrations were then compared to health-based benchmarks (HBBs) for air using a "hazard index" approach whereby the exposure concentration is divided by the HBB. A hazard index greater than 1 using screening-level assumptions indicates additional analysis is needed.

The modeling results for this analysis are shown in Table 5-8. Chemicals were selected based on their relatively high toxicity, the availability of HBB data, and to represent a range of chemical types, i.e., 1,4-dichlorobenzene (typical disinfection byproduct) to represent halogenated semivolatile organic compounds, ethinyl estradiol to represent endocrine disruptor compounds, and hexavalent chromium to represent metals. As seen in the table, all hazard indices are two or more orders of magnitude less than one.

Highly conservative, screening-level assumptions were used for this analysis. These assumptions include the close proximity of workers (i.e., on the top ledge of the tower in the plume centerline instead of typical actual locations, which are at some distance from the towers for the majority of the time) and high chemical concentrations (i.e., the maximum concentrations from the blowdown water instead of more probable lower concentrations due to averaging and removal at FPL's RWTF, biodegradation, photolysis, hydrolysis, and/or volatilization). Additional analysis would only result in lower hazard indices, and thus no additional analysis is needed. The impact from chemical exposure to workers from drift appears to be minimal.

Table 5-8. Screening-Level Analysis of Inhalation of Selected Chemicals in Drift from Reclaimed Water Used for Cooling

Chemical	Water Conc. (µg/L)[(a)]	Air Conc. (mg/m^3)	HBB (mg/m^3)	HBB Source[(b)]	Hazard Index
1,4-Dichlorobenzene	5.7	5.2×10^{-7}	4.5×10^{2}	OSHA PEL	1.2×10^{-9}
1,4-Dichlorobenzene	5.7	5.2×10^{-7}	8×10^{-1}	EPA RfC	6.5×10^{-7}
Ethinyl estradiol	5.8×10^{-2}	5.3×10^{-9}	1×-10^{5}	Caldwell et al. 2010	5.3×10^{-4}
Hexavalent chromium	6.5×10^{1}	5.9×10^{-6}	5×-10^{3}	OSHA PEL	1.2×10^{-3}
Hexavalent chromium	6.5×10^{1}	5.9×10^{-6}	1×10^{-4}	EPA RfC (particulates)	5.9×10^{-2}

(a) Maximum concentration from the blowdown effluent as it is injected underground. While some dilution is expected to occur prior to injection, additional planned treatment of the reclaimed wastewater prior to use also is expected. Therefore, the actual concentration of these constituents in drift would be lower.
(b) OSHA PEL = Occupational Safety and Health Administration permissible exposure limit
EPA RfC = Environmental Protection Agency reference concentration
Caldwell et al. 2010-TN1276

Based on the requirements of Part III of Fla. Admin. Code 62-610 (TN1269) that the reclaimed wastewater supplied by SDWWTP to Units 6 and 7 would be suitable for "…Public Access Areas, Residential Irrigation, and Edible Crops", as well as the additional disinfection and other treatment and mitigation measures identified by FPL in its ER (FPL 2014-TN4058), the strict adherence to NRC and OSHA safety standards, practices, and procedures, and the review team's independent evaluation, the review team concludes that occupational health impacts on Turkey Point onsite personnel would be minimal, and no mitigation would be warranted.

5.8.6 Impacts of Transporting Operations Personnel to and from the Turkey Point Site

This EIS assesses the impact of transporting workers to and from the Turkey Point site from the perspective of three areas of impact: the socioeconomic impacts, the air-quality impacts of fugitive dust and particulate matter emitted by vehicle traffic, and the potential health impacts related to additional traffic-related accidents. Human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 5.4.1.3, and air-quality impacts are addressed in Section 5.7.2.

The general approach used to calculate the nonradiological impacts of fuel and waste shipments is the same as that used to calculate the impacts of transporting operations and outage personnel to and from the proposed Turkey Point Units 6 and 7 plant area and alternative sites (see Section 4.8.3). However, preliminary estimates are the only data available to estimate these impacts. The impacts evaluated in this section for two proposed nuclear generating units at the Turkey Point site are appropriate for characterizing the alternative sites discussed in Section 9.3. Alternative sites evaluated in this EIS include the existing Turkey Point site (proposed new units), and alternative sites at Martin, Glades, Okeechobee, and St. Lucie. There is no meaningful differentiation among the proposed and the alternative sites regarding the nonradiological environmental impacts from transporting operations and outage personnel to the Turkey Point site and alternative sites, so these impacts are not discussed further in Chapter 9.

The review team calculated nonradiological impacts from transporting operations workers based on the following considerations:

- In its ER, FPL stated that 403 workers would be needed for operation of each proposed unit, or a total of 806 workers to operate both proposed Units 6 and 7 (FPL 2014-TN4058). Up to an additional 1,000 temporary workers are anticipated to be needed for refueling outages (FPL 2014-TN4058). The review team determined impacts considering that outages for the two units would not occur simultaneously.
- The average commuting distance for operations and outage workers was conservatively assumed by the review team to be 20 mi one way. This assumption is based on the U.S. Department of Transportation (DOT) data that estimates the typical home to work commute for U.S. residents is approximately 16 mi one way (DOT 2003-TN297).
- To develop representative commuter traffic impacts, data from the DOT provide a Florida-specific fatality rate for all traffic for the years from 2004 to 2008 (DOT 2008-TN411). The average fatality rate for the period from 2004 to 2008 in Florida was used as the basis for estimating Florida-specific injury and accident rates. Adjustment factors were developed using national traffic accident statistics in the DOT publication National Transportation Statistics 2010 (DOT 2010-TN408). The adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the Florida-specific fatality rate to approximate the injury and accident rates for commuters in the State of Florida.

The estimated impacts of transporting operations and outage workers to and from the proposed Turkey Point site and alternative sites are listed in Table 5-9. The total annual traffic fatalities during operations, including both operations and outage personnel, represent about a 0.3 percent increase above the average 316 traffic fatalities per year that occurred in Miami-Dade County, Florida, from 2004 to 2008 (DOT 2008-TN412). The impacts of transporting operations workers to and from the alternative sites were about a 0.03 percent increase for the Martin site (DOT 2008-TN413), a 1.2 percent increase for the Glades site (DOT 2008-TN414), a 0.7 percent increase for the Okeechobee site (DOT 2008-TN415), and a 0.2 percent increase for the St. Lucie site (DOT 2008-TN416). These percentages represent small increases relative to the current traffic fatality risks in the areas surrounding the proposed Turkey Point site and alternative sites.

Table 5-9. Nonradiological Estimated Impacts of Transporting Operations Workers to and from the Turkey Point Site and Alternative Sites

	Accidents Per Year Per Unit	Injuries Per Year Per Unit	Fatalities Per Year Per Unit
Permanent Workers	9.4×10^{0}	4.3×10^{0}	6.4×10^{-2}
Outage Workers	4.2×10^{0}	1.9×10^{0}	2.9×10^{-2}

Based on the information provided by FPL, the review team's independent evaluation, and considering that this increase would be small relative to the current traffic fatalities (that is, before the proposed units are constructed) in the affected counties, the review team concludes that the nonradiological impacts of transporting construction materials and personnel to the proposed Turkey Point site and alternative sites would be minimal, and no mitigation would be warranted.

5.8.7 Summary of Nonradiological Health Impacts

For operation using reclaimed water the review team concludes that the extensive water treatment of the reclaimed water before reuse required by the State of Florida (Part III of Fla. Admin. Code 62-610 (TN1269)), the harsh environment of the cooling-water system, the very low drift rates from the cooling towers, the likely deposition of most of the cooling-tower drift onsite, the disposal of blowdown through deep-well injection and the isolation of the site from the public would likely eliminate any public health risk from thermophilic microorganisms or CECs associated with the operation of Units 6 and 7. The review team also evaluated the potential for public health risk from periodic operation of the RCWs. Concern about the proliferation of harmful thermophilic microorganisms at industrial facilities such as the Turkey Point IWF is typically focused on the station receiving waters for facilities using once through cooling and freshwater. Turkey Point Units 6 and 7 would not use freshwater, would use closed-cycle cooling. The withdrawal of saltwater from under Biscayne Bay eliminates the risk of most thermophilic organisms that do not inhabit saltwater environments. Additionally, because of the periodic nature of the operation of the RCW system, the lack of surface receiving waters due to the deep-well disposal of blowdown, the use of closed-cycle cooling, the filtration effect of withdrawing groundwater, the harsh environment in the cooling-water system, and the isolation of the site from the public, the review team finds that the risk of stimulating population levels of harmful thermophilic microorganism, due to the operation of Units 6 and 7, is highly unlikely. Therefore, the review team determined that the likelihood of impacts from etiological agents on human health from operation using reclaimed water or water from the RCW system would be minimal and mitigation would not be warranted.

The review team evaluated health impacts on the public and workers from the proposed cooling system, noise generated by plant operations, acute and chronic impacts of EMFs, and transporting operations and outage workers to and from the proposed Units 6 and 7. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts on the public and workers from etiological agents, noise generated by plant operations, and acute impacts of EMF would be minimal. The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts. Based on the information provided by FPL, the applicant's compliance with all applicable Federal, State, and local regulations mentioned in the above sections, and the review team's own independent evaluation, the review team concludes that the potential impacts on nonradiological health resulting from the operation of the proposed two additional units at the Turkey Point site would be SMALL, and mitigation would not be warranted.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of the proposed Turkey Point Units 6 and 7, including the estimated radiation dose to a member of the public and to the non-human biota inhabiting the area around the Turkey Point site. Estimated doses to workers at the proposed units are also discussed. Radiological impacts were determined using the Westinghouse AP1000 pressurized water reactor design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation. Revision 19 of the AP1000 reactor design (Westinghouse 2011-TN261) is a certified design as set forth in 10 CFR Part 52, Appendix D. Revision 6 of FPL's ER (FPL 2014-TN4058) references Revision 19 of the Westinghouse AP1000 Design Control Document (DCD); therefore, the COL application and evaluation of radiological impacts of normal operations presented here are based on Revision 19 of the Westinghouse AP1000 DCD (Westinghouse 2011-TN261).

5.9.1 Exposure Pathways

The public and non-human biota would receive radiation dose from a nuclear power station via the liquid effluent, gaseous effluent, and direct radiation pathways. FPL estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding the proposed Turkey Point Units 6 and 7. In ER Section 5.4.1, FPL considered pathways that could cause the highest calculated radiological dose based on the use of the environment around the site (FPL 2014-TN4058). The relative importance of a pathway is based on the type and amount of radioactivity released, the environmental transport mechanism, and the consumption or usage factors of the recipient. For example, factors such as the location of homes in the area, consumption of meat from the area, and consumption of vegetables grown in area gardens were considered.

For the liquid effluent release pathway, FPL proposes to use deep-well injection of liquid effluents to isolate this radiation stream from the public and non-human biota. However, FPL has assessed the possible radiation pathways of the liquid effluents once they are injected into the well.

As discussed in the Appendix 12AA of the Final Safety Analysis Report (FSAR) (FPL 2015-TN4502), the design of proposed Turkey Point Units 6 and 7 includes a number of features to prevent and mitigate leakage from system components such as pipes and tanks that may contain radioactive material. Also, in Appendix 12AA (FPL 2015-TN4502), FPL committed to use the guidance of NEI 08-08A, "Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination," (NEI 2009-TN1277) to the extent practicable in the development of operating programs and procedures. However, the potential still exists for leaks of radioactive material, such as tritium, into the ground, similar to those that have been reported at currently operating power plants. Based on the discussion above, the NRC staff expects that the impacts from such potential leakage for proposed Turkey Point Units 6 and 7 would be minimal.

For the gaseous effluent release pathway, FPL considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): immersion in the radioactive plume, direct radiation exposure from deposited radioactivity, inhalation, ingestion of garden fruit and vegetables, and ingestion of meat animals.

For population doses from the gaseous effluents, FPL used the same exposure pathways as those used for the individual dose assessment, with the addition of a pathway for the ingestion of cow milk. It is assumed that all agricultural products grown within 50 mi of the proposed Turkey Point Units 6 and 7 are consumed by the population within 50 mi of the new units at the Turkey Point site (see Figure 5-4).

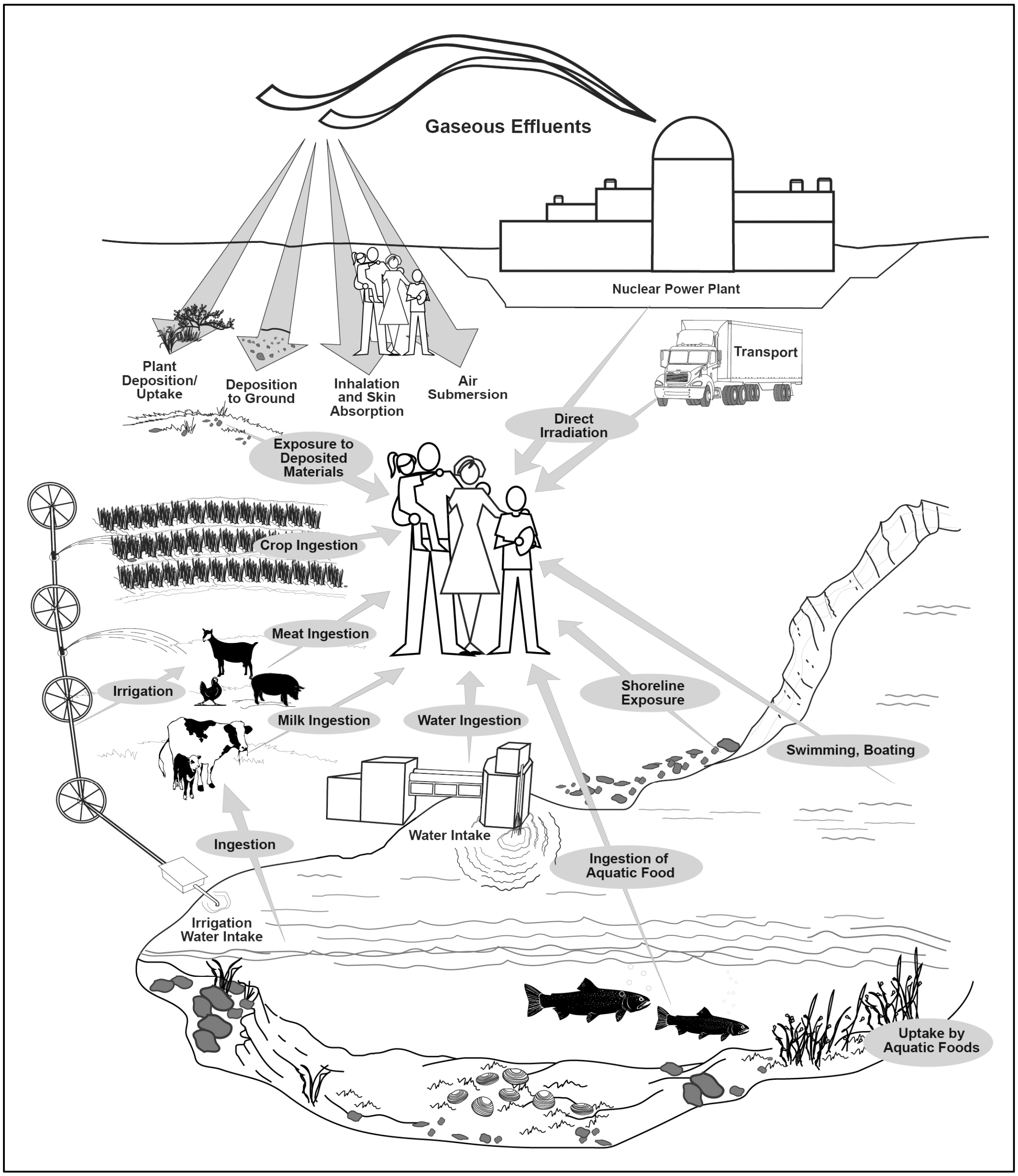

Figure 5-4. Exposure Pathways to Humans (adapted from Soldat et al. 1974-TN710)

In ER Section 5.4.1 (FPL 2014-TN4058), FPL stated that the contained sources of radiation at proposed Units 6 and 7, including the refueling water storage tank, would be shielded such that the direct dose rate at the Turkey Point site boundary would be negligible. This is also stated in Section 12.4.2.1 of the AP1000 DCD (Westinghouse 2011-TN261). The containment and other plant buildings would be shielded and direct radiation from them would be negligible. The AP1000 design also provides for the storage of refueling water inside the containment building instead of in an outside storage tank. This planned storage eliminates refueling water as a source of significant direct radiation to offsite receptors.

Exposure pathways considered in evaluating dose to the biota are shown in Figure 5-4 and Figure 5-5 and include the following:

- ingestion of aquatic foods;
- ingestion of water;
- external exposure from water immersion or surface effect;
- inhalation of airborne radionuclides;
- external exposure to immersion in gaseous effluent plumes; and
- surface exposure from deposition of iodine and particulates from gaseous effluents (NRC 1977-TN90).

The NRC staff reviewed the exposure pathways for the public and biota identified by FPL and found them to be appropriate, based on a documentation review, a tour of the environs, and interviews with FPL staff and contractors during the site visit in June 2010.

5.9.2 Radiation Doses to Members of the Public

In ER Section 5.4, FPL discusses the calculated dose to the MEI and the population living within a 50 mi radius of the Turkey Point site from the direct radiation, liquid, and gaseous effluent release pathways (FPL 2014-TN4058). FPL stated that it conservatively estimated the direct radiation exposure to the MEI from sources of radiation at the proposed Turkey Point Units 6 and 7 would occur at the Turkey Point site boundary and that most of the dose would be a result of the external pathways.

5.9.2.1 Liquid Effluent Pathway

Treated liquid radioactive waste from operations at proposed Turkey Point Units 6 and 7 would be discharged to the plant sump prior to ultimate release to the Boulder Zone via the UIC wells (see Figure 5-6). As discussed in Sections 2.3.1.2, 3.3.1.6, and 5.2.1.3 of this EIS, the highly saline Boulder Zone of the Lower Floridan aquifer is used for deep-well injection of treated municipal wastewater and reverse osmosis concentrates in Miami-Dade County. Injection occurs below the middle confining layer at depths of approximately 2,700 ft or more, approximately 900 ft below the base of the lowest USDW. The Boulder Zone is currently not a source of potable water and there is no viable pathway for the injection well releases to reach potable water. Hence, there is no liquid effluent pathway dose that results from normal plant operations.

As discussed in Section 5.2.1.3, hydrologic alterations affecting the Boulder Zone of the Lower Floridan aquifer would result from the injection of up to 85 Mgd of blowdown water and other liquid waste streams from the proposed units via a deep-well injection system. However, although a normal operation exposure pathway is not expected, because of the unique nature of

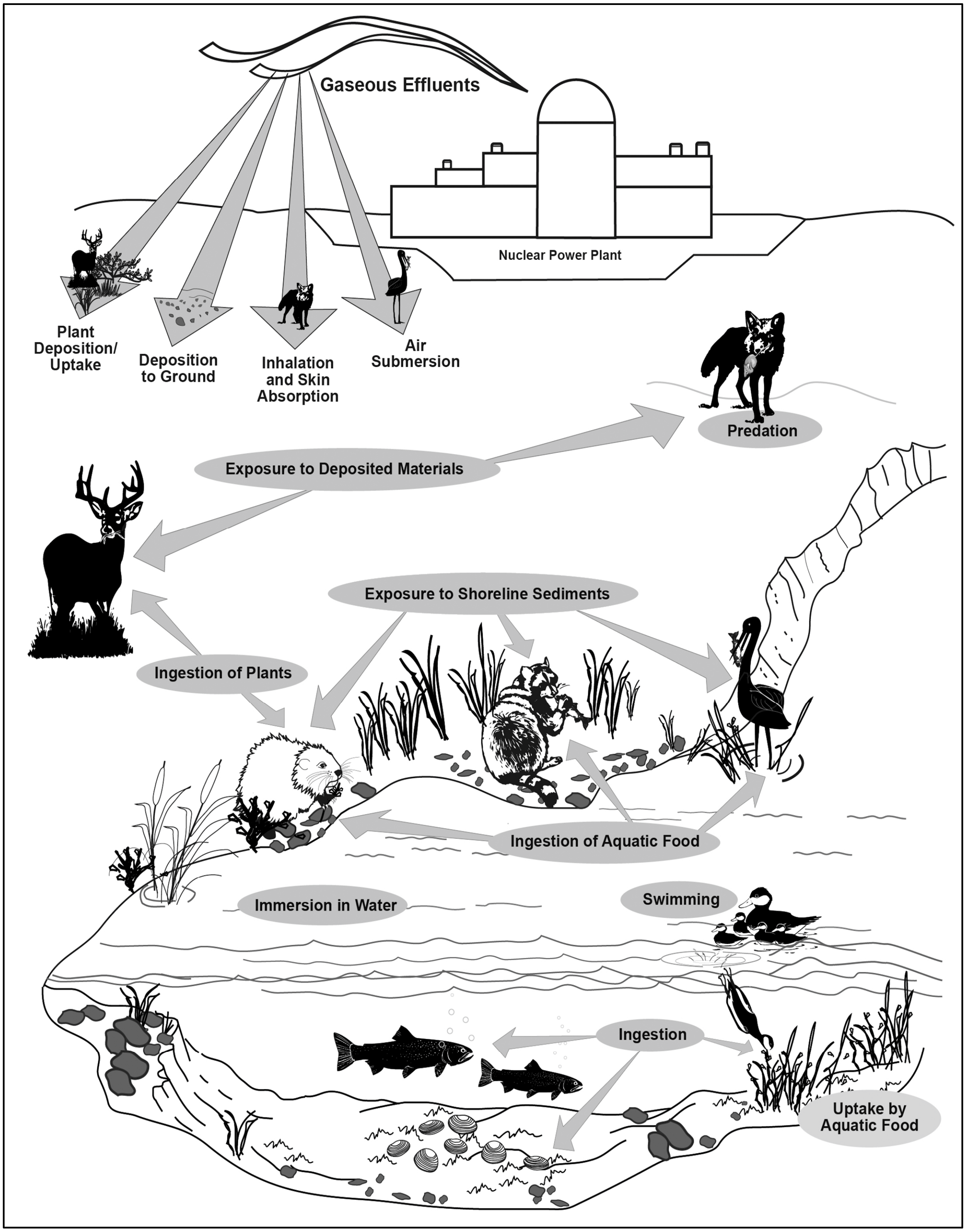

Figure 5-5. Exposure Pathway to Biota Other than Humans (Soldat et al. 1974-TN710)

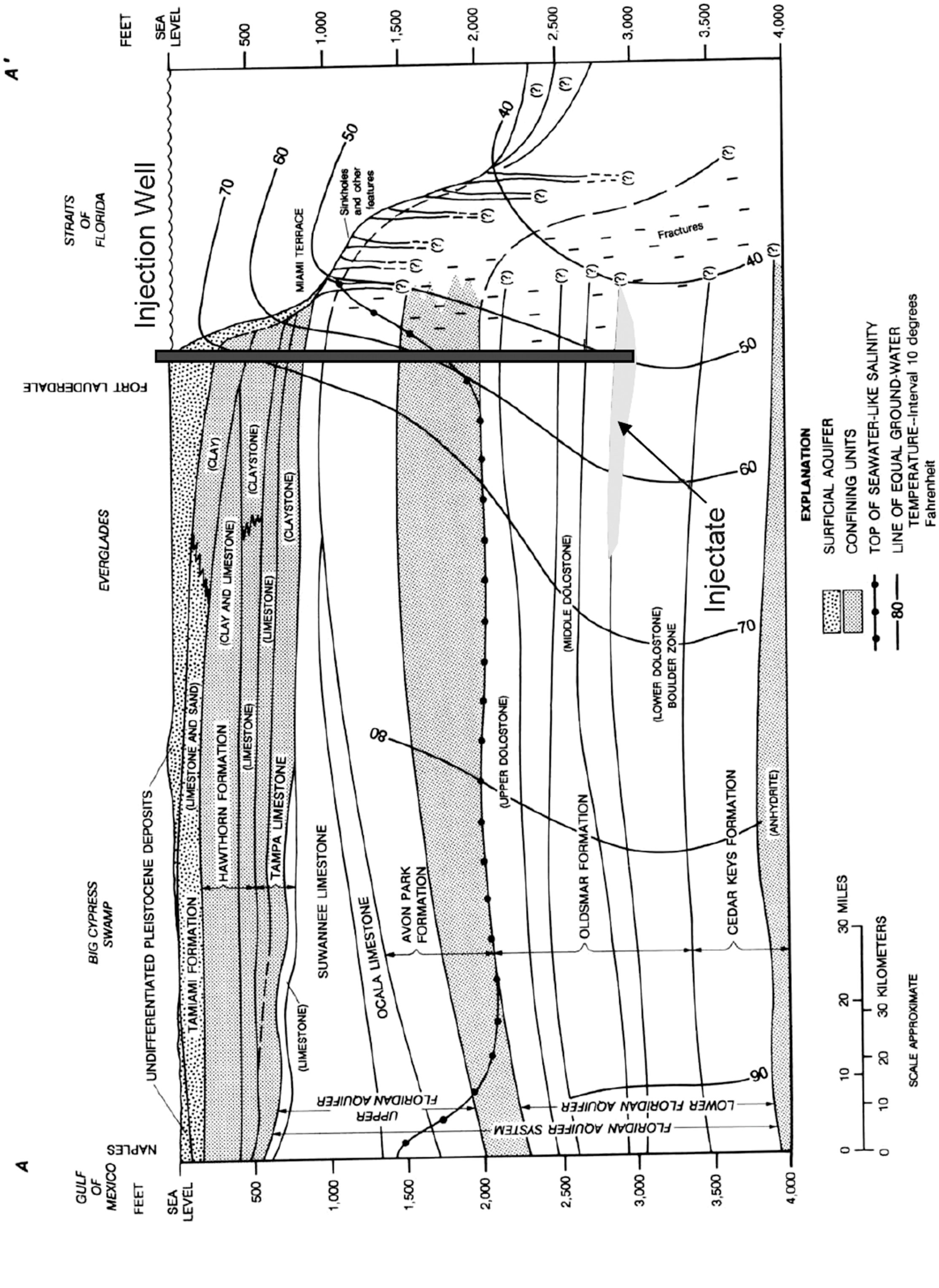

Figure 5-6. Typical Injection Well for Turkey Point Units 6 and 7 (Adapted from Taylor 2009-TN2256; Meyer 1989-TN2255; NRC 2009-TN2257)

the radioactive effluent discharge and in response to NRC RAIs (NRC 2013-TN3937), FPL evaluated three potential dose scenarios in FSAR Section 11.2.3.5 (FPL 2015-TN4502) and ER Section 5.4.1.1 (FPL 2014-TN4058) based on potential groundwater flow pathways of the injected radioactive liquid effluent that could result in inadvertent radioactive exposure to the general public.

In its model, FPL assumed that in model year 1, Unit 6 is the only unit operating and using deep-well injection into the Boulder Zone, and in model year 2, Unit 7 is operating and using deep-well injection. It was assumed that each unit injected for 60 years non-stop (i.e., 40-year initial license and a 20-year license renewal, with no decrease in injection rate due to outages). Thus, from model year 2 through model year 60, both units are operating and using deep-well injection. In model year 61 only Unit 7 is operating and using deep-well injection (i.e., Unit 6 has ceased operation). In model year 62 to model year 100, both units have ceased operations. The analysis goes out to model year 100 to determine how the injection plume decays and dissipates over the 38 years after both units cease deep-well injection.

In order to have a postulated pathway to the surface, the scenarios were based on a freshwater well already existing or being drilled into the Upper Floridan aquifer directly above a conduit in the confining layer above the Boulder Zone (i.e., an opening that extended through the more than 900 ft thick low-permeability rocks over the Boulder Zone). These scenarios also assumed that whatever the radioactive concentration was in the Boulder Zone at the bottom of the conduit was also at the wellhead with no loss in concentration due to travel time or dilution.

One scenario is at the Ocean Reef Club community (this community located approximately 7.7 mi south-southeast of the deep-well injection analysis center point). This scenario was selected because it is the only public use of freshwater from the Upper Floridan aquifer. The other two scenarios are located at the closest private parcel to Turkey Point 6 and 7 (this parcel is located approximately 2.2 mi north-northwest of the deep-well injection analysis center point). Here it is assumed that a freshwater well is drilled into the Upper Floridan aquifer (no such well exists at this time). The NRC staff has reviewed the proposed pathway scenarios for the radioactive liquid effluent injectate and found them to be acceptable.

A discussion of the postulated doses from these scenarios is provided in Section 5.9.3.3.

5.9.2.2 Gaseous Effluent Pathway

FPL calculated the gaseous pathway doses to the MEI using the GASPAR II computer program (Strenge et al. 1987-TN83) at the following locations: nearest site boundary, nearest meat animal, nearest residence, and nearest vegetable garden. The GASPAR II computer program was also used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from submersion in the gaseous effluent cloud and exposure to particulates deposited on the ground; (2) inhalation of gases and particulates; (3) ingestion of meat from animals eating grass affected by gases and particulates deposited on the ground; and (4) ingestion of foods (e.g., vegetables) affected by gases and particulates deposited on the ground. The gaseous effluent releases used in the estimate of dose to the MEI and population are found in Table 11.3-3 of the AP1000 DCD (Westinghouse 2011-TN261) and Table G-3 of Appendix G. Other parameters used as inputs to the GASPAR II program, including population data, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found in Tables 5.4-5 and 5.4-6 of the ER (FPL 2014-TN4058).

As previously discussed, there is no liquid effluent pathway from normal operations, thus the doses derived from the gaseous effluent pathway are the only doses that affect members of the public and non-human biota. Therefore, the doses to and impacts of the gaseous effluents on the public and non-human biota are discussed in Sections 5.9.3 and 5.9.5, respectively.

The NRC staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The NRC staff reviewed the input parameters and values used by FPL (2014-TN4058) for appropriateness, including references made to the Westinghouse AP1000 DCD (Westinghouse 2011-TN261). The NRC staff concluded that the assumed input parameters and values used by FPL were appropriate. The NRC staff performed an independent evaluation of the gaseous pathway doses and obtained similar results for the MEI (see Appendix G for details).

5.9.3 Impacts on Members of the Public

This section describes the NRC staff’s evaluation of the estimated impacts from radiological releases and direct radiation from proposed Turkey Point Units 6 and 7. The evaluation addresses dose from operations to the MEI located at the Turkey Point site and the population dose (collective dose to the population within 50 mi) around the site.

5.9.3.1 Maximally Exposed Individual

In ER Section 5.4 (FPL 2014-TN4058), FPL stated that total body and organ dose estimates to the MEI from gaseous effluents for each new unit would be within the design objectives of 10 CFR Part 50 (TN249), Appendix I. As previously stated, there is no dose due to liquid effluents during normal operations. The MEI doses were determined by considering the maximally exposed adult, teenager, child, and infant at the locations shown here in Table 5-10. The receptor locations listed in the table are those at which the maximum atmospheric dispersion and deposition factors occur for each exposure pathway.

Table 5-10. Gaseous Effluent Exposure Pathway Receptor Locations

Nearest Receptor	Direction	Distance (mi)
Site Boundary (Turkey Point Site Property Boundary)	SSE	0.35
Residence	N	2.7
Vegetable Garden	NW	4.8
Meat Animal (Meat Cow Pasture[(a)])	N	2.7
Non-human Biota	SSE	0.25

(a) There are no milk animals within 5 mi of proposed Turkey Point Units 6 and 7.

Source: FPL 2014-TN4058, Table 5.4-6

The total body and organ doses to the MEI are provided in Table 5-11. FPL summed the contributions from viable pathways to obtain a total dose for each organ and age group. Although Table 5-10 shows that the vegetable garden is farther away than the residence and the meat animal, FPL added the garden doses to the doses from the other two pathways. Furthermore, FPL conservatively assumed that an individual resides at the Turkey Point site boundary, although the nearest actual residence is farther away, as indicated in Table 5-10. In effect, doses were calculated at two locations: the Turkey Point site boundary and a combined residence/garden/meat animal location.

Table 5-11. Annual Individual Doses to the MEI from Gaseous Effluents for One Unit

Pathway	Location	Age Group	Total Body Dose (mrem/yr)	Max Organ Dose (mrem/yr)	Skin Dose (mrem/yr)	Thyroid Dose (mrem/yr)
Plume	Residence	All	6.7×10^{-3}	7.4×10^{-3}(lung)	4.6×10^{-2}	6.7×10^{-3}
Ground	Residence	All	6.56×10^{-3}	6.6×10^{-3}(lung)	7.7×10^{-3}	6.6×10^{-3}
Inhalation	Residence	Adult	1.2×10^{-3}	1.45×10^{-3} (lung)	0.0	9.6×10^{-3}
		Teen	1.2×10^{-3}	1.6×10^{-3} (lung)	0.0	1.2×10^{-2}
		Child	1.0×10^{-3}	1.4×10^{-3} (lung)	0.0	1.4×10^{-2}
		Infant	5.9×10^{-2}	8.7×10^{-4} (lung)	0.0	1.2×10^{-2}
Vegetable	Vegetable	Adult	6.4×10^{-3}	3.3×10^{-2} (bone)	0.0	8.6×10^{-2}
	Garden	Teen	9.2×10^{-3}	5.0×10^{-2} (bone)	0.0	1.1×10^{-1}
		Child	2.0×10^{-2}	1.14×10^{-1} (bone)	0.0	2.1×10^{-1}
Meat	Residence	Adult	2.64×10^{-3}	1.14×10^{-2} (bone)	0.0	9.4×10^{-3}
		Teen	2.1×10^{-3}	9.54×10^{-3} (bone)	0.0	7.0×10^{-3}
		Child	3.8×10^{-3}	1.8×10^{-2} (bone)	0.0	1.1×10^{-2}
Total MEI Dose[(a)]		Adult	2.3×10^{-2}	5.8×10^{-2} (bone)	5.3×10^{-2}	1.2×10^{-1}
		Teen	2.6×10^{-2}	7.3×10^{-2} (bone)	5.3×10^{-2}	1.4×10^{-1}
		Child	3.8×10^{-2}	1.45×10^{-1} (bone)	5.3×10^{-2}	2.44×10^{-1}
		Infant	1.4×10^{-2}	1.34×10^{-2} (bone)	5.3×10^{-2}	2.5×10^{-2}

(a) Total MEI dose is a sum of the residence, vegetable, and meat pathways.
There are no milk cows/goats within 5 mi of the Turkey Point site.
Assumes the MEI's food comes from nearest meat and vegetable sources to the Turkey Point site.

Source: FPL 2014-TN4058, Table 5.4-7

Table 5-12 presents the doses at the exclusion area boundary from gaseous effluents and would be within the design objectives of 10 CFR Part 50 (TN249), Appendix I of 10 mrad/yr air dose from gamma radiation, 20 mrad/yr air dose from beta radiation, 5 mrem/yr to the total body, and 15 mrem/yr to the skin. In addition, dose to the thyroid from gaseous effluents would be within the 15 mrem/yr Appendix I dose design objective. The NRC staff completed an independent evaluation of compliance with Appendix I dose design objectives and found similar results. While liquid effluents are not part of the exposure pathway for releases for the reasons previously mentioned, the combined gaseous and liquid effluents from the Turkey Point Units 6 and 7 would be below the Appendix I dose design objectives.

Table 5-12. Comparisons of the Dose Estimates from Liquid and Gaseous Effluents to 10 CFR Part 50 (TN249), Appendix I Design Objective at the Turkey Point Site Boundary

Radionuclide Releases/Dose (from site boundary)	FPL Dose Estimates[a]	Appendix I Design Objectives
Gaseous Effluents		
Beta air dose	18 mrad	20 mrad
Gamma air dose	4.2 mrad	10 mrad
External total body dose	3.6 mrem	5 mrem
Skin dose	14 mrem	15 mrem
Liquid Effluents		
Total body dose from all pathways	0 rem[b]	3 mrem
Critical organ dose from all pathways	0 rem[b]	10 mrem

(a) This is the dose for a single unit (i.e., either Unit 6 or Unit 7).
(b) There are no exposure pathways for liquid effluents to reach a population under normal operating conditions, as previously discussed and in Section G.2. However, under the pathway scenarios assessed by FPL, Appendix I criteria were met and is considered bounding.

Source: FPL 2014-TN4058, Table 5.4-8

FPL compared the combined doses estimates from direct radiation and gaseous and liquid effluents from the two new units as well as the two existing units to the regulatory limits of 40 CFR Part 190 (TN739). FPL states the dose limits for members of the public in 40 CFR Part 190 (TN739) are more restrictive than those in 10 CFR 20.1301(a)(1) (TN283). To FPL, the demonstration of compliance with the dose limits of 40 CFR Part 190 (TN739) is also a demonstration of compliance with the 0.1 rem total effective dose equivalent (TEDE) limit of 10 CFR 20.1301(a)(1) (TN283). As stated earlier, exposure at the site boundary from direct radiation sources at the new units would be negligible and would not contribute significantly to the MEI dose. Table 5-13 compares FPL's calculated doses from the existing two operating units and the two proposed units to the dose standards from 40 CFR Part 190; i.e., 25 mrem/yr to the total body, 75 mrem/yr to the thyroid, and 25 mrem/yr to any other organ. The NRC staff completed an independent evaluation of compliance with 40 CFR Part 190 standards and found similar results. The assessment shows that the 40 CFR Part 190 (TN739) standards would be met.

Table 5-13. Cumulative Turkey Point Site Dose to the MEI from Units 6 and 7 Combined with Units 3 and 4

Type of Dose (mrem/yr)	FPL Units 3 and 4[a]	FPL Units 6 and 7 Liquid Dose[b]	FPL Units 6 and 7 Gaseous Dose[c]	Combined Maximum Individual Dose	40 CFR Part 190 Dose Standards
Total Body	0.0029	0	7.8	7.8	25
Thyroid	0.0059	0	15.0	15.0	75
Other Organ	0.0059	0	8.4	8.4	25

Source: FPL 2014-TN4058, Tables 5.4-8 and 5.4-9

(a) Bounding values from 5 years of effluent reports; theoretical values (thyroid, bone, and skin dose assumed to be the same).
(b) Under normal operating conditions expected to be zero.
(c) Values from table representing dose from both AP1000 units.

5.9.3.2 Population Dose

In ER Table 5.4-10 (FPL 2014-TN4058), FPL estimated the collective total body dose within a 50 mi radius of the Turkey Point site to be 8.0 person-rem/yr from both proposed Turkey Point Units 6 and 7. The estimated collective dose to the same population from natural background radiation is estimated to be 2.5×10^6 person-rem/yr. The dose from natural background radiation was calculated by multiplying the 50 mi population estimate for the year 2080 of 7.5 million people given in ER Table 2.5-1 (FPL 2014-TN4058) by the annual background dose rate of 311 mrem/yr (NCRP 2009-TN420).

Collective population doses from gaseous effluent pathway were estimated by FPL using the GASPAR II computer code. The NRC staff performed an independent evaluation of population doses and obtained similar results (see Appendix G).

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 report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report (National Research Council 2006-TN296), uses the linear, no-threshold 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, non-fatal 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 it is taken from Publication 103 of the International Commission on Radiological Protection (ICRP 2007-TN422).

Both the National Council on Radiation Protection and Measurements (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 1,754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995-TN728; ICRP 2007-TN422). As noted above, the estimated collective whole body dose to the population living within 50 mi of the Turkey Point Units 6 and 7 is 8.0 person-rem/yr, which is less than the value of 1,754 person-rem/yr that ICRP and NCRP suggest would most likely result in zero excess health effects (NCRP 1995-TN728; ICRP 2007-TN422).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (Jablon et al. 1990-TN1257). The NCI report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found “no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities” (Jablon et al. 1990-TN1257).

5.9.3.3 Deep-Well Injection Scenarios – Postulated Doses

As previously discussed in Section 5.9.2.1, although there is no normal exposure pathway for the deep-well injected effluent to reach the public, FPL postulated three public exposure scenarios that could theoretically result in having treated liquid radioactive effluent mixed into the Boulder Zone reach the Upper Floridan aquifer, a potential pathway for public exposure. One of these scenarios is at the Ocean Reef Club (located approximately 7.7 mi south-southeast of the deep-well injection analysis center point) and two scenarios are at a private parcel of land (located approximately 2.2 mi north-northwest of the deep-well injection analysis center point).

With respect to the Ocean Reef Club scenario (where a well into the Upper Floridan aquifer already exists), FPL's groundwater analysis determined that no effluent radionuclides will migrate to this location over 100-year period. Therefore, FPL estimated that members of the public in the Ocean Reef Club community would not receive a postulated dose from deep-well the injected liquid effluent.

With respect to the dose receptors for the two scenarios at the private parcel of land, one was a child and the other was a well driller.

- The first scenario assumed a child (i.e., the most conservative member of the public dose receptor) ingested water from the well and ingested food irrigated by water from the well for an entire year.
- The second scenario assumed a driller, while drilling the well, is standing in a puddle of water discharged by the well during the drilling process, and thus is exposed by inhalation (i.e., from the puddle evaporation "cloud"); deposition (i.e., vapor from the "cloud" condensing on the driller); and immersion (i.e., from being surrounded by the "cloud"). The exposure duration was for 12 hours per day for 45 days. In addition, it was assumed that the driller also ingested water from the well and ingested food irrigated by water from the well for an entire year.

FPL's groundwater analysis determined that at the private land parcel location, the following maximum radionuclide concentrations occur in the following years after the start (i.e., model year 1) of deep-well injection:

- tritium (H-3) 3.1E+04 pCi/L 25 years
- cesium-134 (Cs-134) 7.7E-03 pCi/L 15 years
- cesium-137 (Cs-137) 7.6E-01 pCi/L 42 years
- strontium-90 (Sr-90) 5.6E-04 pCi/L 41 years.

Only these four effluent radionuclides were analyzed in the groundwater analysis because FPL determined that when using the LADTAP II computer program (Strenge et al. 1986-TN82), these radionuclides contributed over 99 percent of the dose. For additional conservatism, while the maximum concentration for each radionuclide happen at different times, FPL assumed for the dose analysis that the maximum concentrations occur concurrently.

With respect to postulated dose due to ingestion, LADTAP II was used for both the child and the driller. For the postulated driller dose due to the "cloud," FPL used the guidance provided by the EPA in EPA-402-R-93-081 (Eckerman and Ryman 1993-TN3955) and EPA 550-B-99-099 (EPA 2009-TN3954).

As determined by FPL in ER Tables 5.4-2 and 5.4-3, the largest postulated dose is received by the driller at 2.8 mrem whole body and maximum organ dose of 3.9 mrem to the liver per unit (FPL 2014-TN4058). Thus the postulated scenario doses received from the Turkey Point Units 6 and 7 liquid effluents would be below the Appendix I dose design objectives of 3 mrem whole body and 10 mrem organ dose.

The NRC staff performed an independent confirmatory evaluation of these hypothetical liquid pathways and concluded that FPL's analysis was appropriate. Results of the NRC staff's independent review are found in Appendix G.

5.9.3.4 Summary of Radiological Impacts on Members of the Public

The NRC staff evaluated the potential health impacts from routine gaseous radiological effluent releases from proposed Turkey Point Units 6 and 7. Based on information provided by FPL, and the NRC's own independent evaluation, the NRC staff concluded there would be no observable health impacts on the public from normal operation of the proposed units, any health impact would be SMALL, and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

For proposed Turkey Point Units 6 and 7, as discussed in Section 12.4.1.7 of the AP1000 DCD (Westinghouse 2011-TN261), the estimated annual occupational dose, including outage activities, is less than 63.2 person-rem per unit. By comparison, the annual collective dose per operating pressurized water reactor in the United States was 51 person-rem in 2014 (NRC 2016-TN4761). The dose to Unit 7 construction workers during the operation of Unit 6 and the existing units is addressed in EIS Section 4.9.

The licensee of a new plant would need to maintain individual doses to workers within 5 rem annually as specified in 10 CFR 20.1201 (TN283) and incorporate provisions to maintain doses as low as is reasonably achievable (ALARA). FPL has described the health physics program in Section 12.5 of its FSAR for Turkey Point Units 6 and 7 and the radiation protection features in FSAR Section 12.3 (FPL 2015-TN4502). Based on these descriptions, FPL would ensure that occupational exposures are maintained ALARA. In addition, the Turkey Point Units 6 and 7 FSAR (FPL 2015-TN4502) discusses plans to establish worker training, monitoring, and radiation safety programs based on NEI 07-03A, "Generic FSAR Template Guidance for Radiation Protection Program," (NEI 2009-TN1279) to the extent practicable.

The NRC staff concludes that the health impacts from occupational radiation exposure would be SMALL based on individual worker doses being maintained within 10 CFR 20.1201 (TN283) limits and collective occupational doses being typical of doses found in current operating light-water reactors. Additional mitigation would not be warranted because the operating plant would be required to maintain doses ALARA.

5.9.5 Impacts on Non-Human Biota

FPL estimated doses to non-human biota in the environs for the Turkey Point site, in many cases using surrogate species. Surrogate species used in the ER are well-defined and provide an acceptable method for evaluating doses to non-human biota (Soldat et al. 1974-TN710). Surrogate species analysis was performed for terrestrial species (e.g., muskrats, raccoons, herons, and ducks [FPL 2014-TN4058]). Exposure pathways considered in evaluating dose to the non-human biota are discussed in Section 5.9.1. The NRC staff's evaluation is presented in Appendix G.

5.9.5.1 Liquid Effluent Pathway

As discussed in Section 5.9.2.1, there is no liquid effluent pathway for exposure of non-human biota due to deep-well injection. Therefore, this pathway is not considered for estimating doses to fish, invertebrates, algae, and all terrestrial species.

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure because of immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. The dose calculated to the MEI from gaseous effluent releases in Section 5.9.3 would also be applicable to terrestrial surrogate species with two modifications. One modification defined in ER Section 5.4.4 (FPL 2014-TN4058) was increasing the ground-deposition factors by a factor of two because terrestrial animals would be closer to the ground than a member of the public. The second modification was to use the biota location delineated in Table 5-14. The total body dose estimates to the surrogate species from the gaseous pathway for one unit are shown in Table 5-15. In addition, Appendix G presents the NRC staff's estimate of the dose to the American crocodile of 174.7 mrad/yr.

Table 5-14. FPL Estimate of Non-Human Biota Doses for Proposed Turkey Point Units 6 and 7 for a Single Unit

Biota	Total Body Biota Dose (mrad/yr)[(a)]
Saltwater Fish	0.0
Invertebrate	0.0
Algae	0.0
Muskrat	26.0
Raccoon	26.0
Heron	26.0
Duck	26.0

(a) Radiological doses to non-human biota are expressed in units of absorbed dose (rad).

Source: FPL 2014-TN4058, Section 5.4.4

Table 5-15. Comparison of the FPL Estimate of Biota Doses from the Proposed Turkey Point Units 6 and 7 to the IAEA/NRCP Guidelines for Biota Protection

Biota	Estimate of Dose to Biota[(a)] (mrad/d)	IAEA/NCRP Guidelines for Protection of Biota Populations (mrad/d)
Saltwater Fish	0.00	1,000
Invertebrate	0.00	1,000
Algae	0.00	1000
Muskrat	0.14	100
Raccoon	0.14	100
Heron	0.14	100
Duck	0.14	100

(a) Dose is for both units based on the single unit total dose from Table 5-14 converted to mrad/d.

Source: FPL 2014-TN4058, Section 5.4.4

5.9.5.3 Summary of Impacts on Biota Other Than Humans

The International Atomic Energy Agency (IAEA 1992-TN712) and the National Council on Radiation Protection and Measurements (NCRP 1991-TN729) reported that a chronic dose rate of no greater than 10 mGy/d (1,000 mrad/d) to the MEI in a population of aquatic organisms would ensure protection of the population. The IAEA (IAEA 1992-TN712) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations.

Table 5-15 compares the estimated total body dose rates to surrogate non-human biota species produced by releases from proposed Turkey Point Units 6 and 7 for both units, to the IAEA/NCRP biota dose guidelines (IAEA 1992-TN712; NCRP 1991-TN729). From the FPL estimate (FPL 2014-TN4058), the gaseous pathway dose is about 0.14 mrad/d. In Appendix G, the NRC staff's estimate of the dose to the American crocodile is 0.96 mrad/d. Thus, the doses to non-human biota are far below the 100 mrad/d IAEA guideline (IAEA 1992-TN712) for terrestrial biota and the 1,000 mrad/d guideline for aquatic biota. Based on the NRC staff's independent evaluation, the NRC staff concludes that the radiological impact on biota from the routine operation of the proposed Turkey Point Units 6 and 7 would be SMALL, and additional mitigation would not be warranted.

5.9.6 Radiological Monitoring

FPL has conducted a radiological environmental monitoring program (REMP) around the Turkey Point site since 1969 (AEC 1972-TN999).

On April 3, 2012, the NRC published in the *Federal Register* (77 FR 20059) (TN1001) a final Environmental Assessment and Finding of No Significant Impact and on June 15, 2012 the final approval of the licensing amendments for the approximately 15 percent extended power uprates of Turkey Point Units 3 and 4 (NRC 2012-TN1438). A result of the extended power uprates for Turkey Point Units 3 and 4 was a supplemental REMP sampling program.

In addition to the REMP and the Offsite Dose Calculation Manual (ODCM) description in the Annual Radiological Effluent Release Report, ODCM Appendix 5A discusses a supplemental REMP sampling program that is agreed upon by the State of Florida Department of Health and

Rehabilitative Services and FPL. This supplemental sampling program is not required by regulation, but is performed to provide a broader database for the REMP (FPL 2011-TN119). The sampling under this supplemental program provides additional data, including data from sampling in the discharge canal. A discussion of the cooling-canal monitoring program is provided in EIS Section 2.11.

Currently, radiological releases are summarized in the annual reports titled *Turkey Point, Units 3 and 4, Annual Radioactive Effluent Release Report* and *Turkey Point, Units 3 and 4, Annual Radiological Environmental Operating Report*. The limits for all radiological releases are specified in the Turkey Point ODCM, and these limits are designed to meet Federal standards and requirements. The REMP includes monitoring of the aquatic environment (fish, invertebrates, and shoreline sediment), atmospheric environment (airborne radioiodine, gross beta, and gamma), and terrestrial environment (vegetation) and direct radiation. The NRC staff reviewed these annual reports for calendar years 2002 through 2015 (the references for these reports can be found in Section 2.11). These reports show that doses to individuals around the Turkey Point site were a small fraction of the limits specified in Federal environmental radiation standards, 10 CFR Part 20 (TN283), 10 CFR Part 50, Appendix I (TN249), and 40 CFR Part 190 (TN739).

As discussed in the ODCM, groundwater is sampled for tritium (FPL 2011-TN119). However, no drinking water pathway exists from groundwater at the Turkey Point site (FPL 2009-TN100). In addition, as stated in FSAR Section 2.4.12.2.1.3 (FPL 2015-TN4502), as part of the injection permit, FPL would also install a dual-zone monitoring well. The UIC wells would be regulated by and fully comply with the requirements of Fla. Admin. Code Chapter 62-528 (TN556) and applicable FDEP rules (FDEP 2012-TN1280).

5.10 Nonradioactive Waste Impacts

This section describes the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste and mixed waste during operation of proposed Turkey Point Units 6 and 7. As discussed in Section 3.4.4, the types of nonradioactive waste that would be generated, handled, and disposed of during operations include municipal solid waste, industrial solid wastes, stormwater runoff, sanitary waste, liquid effluents containing chemicals or biocides, industrial liquid wastes, and combustion emissions. In addition, small quantities of hazardous waste and mixed waste (waste that has both hazardous and radioactive characteristics) may be generated during plant operations. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

5.10.1 Impacts on Land

The expected nonradioactive waste streams destined for land-based treatment or disposal during operation include water-treatment sludge, laboratory wastes, trash, sanitary waste, and hazardous waste.

Any uncontaminated sediment or excavated soils would be stockpiled onsite in designated areas with appropriate engineering controls to limit surface-water runoff. Nonhazardous solid waste generated during operations would be segregated and recycled to the extent practicable, and the balance would be disposed of at offsite, licensed commercial waste-disposal facilities. Spent filters from water and wastewater treatment would be disposed in accordance with applicable industrial solid-waste regulations. FPL estimates that during operations, Units 6 and 7 would generate an average of 1,000 T of nonradioactive, nonhazardous solid waste annually. (FPL 2014-TN4058).

Approximately 1,300 gallons of residual sludge from the sanitary wastewater-treatment plant would be sent to a licensed offsite disposal facility. The FPL RWTF will produce an estimated 435 T/d of sludge, which will be disposed of in licensed landfills (FPL 2014-TN4058).

FPL estimates that proposed Units 6 and 7, combined, would generate about 4,800 lb of nonradioactive hazardous waste annually. All hazardous wastes would be collected and temporarily stored onsite, and then transported offsite by a licensed and permitted Resource Conservation and Recovery Act of 1976, as amended (RCRA) (42 U.S.C. § 6901 et seq.) (TN1281) waste hauler, and treated or disposed of offsite at a RCRA-permitted facility (FPL 2014-TN4058).

Mixed waste contains both low-level radioactive waste and hazardous waste. The generation, storage, treatment, or disposal of mixed waste is regulated by Atomic Energy Act of 1954 (42 U.S.C. § 2011 et seq.) (TN663), the Solid Waste Disposal Act of 1965 (42 U.S.C. § 82 et seq.) (TN1032), as amended by RCRA in 1976, and the Hazardous and Solid Waste Amendments (42 U.S.C. § 6921 et seq.) (TN1033) (which amended RCRA in 1984). The mixed waste from proposed Turkey Point Units 6 and 7 would be handled and managed in accordance with the applicable Federal, State, and local requirements. The packaged waste would be stored in the auxiliary and radwaste buildings until being shipped offsite to a licensed disposal facility (FPL 2014-TN4058).

Because no wastes would be landfilled onsite and 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, the review team expects that impacts on land from nonradioactive and mixed wastes generated during operation of the Turkey Point Units 6 and 7 would be minimal, and no further mitigation would be warranted.

5.10.2 Impacts on Water

The nonradioactive liquid waste streams during operation would include cooling-tower blowdown, demineralized water system effluent, filter backwash wastewater, water-treatment wastes, discharge from floor and equipment drains, fire-protection water, stormwater runoff, and effluents from the sanitary waste-treatment effluent (FPL 2014-TN4058).

All nonradioactive, liquid discharges during operations would need to comply with the applicable provisions of the site's NPDES stormwater operations permit for industrial activities issued under Fla. Admin. Code 62-621 (TN709). FPL would direct stormwater during operations to the IWF under a requested modification of the site's Industrial Wastewater Permit No. FL0001562 (FPL 2014-TN4058). Fire-protection water from testing would also be routed to the IWF through the stormwater system (FPL 2010-TN272).

All other nonradioactive liquid waste streams would be discharged onsite in the UIC wells, with the exception of oil collected from oil/water separators. Collected oil would be transported offsite by a licensed waste contractor. Waste oil from Turkey Point Units 3 and 4 is currently recycled for heat reclamation and similar practices are planned for the waste oil from Units 6 and 7 (FPL 2014-TN4058). Effluent streams that would be directed to the UIC wells include water rejected from the demineralized water system, service-water system blowdown, CWS blowdown; water from equipment, floor, and wash drains; water from oil/water separators; treated sanitary wastewater; component cooling-system water; small volumes of liquid radwaste effluent; and potentially a small portion of the water from the FPL RWTF (FPL 2010-TN272).

FPL also plans to construct and operate a fleet vehicle maintenance facility, which would generate waste oil, waste coolant, and potentially solvent from the solvent wash tank. The maintenance facility would be served by a local septic tank. Discharges would be regulated in compliance with Pollution Control Facility Permit No. IW5-006229-2012-2012, as it is renewed and updated (FPL 2014-TN4058).

Because all nonradioactive liquid wastes, except those noted above, would be combined into a single, permitted, and monitored discharge stream, the review team concludes that impacts on water from nonradioactive liquid wastes generated during operation of proposed Turkey Point Units 6 and 7 would be minimal, and no further mitigation would be warranted.

5.10.3 Impacts on Air

The nonradioactive gaseous waste streams during operation would include emissions from the combustion of fossil fuels, volatile emissions from those fuels, and other VOCs from the use of materials such as paints, oils, and solvents.

Gaseous emissions would be produced by the combustion of diesel fuel during monthly testing of the 10 diesel engines that would power fire pumps and standby generators. Each of these diesel engines would have an associated fuel tank that would release small quantities of VOCs. Additional VOCs would be released from the use of paints, oils, solvents, and other standard building and maintenance materials.

Any emissions from the fleet vehicle maintenance facility would be offset by a reduction in emissions from offsite service stations, at which the FPL vehicle fleet would need maintenance in the absence of an onsite maintenance facility.

Estimates of the GHG production, primarily CO_2, from the operation of a 1,000 MW(e) nuclear power plant for 40 years, equal 320,000 MT of CO_2 equivalent, or about 640,000 MT for proposed Units 6 and 7 combined, exclusive of the uranium fuel cycle. Of this total, approximately 380,000 MT pertain to periodic testing of diesel engines for the auxiliary power and fire-protection water systems and most of the remaining 260,000 MT arise from worker transportation. The estimated annual production of 16,000 MT is small compared to the estimated CO_2 equivalent production of 14,000,000 MT from a coal-fired power plant and 5,900,000 MT from a natural-gas-fired power plant of comparable size (FPL 2014-TN4058).

Nonradioactive gaseous emissions from operations (including GHG emissions) would be limited in magnitude. FPL would install equipment with appropriate emission controls and comply with all applicable Federal, State, and local requirements. Because nonradioactive gaseous emissions are limited in magnitude and FPL would implement emission control measures and comply with all applicable Federal, State, and local requirements, the review team concludes that impacts on air from nonradioactive gaseous wastes generated during operation of proposed Turkey Point Units 6 and 7 would be minimal, and no further mitigation would be warranted.

5.10.4 Summary of Nonradiological Waste Impacts

Solid, liquid, gaseous, hazardous, and mixed wastes generated during operation of the proposed Turkey Point Units 6 and 7 would be handled according to County, State, and Federal regulations. County and State permits for handling and disposal of solid waste would be obtained and implemented. Compliance with the permits for releases of cooling water and other liquid effluents would ensure compliance with the Federal Water Pollution Control Act (Clean Water Act) (33 U.S.C. § 1251 et seq.) (TN662) and Florida water-quality standards. Air emissions from the facility would be minimal and would not reduce the local air quality. All transportation, storage, and disposal of regulated hazardous and mixed wastes would be in accordance with applicable Federal, State, and local requirements.

Based on (1) the information provided by FPL; (2) the planned practices for recycling, minimizing, managing, and disposing of wastes; (3) the requirements to obtain regulatory approvals for waste disposal and discharges; and (4) the review team’s independent evaluation, which determined impacts to land, water and air would be minimal, the review team concludes that the potential impacts from nonradioactive and mixed waste resulting from the operation of the proposed Turkey Point Units 6 and 7 would be SMALL, and mitigation would not be warranted.

5.11 Environmental Impacts of Postulated Accidents

The NRC staff considered the radiological consequences for the environment of potential accidents at the proposed Turkey Point Units 6 and 7. FPL based its COL application on the proposed installation of AP1000 reactors for Units 6 and 7. Revision 19 of the AP1000 reactor design (Westinghouse 2011-TN261) is a certified design as set forth in 10 CFR Part 52 (TN251), Appendix D. The FPL application (FPL 2013-TN2885) references Revision 19 of the AP1000 DCD.

The term “accident,” as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially greater than permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20 (TN283), Appendix B, Table 2.

Many safety features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, are intended to prevent the release of radioactive materials from nuclear power plants. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas ALARA are specified in 10 CFR Part 50 (TN249), Appendix I. Additional measures are designed to mitigate the consequences of failures. These include the NRC's reactor site criteria in 10 CFR Part 100 (TN282), which require that the site has certain characteristics that reduce the risk to the public and the potential impacts of an accident. Licensees must have emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47 (TN249), 10 CFR Part 50 (TN249), Appendix E, and NUREG–0654/FEMA-REP-1 (NRC 1980-TN512). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

On March 11, 2011, and for an extended period thereafter, several nuclear power plants in Japan experienced the loss of important equipment necessary to maintain reactor cooling after the combined effects of severe natural phenomena (i.e., an earthquake followed by a tsunami it caused). In response to these events, the Commission established a task force (NTTF) to review the current regulatory framework in place in the United States and to make recommendations for improvements. The task force reported the results of its review (NRC 2011-TN684) and presented its recommendations to the Commission on July 12 and July 19, 2011, respectively. As part of the short-term review, the task force concluded that while improvements are expected to result from the lessons learned, the continued operation of nuclear power plants and licensing activities for new plants did not pose an imminent risk to public health and safety. A number of areas were recommended to the Commission for long-term consideration. Collectively, these recommendations are intended to clarify and strengthen the regulatory framework for protection against severe natural phenomena, mitigation of the effects of such events, coping with emergencies, and improving the effectiveness of NRC programs. By nature of the passive design and inherent 72-hour coping capability for core, containment, and spent fuel pool cooling with no operator action required, the AP1000 design has many of the design features and attributes necessary to address the task force recommendations (NRC 2011-TN684).

On March 12, 2012, the Commission issued three Orders and a Request for Information (RFI) to holders of U.S. commercial nuclear reactor licenses and construction permits to enhance safety at U.S. reactors based on specific lessons learned from the event at Japan's Fukushima Dai-ichi Nuclear Power Plant as identified in the task force report.

The first Order (EA-12-049) and third Order (EA-12-051) apply to every U.S. commercial nuclear power plant, including recently licensed new reactors (77 FR 16091 [TN2476]; 77 FR 16082 [TN1424]). The first Order requires a three-phase approach for mitigating beyond-design basis external events. Licensees are required to use installed equipment and resources to maintain or restore cooling of the core, containment, and spent fuel during the initial phase. (For the AP1000 design, this is the first 72 hours.) During the transition phase (the next 4 days), licensees are required to provide portable, onsite equipment and consumables sufficient to maintain or restore these functions until they can be accomplished with resources brought from offsite. During the final phase (after 7 days), licensees are required to obtain sufficient offsite resources to sustain those functions indefinitely (77 FR 16091) (TN2476). The second Order requires reliable hardened vent systems at boiling water reactor facilities with "Mark I" and "Mark II" containment structures (77 FR 16098) (TN2477). The third Order requires reliable spent fuel pool level instrumentation (77 FR 16082) (TN1424). The RFI addressed five topics: (1) seismic reevaluations, (2) flooding reevaluations, (3) seismic hazard walkdowns, (4) flooding hazard walkdowns, and (5) a request for licensees to assess their current communications system and equipment under conditions of onsite and offsite damage and prolonged station blackout, and perform a staffing study to determine the number and qualifications of staff required to fill all necessary positions in response to a multi-unit event (NRC 2012-TN3236; 77 FR 16082 [TN1424]; 77 FR 16091 [TN2476]; NRC 2012-TN3237). The RFI asked reactor licensees to reevaluate seismic and flooding hazards using methods to determine if their plants' design should be changed.

The NRC staff issued RAIs to FPL requesting information to address the requirements of the first and third Orders, and information sought under the first and fifth RFI topics (NRC 2012-TN3239). FPL addressed the first and third Orders along with the fifth RFI by proposing license conditions to be implemented prior to initial fuel loading (FPL 2014-TN4058; FPL 2014-TN4103). The AP1000 containment design differs from those identified in the second Order; therefore, the actions addressed in this Order are not applicable to the Turkey Point Units 6 and 7. The NRC's evaluation of FPL's responses will be addressed in the NRC's final safety evaluation report (FSER) and any changes to the COL application that are deemed necessary will be incorporated into the applicant's FSAR (FPL 2015-TN4502).

The severe accident evaluation presented later in this section draws from the analyses developed in the NRC staff's safety review, which includes consideration of severe accidents initiated by external events and those that involve fission product releases. The staff evaluation discusses the environmental impacts of severe accidents in terms of risk, which considers both the likelihood of a severe accident and its consequences. For reasons discussed below, the staff has determined that the Fukushima accident and the NRC's implementation of the task force recommendations do not change the staff's conclusions about the environmental impacts of design basis accidents or severe accidents. These conclusions are based on the Turkey Point Units 6 and 7 COL FSAR, Revision 7 (FPL 2015-TN4502), which was submitted to the NRC by a letter dated October 14, 2015 (FPL 2015-TN4586). FPL has indicated that changes are made to the site grading and footprint of the plant area, which are integral parts of the design basis flood for the proposed Turkey Point Units 6 and 7 (FPL 2015-TN4502).

Each new reactor application evaluates the natural phenomena that are pertinent to the site for the proposed reactor design by applying present-day regulatory guidance and methodologies. This includes a determination of the characteristics of the flood and seismic hazards. With respect to flooding, FPL documented the flood hazard in the FSAR consistent with present-day guidance and methodologies. The final flood hazard analysis was submitted by FPL as part of Revision 7 of the FSAR (FPL 2015-TN4502). As set forth in Section 2.4, Hydrologic Engineering, of the Advanced Safety Evaluation (NRC 2016-TN4775), the NRC staff finds that the applicant appropriately considered flood-causing phenomena and their combinations that are relevant for Turkey Point Units 6 and 7. The Advanced Safety Evaluation Section 2.4 provides the detailed results of the NRC staff's safety review for flooding.

With respect to the consideration of severe accidents initiated by seismic events, FPL developed its response to the staff's seismic hazard RAI stemming from the first RFI topic (FPL 2013-TN3241) and modified the Turkey Point Units 6 and 7 COL FSAR, Revision 7 (FPL 2015-TN4502) to reflect the information provided in the RAI response. The RAI requested that FPL evaluate the impact of the latest information affecting seismic hazard analysis (SHA) for the eastern United States. In response to the staff's RAI, FPL reevaluated its SHA. The NRC staff reviewed and evaluated the applicant's response, which was incorporated in Section 2.5 of

Revision 7 of the FSAR (FPL 2015-TN4502), and determined that the applicant's analyses of vibratory ground motion adequately characterized the Turkey Point Site. The detailed results of the NRC staff's seismic safety review is provided in Section 2.5, Geology, Seismology, and Geotechnical Engineering, of the Advanced Safety Evaluation (NRC 2016-TN4775).

In addition to the above considerations for seismic and flooding hazards, the safety features of the AP1000 design support the conclusion that the Fukushima accident does not warrant a change in the assessment of environmental risks from severe accidents considered in the Turkey Point Units 6 and 7 EIS analysis. In particular, the potential design-related vulnerabilities raised by the event at Fukushima, such as the impact of the extended loss of alternating-current electric power on core cooling systems, would not materially affect the analysis of severe accidents for Turkey Point Units 6 and 7 because the AP1000 has been designed to prevent and mitigate severe accidents given a loss of all alternating-current electrical power sources. As previously noted in the task force report on loss of alternating-current electrical power, the AP1000 passive safety systems would remove the decay heat from the reactor core and spent fuel. They will maintain adequate core cooling for a period of 72 hours without further operator action, unlike the facilities at the Fukushima site. This core cooling by the passive safety systems can be sustained for an extended period beyond 72 hours during which the only operator actions are to refill the tank that is the source of water for the passive safety systems and distribute the water when needed.

Additional details are provided in the staff's Safety Evaluation Report for the AP1000 design certification. The NRC staff's design-certification review (76 FR 82079) (TN248) regarding the safety of the AP1000 design concluded that the design has a very high capacity to withstand beyond-design basis events.

In summary, none of the information the staff has identified about the Fukushima accident or the steps taken by the NRC to date to implement the task force recommendations suggests that the seismic and flooding hazards or the available mitigation capability assumed in the Turkey Point Units 6 and 7 EIS analysis of severe accidents would be affected. For these reasons, the NRC's analysis of the environmental impacts of design basis and severe accidents presented herein remains valid.

This section discusses (1) the types of radioactive materials, (2) the paths to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both design basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. Most of the material in the fuel is in the form of nonvolatile solids. However, a significant amount of material is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and therefore lower tendencies to escape from the fuel than the noble gases and iodines.

Radiation dose to individuals is determined by their proximity to radioactive material; the amount of radioactive material inhaled, ingested, or absorbed through the skin; the duration of their exposure; and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water; (2) inhalation of radioactive material; and (3) ingestion of food or water containing material initially deposited on the ground and in water.

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 report by the National Research Council (2006-TN296), 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.

Physiological effects are clinically detectable if individuals receive radiation exposure resulting in a dose greater than about 25 rad over a short period of time (hours). Doses of about 250 to 500 rad received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design Basis Accidents

FPL evaluated the potential consequences of postulated accidents to demonstrate that an AP1000 could be constructed and operated at the Turkey Point site without undue risk to the health and safety of the public (FPL 2014-TN4058). FPL used a set of DBAs that are representative for the AP1000 design for the Turkey Point site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability of occurrence with high consequences.

The DBA review focuses on the certified AP1000 reactors at the Turkey Point site. The bases for analyses of postulated accidents for this design are well established because they have been considered part of the NRC's reactor design-certification process for the AP1000 design. Potential consequences of DBAs are evaluated by the following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the AP1000 for evaluating potential accidents are based on guidance in Regulatory Guide 1.183, *Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors* (NRC 2000-TN517).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor (χ/Q), which has units of seconds per cubic meter (s/m^3). Acceptable methods of calculating the χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983-TN279).

Table 5-16 lists χ/Q values the NRC staff considers pertinent to the environmental review of DBAs for the Turkey Point site. Smaller χ/Q values are associated with lower concentration or greater dilution capability. The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the exclusion area boundary (EAB), the postulated DBA dose and its χ/Q are calculated for a short term (i.e., 2 hours). For the low-population zone (LPZ), they are calculated for the course of the accident (i.e., 30 days composed of four time periods). The second column in Table 5-16 lists corresponding χ/Q values for Turkey Point site (FPL 2014-TN4058); these values were calculated using 3 years of meteorological data (2002, 2005, and 2006) for the Turkey Point site and assuming that the ground-level releases point was located on a line enclosing all potential release points (between the two proposed reactors). Although PAVAN code calculations were performed twice with the building wake credited and not credited, the reported results do not take any credit for building wake for EAB receptors within the building wake influence zone to ensure conservative results and are based on 50 percent χ/Q values as documented in FPL's ER (FPL 2014-TN4058).

Table 5-16. Atmospheric Dispersion Factors for Turkey Point Site DBA Calculations

Time Period and Boundary	χ/Q (s/m^3)
0 to 2 hr, exclusion area boundary	1.89×10^{-4}
0 to 8 hr, low-population zone	5.29×10^{-6}
8 to 24 hr, low-population zone	4.02×10^{-6}
1 to 4 d, low-population zone	2.21×10^{-6}
4 to 30 d, low-population zone	9.39×10^{-7}

Source: FPL 2014-TN4058,Table 7.1-11

Table 5-17 lists the set of DBAs considered by FPL and presents estimates of the environmental consequences of each accident in terms of TEDE. TEDE is estimated by the sum of the committed effective dose equivalent from inhalation and the deep dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988-TN68) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993-TN3955) were used to calculate the deep dose equivalent.

The NRC staff reviewed FPL's selection of DBAs by comparing the accidents listed in the application with the DBAs considered in the AP1000 DCD. The DBAs in FPL's ER (FPL 2014-TN4058) are the same as those considered in Revision 19 of the AP1000 DCD (Westinghouse 2011-TN261). The NRC staff concludes the set of DBAs in FPL's ER is appropriate.

The review criteria used in the NRC staff's safety review of DBA doses are included in Table 5-17 to illustrate the magnitude of the calculated environmental consequences (TEDE doses). In all cases, the calculated TEDE values are considerably smaller than those used as safety review criteria.

Table 5-17. Design Basis Accident Doses for an AP1000 Reactor for Proposed Turkey Point Units 6 and 7

Accident	Standard Review Plan Section[(b)]	TEDE in rem[(a)]		
		EAB[(c)]	LPZ[(d)]	Review Criterion
Main Steam Line Break	15.1.5			
Preexisting iodine spike		0.19	0.0088	25
Accident-initiated iodine spike		0.22	0.024	2.5
Steam Generator Tube Rupture	15.6.3			
Preexisting iodine spike		0.52	0.016	25
Accident-initiated iodine spike		0.22	0.01	2.5
Loss-of-Coolant Accident	15.6.5	9.1	0.56	25
Rod Ejection	15.4.8	0.67	0.06	6.3
Reactor Coolant Pump Rotor Seizure (locked rotor)	15.3.3			
No feedwater		0.19	0.0043	2.5
Feedwater available		0.15	0.0091	2.5
Failure of Small Lines Carrying Primary Coolant Outside Containment	15.6.2	0.41	0.011	2.5
Fuel Handling	15.7.4	1.0	0.026	6.3

(a) To convert rem to Sieverts, divide by 100.
(b) NUREG–0800 (NRC 2007-TN613).
(c) EAB = exclusion area boundary.
(d) LPZ = low-population zone.
(e) 10 CFR 52.79(a)(1) (TN251) and 10 CFR 100.21 (TN282) criteria.
(f) Standard Review Plan criterion.
The more restrictive limits shown are applicable to safety analysis report doses.

Source: FPL 2014-TN4058, Table 7.1-12

The NRC staff reviewed the DBA analysis in FPL's ER, which is based on analyses performed for design certification of Revision 19 of the AP1000 reactor design with adjustments for Turkey Point site-specific characteristics. The NRC staff also performed an independent confirmatory DBA analysis with consideration of both Revision 17 and Revision 19 of the AP1000 DCD (Westinghouse 2008-TN496; Westinghouse 2011-TN261). The results of the FPL and NRC staff analyses indicate that the environmental risks associated with DBAs from an AP1000 reactor built at the Turkey Point site would be small. On this basis, the staff concludes that the environmental consequences of DBAs at the Turkey Point site would be SMALL for an AP1000 reactor.

5.11.2 Severe Accidents

In its ER (FPL 2014-TN4058), FPL considers the potential consequences of severe accidents for an AP1000 reactor at the Turkey Point site. Three pathways are considered: (1) the atmospheric pathway, in which radioactive material is released to the air; (2) the surface-water pathway, in which airborne radioactive material falls out on open bodies of water; and (3) the groundwater pathway, in which groundwater is contaminated by a basemat (floor) melt-through with subsequent contamination of surface water by the groundwater.

FPL's consequence assessment is based on the probabilistic risk assessment (PRA) for Revision 15 of the of the AP1000 design (Westinghouse 2005-TN3242), which is certified in 10 CFR Part 52 (TN251), Appendix D. Westinghouse subsequently upgraded and updated the PRA model; however, Westinghouse reviewed the AP1000 probabilistic risk assessment for Revision 15 and concluded that the PRA remains valid for proposed revisions to the DCD (Westinghouse 2009-TN3243). The NRC staff evaluated the current PRA model and its results, using guidance in *Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications* (DC/COL-ISG-3) (NRC 2008-TN671), and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. FPL is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it would no longer use the bounding assumptions of the design-specific PRA.

FPL in its ER evaluation of the potential environmental consequences for the atmospheric and surface-water pathways (FPL 2014-TN4058) incorporates the results of the MELCOR Accident Consequence Code System (MACCS) computer code Version 1.13.1 (Chanin and Young 1998-TN66) run using AP1000 reactor source-term information and Turkey Point site-specific meteorological, population, and land-use data. FPL provided the NRC staff with copies of the input and output files for the MACCS computer runs (FPL 2014-TN3660). The NRC staff reviewed the files, ran confirmatory calculations, and determined that FPL's results are reasonable.

The MACCS computer code was developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG–1150 (NRC 1990-TN525). The MACCS code evaluates the consequences of atmospheric releases of radioactive material after a severe accident. The pathways modeled include exposure to the passing plume, exposure to radioactive material deposited on the ground and skin, inhalation of material in the passing plume and re-suspended from the ground, and ingestion of radioactively contaminated food and surface water.

Three types of severe accident consequences were assessed in the MACCS analysis: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS estimates both early fatalities and latent cancer fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990-TN526). Latent cancer fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within a 50 mi radius of the site. Economic costs of a severe accident include the costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual radioactive contamination after a severe accident. Farmland decontamination is an estimate of the area that has an average whole body dose rate for the 4-year period after the release that would be greater than 0.5 rem/yr if not reduced by decontamination and that would have a calculated dose rate after decontamination of less than 0.5 rem/yr. Decontaminated farmland is not necessarily suitable for farming.

Risk is the product of the frequency and the consequences of an accident. For example, the probability of a severe accident without loss of containment for an AP1000 reactor at the Turkey Point site is estimated to be 2.2×10^{-7} per reactor-year (Ryr), and the cumulative population dose associated with a severe accident without loss of containment at the Turkey Point site is calculated to be 18,182 person-rem. The population dose risk for this class of accidents is the product of 2.2×10^{-7}/Ryr and 18,182 person-rem, or 0.004 person-rem/Ryr.

The risks presented in the tables that follow are risks per year of reactor operation. FPL has submitted an application to construct and operate two AP1000 reactors at the Turkey Point site. The consequences of a severe accident would be the same regardless of whether one or two reactors were built at the site. If two reactors were built, the risks would apply to each reactor, and the total risk for the site would be approximately double the risk for a single reactor. The following sections discuss the estimated risks associated with each pathway.

5.11.2.1 Air Pathway

The MACCS code directly estimates consequences associated with releases to the air pathway. FPL used the MACCS code to estimate consequences to the population in 2080 based on meteorological data for 2002, 2005, and 2006. The 2002 meteorological data were used for most of the subsequent analyses because the data resulted in the largest consequence of the 3 years analyzed. The analysis assumed that 95 percent of the population was evacuated after the declaration of general emergency. The use of 95 percent of the population evacuated is conservative when it is compared to the general practice of using 99.5 percent for the fraction of the population assumed to be evacuated after the declaration of general emergency. An evacuation speed of 1 mph was assumed. The 1 mph evacuation speed was selected conservatively based on a study (KLD 2012-TN3244) conducted to estimate the evacuation time using expected traffic patterns during a general emergency.

The core damage frequencies (CDFs) given in Table 5-18 are for internally initiated accident sequences while the plant is at power. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. Estimates of the CDFs for externally initiated events and during shutdown are discussed later in Section 5.11.2.4.

The risks calculated from the results of the MACCS runs are also presented in Table 5-18. This table shows that the probability-weighted consequences (i.e., risk) of severe accidents for an AP1000 reactor located at Turkey Point site are small for all categories of risk considered. For perspective, Table 5-19 and Table 5-20 compare the health risks from severe accidents for an AP1000 reactor at the Turkey Point site with the risks for current-generation reactors at various sites and with the health risks for AP1000 reactors at the North Anna, Clinton, Grand Gulf, and Vogtle early site permit sites.

In Table 5-19, the health risks estimated for an AP1000 reactor at the Turkey Point site are compared with health-risk estimates for the five reactors considered in NUREG–1150 (NRC 1990-TN525). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG–1150 (NRC 1990-TN525), only internally initiated events are presented in Table 5-20. Table 5-20 also compares the health risks of an AP1000 reactor at the Turkey Point site with the health risks of an AP1000 reactor at four early site permit sites: North Anna (NRC 2006-TN7), Clinton (NRC 2006-TN672), Grand Gulf (NRC 2006-TN674), and Vogtle (NRC 2008-TN673).

Table 5-18. Mean Environmental Risks from AP1000 Reactor Severe Accidents at the Turkey Point Site

			Environmental Risk					
Release Category Description (Accident Class)		Core Damage Frequency (per Ryr)	Population Dose[(a)] (person-rem/Ryr)	Fatalities (per Ryr) Early[(b)]	Fatalities (per Ryr) Latent[(c)]	Cost[(d)] ($/Ryr)	Land Requiring Decontamination[(e)] (ac/Ryr)	Population Dose from Water Ingestion[(a,f)] (person-rem/Ryr)
IC	Intact containment	2.2×10^{-7}	4.0×10^{-3}	0.0	2.4×10^{-6}	0.78	1.6×10^{-7}	1.6×10^{-5}
BP	Containment bypass	1.1×10^{-8}	2.0×10^{-1}	3.0×10^{-7}	1.4×10^{-4}	497	2.8×10^{-4}	9.2×10^{-3}
CI	Containment isolation failure	1.3×10^{-9}	8.3×10^{-3}	1.3×10^{-9}	5.4×10^{-6}	18	1.3×10^{-5}	1.7×10^{-4}
CFE	Early containment failure	7.5×10^{-9}	5.0×10^{-2}	2.5×10^{-8}	3.4×10^{-5}	116	7.9×10^{-5}	1.3×10^{-3}
CFI	Intermediate containment failure	1.9×10^{-9}	1.5×10^{-3}	5.0×10^{-11}	9.9×10^{-7}	4.2	3.5×10^{-6}	1.6×10^{-4}
CFL	Late containment failure	3.5×10^{-13}	4.3×10^{-6}	0.0	2.7×10^{-9}	0.014	9.0×10^{-9}	3.3×10^{-9}
	Total	2.4×10^{-7}	2.7×10^{-1}	3.2×10^{-7}	1.8×10^{-4}	636	3.8×10^{-4}	1.1×10^{-2}

(a) To convert to person-Sv, divide by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990-TN526).
(c) Latent cancer fatalities are fatalities related to low doses or dose rates that could occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990-TN526).
(e) Land risk is farmland requiring decontamination prior to resumption of agricultural usage.
(f) The meteorology data of 2005 yielded the largest population dose from water ingestion that are noted in this column.

Source: FPL 2014-TN4058, Table 7.2-1

Table 5-19. Comparison of Environmental Risks for an AP1000 Reactor at the Turkey Point Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG−1150 and the AP1000 at Four Early Site Permit Sites[a]

	Core Damage Frequency (per Ryr)	50 mi Population Dose Risk (person-rem/Ryr)[b]	Fatalities per Ryr		Average Individual Fatality Risk per Ryr	
			Early	Latent	Early	Latent Cancer
Grand Gulf[c]	4.0×10^{-6}	$5 \times 10^{+1}$	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[c]	4.5×10^{-6}	$7 \times 10^{+2}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[c]	5.7×10^{-5}	$1 \times 10^{+3}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[c]	4.0×10^{-5}	$5 \times 10^{+2}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[c]	3.4×10^{-4}	$5 \times 10^{+3}$	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
AP1000[d] Reactor at the Turkey Point Site	2.4×10^{-7}	2.7×10^{-1}	3.2×10^{-7}	1.8×10^{-4}	2.0×10^{-10}	2.6×10^{-12}
AP1000[e] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}	1.2×10^{-10}	4.0×10^{-5}	2.6×10^{-13}	4.9×10^{-11}
AP1000[f] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}	1.4×10^{-8}	1.2×10^{-6}	6.4×10^{-13}	5.5×10^{-11}
AP1000 Reactor at Vogtle[g]	2.4×10^{-7}	2.8×10^{-2}	1.9×10^{-10}	1.9×10^{-5}	1.6×10^{-12}	1.1×10^{-11}
AP1000[h] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}	1.0×10^{-12}	6.9×10^{-6}	1.0×10^{-14}	2×10^{-11}

(a) NRC 1990-TN525.
(b) To convert to person-Sv, divide by 100.
(c) Risks were calculated using the MACCS code and presented in NUREG–1150 (NRC 1990-TN525).
(d) Calculated with MACCS code using Turkey Point site-specific input, Turkey Point Units 6 and 7 COL Application, Part 3 – Environmental Report (FPL 2014-TN4058, Table 7.2-1).
(e) NUREG–1811 (NRC 2006-TN7).
(f) NUREG–1815 (NRC 2006-TN672).
(g) NUREG–1872 (NRC 2008-TN673).
(h) NUREG–1817 (NRC 2006-TN674).

Table 5-20. Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for an AP1000 Reactor at the Turkey Point Site with Risks Initiated by Internal Events for Current Plants Undergoing Operating License Renewal Review and Environmental Risks of the AP1000 Reactor at Other Sites

	Core Damage Frequency (per yr)	80 km (50 mi) Population Dose Risk (person-rem/Ryr)[(a)]
Current Reactor Maximum[(b)]	2.6×10^{-4}	$9.5 \times 10^{+1}$
Current Reactor Mean[(b)]	2.7×10^{-5}	$2.0 \times 10^{+1}$
Current Reactor Median[(b)]	1.6×10^{-5}	$1.4 \times 10^{+1}$
Current Reactor Minimum[(b)]	1.9×10^{-6}	5.5×10^{-1}
AP1000[(c)] Reactor at the Turkey Point Site	2.4×10^{-7}	2.7×10^{-1}
AP1000[(d)] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}
AP1000[(e)] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}
AP1000[(f)] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}
AP1000[(g)] Reactor at Vogtle	2.4×10^{-7}	2.8×10^{-2}

(a) To convert to person-Sv, divide by 100.
(b) Based on MACCS calculations for over 70 current plants at over 40 sites.
(c) Calculated with MACCS code using Turkey Point site-specific input, Turkey Point Units 6 and 7 COL Application, Part 3 – Environmental Report (FPL 2014-TN4058, Table 7.2-1).
(d) NUREG–1811 (NRC 2006-TN7).
(e) NUREG–1815 (NRC 2006-TN672).
(f) NUREG–1817 (NRC 2006-TN674).
(g) NUREG–1872 (NRC 2008-TN673).

The last two columns of Table 5-19 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the staff compares these estimates to the safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (51 FR 30028) (TN594). These goals are presented here solely to provide a point of reference for the environmental analysis and do not serve the purpose of a safety analysis. The Safety Goal Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from a nuclear power plant operation as follows:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.
- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.

- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed," is about 4.0×10^{-4}/yr, including a 1.3×10^{-4}/yr risk associated with transportation accidents (NSC 2010-TN3240). One-tenth of 1 percent of these figures implies that the individual risk of prompt fatality from a reactor accident should be less than 4×10^{-7}/Ryr.
- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the United States, which is about 1 in 500 or 2×10^{-3}/yr (Reed 2007-TN523). One-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to 2×10^{6}/Ryr.
- MACCS computer code calculates average individual early and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1 mi of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 10 mi of the plant. For the plants considered in NUREG–1150 (NRC 1990-TN525), these risks were well below the Commission's safety goals. Risks calculated by FPL for the AP1000 reactor design at the Turkey Point site are lower than the risks associated with the current-generation reactors considered in NUREG–1150 (NRC 1990-TN525) and are well below the Commission's safety goals.

The NRC staff compared the CDF and population dose risk estimate for an AP1000 reactor at the Turkey Point site with statistics summarizing the results of contemporary severe accident analyses performed for over 70 reactors at over 40 sites. The results of these analyses are included in the final site-specific Supplements 1 through 51 to the *Generic Environmental Impact Statement (GEIS) for License Renewal* (NUREG–1437) (NRC 2013-TN2654), and in the ERs included with license renewal applications for those plants for which supplements have not been published. All of the analyses were completed after publication of NUREG–1150 (NRC 1990-TN525), and the analyses for most of the reactors used MACCS, which was released in 1997. Table 5-20 shows that the CDFs estimated for the AP1000 reactor are significantly lower than the CDFs of current-generation reactors. Similarly, the population doses estimated for an AP1000 reactor at the Turkey Point site are well below the mean and median values for current-generation reactors undergoing license renewal.

Finally, the population dose risk from a severe accident for an AP1000 reactor at the Turkey Point site (0.27 person-rem/Ryr) may be compared to the dose risk for normal operation of a single AP1000 reactor at the Turkey Point site (4.0 person-rem/Ryr; see Section 5.9.3.2). The risk associated with a severe accident is about 15 times lower than the risk associated with normal operations. Comparatively, the population dose risk associated with a severe accident is small.

5.11.2.2 Surface-Water Pathways

Surface-water pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water and include ingestion of water and aquatic foods as well as water submersion and activities occurring near the water. Of these surface-water pathways, the ingestion of contaminated water was evaluated by MACCS code (Chanin and Young 1998-TN66). The risks associated with this surface-water pathway calculated for the Turkey Point site are included in the last columns of Table 5-18. The water-ingestion dose risk of 1.1×10^{-2} person-rem/Ryr is small compared to the total population dose risk of 0.27 person-rem/Ryr (FPL 2014-TN4058).

Although surface-water pathways beyond water ingestion are not considered in the MACCS code, they have been examined in the GEIS for license renewal in the context of renewal of licenses for current-generation reactors. Environmental consequences of potential surface-water pathways related to immersion, which involves swimming, fishing, boating, and performing activities near the shoreline, are not modeled by MACCS. FPL relied on generic analyses in the GEIS (NRC 2013-TN2654) for the immersion pathway. The GEIS (NRC 2013-TN2654) reiterates conclusions set forth in the *Final Environmental Statement Related to the Operation of Enrico Fermi Atomic Power Plant, Unit No. 2* (NUREG–0769) (NRC 1981-TN675) that indicate doses from shoreline activities and swimming are smaller than either water-ingestion doses or aquatic food ingestion doses.

For sites near large waterbodies, the NRC evaluated doses from the aquatic food pathway (fishing) for the current nuclear fleet discharging to various bodies of water in the GEIS (NRC 2013-TN2654). The NRC evaluation concluded that with interdiction, the risk associated with the aquatic food pathway is SMALL relative to the atmospheric pathway for most sites and essentially the same as the atmospheric pathway for the few sites with large annual aquatic food harvests. The new plant atmospheric pathway doses are lower than those of the current U.S. nuclear fleet; therefore, the doses from surface-water sources are consistently lower for the new plant as well.

FPL used the National Marine Fisheries Service database to determine the amount of commercial fish harvested for Hope Creek, Calvert Cliffs, and Turkey Point sites for the year 2010 (FPL 2010-TN1365). The amount of fish commercially harvested on the Florida east coast was 27,459,579 lb compared to 47,333,206 lb for the Chesapeake Bay area. FPL estimated that the expected uninterdicted aquatic food exposure pathway dose risk for the Turkey Points site would be lower than the uninterdicted aquatic food exposure pathway dose at the Calvert Cliff site. The NRC staff therefore agrees that the use of the Calvert Cliff site as a surrogate for the aquatic food exposure pathway is a reasonable assumption.

The NRC staff expects the actual dose rate to be a factor of 2 to 10 times smaller due to interdiction of contaminated food (NRC 2013-TN2654). The NRC staff also expects, because the AP1000 atmospheric exposure pathway doses are lower than those of the existing licensed power reactors, it is reasonable to conclude that the doses from surface-water sources would be considerably lower than those reported above for the surface-water exposure pathway. On this basis, the NRC staff believes that the overall surface-water pathway risk remains small when compared to the total population dose risk from all sources.

5.11.2.3 Groundwater Pathway

The groundwater pathway involves a reactor core melt, reactor vessel failure, and penetration of the floor (basemat) below the reactor vessel. Ultimately, core debris could reach the groundwater where soluble radionuclides are transported with the groundwater. In the GEIS (NRC 2013-TN2654), the NRC staff assumes a 1×10^{-4}/Ryr probability of occurrence of a severe accident with a basemat melt-through leading to potential groundwater contamination, and concludes that groundwater contribution to risk is generally a small fraction of the risk attributable to the atmospheric pathway. The FPL ER (FPL 2014-TN4058) summarizes the discussion in NUREG–1437 (NRC 2013-TN2654) and reaches the same conclusion.

The NRC staff has reevaluated its assumption of a 1×10^{-4}/Ryr probability of a basemat melt-through. The NRC staff believes that the 1×10^{-4} probability is too large for new plants. Design elements have been included in the AP1000 reactor design to minimize the potential for reactor core debris to reach groundwater. These elements include external reactor vessel cooling and ex-vessel core debris cooling. Further, the probability of core melt with a basemat melt-through should be no larger than the total CDF estimate for the reactor. Table 5-18 gives a total CDF estimate of 2.4×10^{-7}/Ryr for the AP1000 reactor. NUREG–1150 (NRC 1990-TN525) indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. If the CDFs for AP1000 severe accidents in which containment remains intact are subtracted from the total AP1000 CDF to get the CDF for severe accidents in which basemat melt-through is a possibility, the CDF is on the order of 2×10^{-8}/Ryr. On this basis, the NRC staff believes that a basemat melt-through probability of 2×10^{-8}/Ryr is reasonable and still conservative. The groundwater pathway is also more tortuous and affords more time for implementing protective actions than the air pathway and, therefore, results in a lower risk to the public. As a result, the NRC staff concludes that the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on the overall plant risk.

5.11.2.4 Externally Initiated Events

The analyses described above are specifically for internally initiated events. FPL's ER Revision 6 (FPL 2014-TN4058) also addresses potential consequences from externally initiated events consistent with the Turkey Point Units 6 and 7 COL FSAR, Revision 7 (FPL 2015-TN4502). FPL's approach is to qualitatively estimate the total event core damage frequency (internal and external events), which is approximately double the internal event core damage frequency. Application of such an external events multiplier would approximately double the resulting dose-risk or cost-risk. The review team considered these consequences, which are similar to the consequences of internal severe accidents, in evaluating the risks of external severe accidents in light of their probabilities, as set forth below, and as a contributor to the SAMDA evaluation. The AP1000 reactor vendor and the NRC have addressed three externally initiated events during initial design certification of the AP1000 reactor: (1) seismic, (2) internal fire, and (3) internal flooding events. The results of these analyses are described in Section 19.1.5 of the FSER for Revision 15 of the AP1000 DCD (NRC 2004-TN3253). While amending the certified design, the seismic hazard was reevaluated and the seismic margin analysis was revised. The results are described in Revision 19 of the AP1000 DCD (Westinghouse 2011-TN261). The NRC staff's evaluation is documented in Section 19.1.5 of Supplement 2 to the AP1000 FSER

(NRC 2011-TN2479). In addition, high winds, external flooding, transportation-related events, and potential hazards from nearby industrial facilities were assessed. The NRC staff's evaluation is documented in Sections 19.1.5.4 through 19.1.5.7 of the same supplement.

With respect to seismic events, the AP1000 reactor vendor performed a PRA-based seismic margin analysis. This analysis indicated that there is a high confidence (95 percent) that safety systems and components would survive a seismic event with a peak ground acceleration of 0.5 g. The safe-shutdown earthquake for the AP1000 reactor design is 0.3 g. Consequently, the NRC staff concluded in the FSER that the AP1000 reactor design is acceptable (NRC 2004-TN3253). After re-evaluating the seismic hazard for the amended design and for a spectrum of site characteristics ranging from soft soil to hard rock and updating the PRA-based seismic margin analysis, the applicant reported the same results for the amended design. Consequently, the NRC staff concluded that the amended design is acceptable (NRC 2011-TN2479). FPL reported the same results for the amended design. The NRC staff reviewed and evaluated FPL's results to ensure they meet all applicable regulatory requirements (NRC 2016-TN4805). The NRC staff considers it unlikely for the site-specific evaluation to differ from the AP1000 conclusions.

With respect to other external events, the applicant found that the risks are negligible. For high winds, the annual CDF was determined not to exceed 1×10^{-8} per year, and a more detailed analysis was not required. Similarly, the design basis flood elevation (24.8 ft) is below the design plant grade (26.0 ft), and no further evaluation of accidents resulting from external floods is required.

With respect to internal fires, the AP1000 reactor vendor estimated the fire-induced CDF to be about 5.6×10^{-8}/yr during power operation and about 8×10^{-8}/yr during shutdown, and considers these estimates to be conservative. While the NRC staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, concluded that the AP1000 reactor design is capable of withstanding severe accident challenges from internal fires in a manner superior to most, if not all, operating plant designs (NRC 2011-TN2479). The applicant reaches similar conclusions for the other external hazards, as summarized in Chapter 19 of the Turkey Point Units 6 and 7 COL FSAR, Revision 7 (FPL 2015-TN4502).

With respect to internal flooding, the AP1000 reactor vendor did not perform a detailed PRA to assess the risk from internal flooding. Instead, the vendor performed an internal flooding PRA commensurate with the level of detail available and, where detailed information was not available, made conservative assumptions to bound the flooding analysis. In its safety review, the NRC staff found that this analysis was adequate to identify potential vulnerabilities and to lend insight into the design that could be used to support design-certification requirements. Quantification of potential scenarios with the plant at power resulted in a total CDF from internal floods of about 1×10^{-9}/yr. The CDF from internal floods when the plant is shutdown is estimated to be about 3.2×10^{-9}/yr. The vendor considers these estimates to be conservative. While the NRC staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, concluded that the AP1000 reactor design is capable of withstanding severe accident challenges from internal floods in a manner superior to operating plants and is consistent with the conclusions from the vendor's internal flood risk analysis (NRC 2011-TN2479).

With respect to high winds, the AP1000 reactor vendor considered extratropical cyclones, hurricanes up to Category 5 on the Saffir-Simpson scale, and tornadoes up to EF5 on the enhanced Fujita scale. The total contribution of high winds to CDF was reported to be 1.38×10^{-8}/yr by the AP1000 reactor vendor (Westinghouse 2011-TN261), assuming that only safety systems are available. The more detailed analysis in the Turkey Point Units 6 and 7 COL FSAR, Revision 7 (FPL 2015-TN4502) also estimated CDF probability from high wind on the order of 1.0×10^{-8}/yr. The NRC staff reviewed and evaluated FPL's results to ensure they meet all applicable regulatory requirements (NRC 2016-TN4805). The NRC staff considers it unlikely for the site-specific evaluation to differ from the AP1000 conclusions.

With respect to external flooding, the AP1000 reactor vendor considered all sources of flooding that could occur at any site and concluded that, as long as floodwaters did not rise to the level of the plant grade, there would be no contribution to CDF. More detail evaluation of external flooding at Turkey Point site also confirmed that the flood level at probable maximum precipitation will be below the plant grade. As noted in the Turkey Point Units 6 and 7 COL FSAR, Revision 7 (FPL 2015-TN4502),

> …flood levels at Turkey Point Units 6 & 7 during severe storms, such as the PMP [probable maximum precipitation] event, would be controlled by storm tides in the Biscayne Bay because Turkey Point Units 6 & 7 are located on the Biscayne Bay shoreline and there are no major streams or rivers nearby. As a result, a detailed modeling analysis to determine the flood levels from PMF [probable maximum flood] on streams and rivers was not performed for Turkey Point Units 6 & 7.

The NRC staff reviewed and evaluated FPL's results to ensure they meet all applicable regulatory requirements (NRC 2016-TN4775). The NRC staff considers it unlikely for the site-specific evaluation to differ from the AP1000 conclusions with respect to external flooding.

With respect to all other hazards related to transportation and nearby industrial activities, the risks from accidents are addressed by the AP1000 reactor vendor in a generic but bounding manner. These accidents have also been addressed as a part of Chapter 19 and Chapter 2 of the Turkey Point Units 6 and 7 COL FSAR, Revision 7 (FPL 2015-TN4502), and FPL found them to be highly unlikely or to have an insignificant contribution to CDF; therefore, they were screened out. The NRC staff reviewed FPL's results to ensure they meet all applicable regulatory requirements (NRC 2016-TN4775, NRC 2016-TN4805).

The NRC staff considers it unlikely for the site-specific evaluation for these other hazards to differ from the AP1000 conclusions.

5.11.2.5 Summary of Severe Accident Impacts

The FPL application refers to Revision 19 of the AP1000 reactor certified design (10 CFR Part 52) [TN251], Appendix D). The consequence assessment is based on the PRA for Revision 15 of the AP1000 design (Westinghouse 2005-TN3242). Westinghouse subsequently upgraded and updated the PRA; however, Westinghouse reviewed the AP1000 PRA report submitted with Revision 15 of the DCD and concluded that the reported results and insights remain valid for proposed revisions of the DCD (Westinghouse 2010-TN3251). The NRC staff evaluated the current PRA model and its results, using guidance in *Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications* (DC/COL-ISG-3)

(NRC 2008-TN671), and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. FPL is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA. The NRC staff considers it unlikely that the PRA would change sufficiently to cause the NRC staff to materially change its conclusions related to severe accident risks.

The NRC staff reviewed the risk analyses in the ER (FPL 2014-TN4058) and conducted a confirmatory analysis of the probability-weighted consequences of severe accidents for proposed Turkey Point Units 6 and 7 using the MACCS code. The results of both the FPL analysis and the NRC staff analysis indicate that the environmental risks associated with severe accidents if an AP1000 reactor were to be located at the Turkey Point site would be small compared to risks associated with operation of the current-generation reactors at the Turkey Point site (e.g., Units 3 and 4) and other sites. These risks are below the NRC safety goals. On these bases, the NRC staff concludes that the environmental impact of the probability-weighted consequences of severe accidents at the Turkey Point site would be SMALL for the proposed AP1000 reactors.

5.11.3 Severe Accident Mitigation Alternatives

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to determine whether there are severe accident mitigation design alternatives (SAMDAs), procedural modifications, or training activities that can be justified to further reduce the risks of severe accidents (NRC 2000-TN614). FPL based its COL application on the AP1000 reactor design (see 10 CFR Part 52 [TN251], Appendix D – Design Certification Rule for the AP1000 Design), which incorporates many features intended to reduce CDFs and the risks associated with severe accidents. The effectiveness of the AP1000 reactor design features is evident in Table 5-19 and Table 5-20, which compare CDFs and severe accident risks for the AP1000 reactor with CDFs and risks for current-generation reactors. The CDFs and risks have generally been reduced considerably when compared to the existing current-generation reactors.

Consistent with the direction from the Commission to consider the SAMDAs at the time of initial certification, the AP1000 reactor vendor (Westinghouse 2005-TN3242) and the NRC staff (NRC 2004-TN3253; NRC 2005-TN3252) considered a number of design alternatives for an AP1000 reactor at a generic site. The conclusion of the NRC staff's review was as follows:

> … none of the potential design modifications evaluated are justified on the basis of benefit-cost considerations. The NRC further concludes that it is unlikely that any other design changes would be justified in the future on the basis of person-rem exposure because the estimated CDFs are very low on an absolute scale.

Westinghouse reviewed the AP1000 PRA for Revision 15 and concluded that the PRA remains valid for the revision of the DCD (Westinghouse 2010-TN3251); this conclusion is unchanged for subsequent revisions through Revision 19 (Westinghouse 2011-TN261). Furthermore, the NRC staff evaluated the current PRA, using guidance in *Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications*

(DC/COL-ISG-3) (NRC 2008-TN671), and concluded that the PRA submitted with Revision 15 is a conservative and acceptable basis for evaluating severe accidents and strategies for mitigating them. Therefore, the NRC staff considers the PRA for DCD Revision 15 to be an adequate basis for a SAMDA analysis for an application referencing DCD Revision 19. Consequently, the NRC staff incorporates by reference the environmental assessment accompanying the design-certification rulemaking for Appendix D to 10 CFR Part 52 (TN251) (NRC 2006-TN7; NRC 2006-TN672; NRC 2006-TN674).

Section 5.11.2 presents the environmental risks from various classes of severe accidents for the Turkey Point site. Site-specific information appears in SAMDA evaluations as population dose risk (person-rem/Ryr) and offsite economic costs ($/Ryr). The staff considers these two elements to be the appropriate metrics to use to determine whether the site characteristics are bounded by the site parameters because they are calculated from the site-specific meteorology, population distribution, and land-use data. Appendix 1B of the AP1000 DCD (Westinghouse 2011-TN261) lists the population dose risk (person-rem/Ryr) used in the DCD generic SAMDA review. While it does not list the offsite economic costs, it does include a maximum attainable benefit that considers offsite economic costs, onsite exposure costs, onsite cleanup costs, and replacement power costs, in addition to the cost associated with the offsite population dose risk. To perform a like-kind comparison, the NRC staff used the maximum attainable benefit-cost for Turkey Point site. The DCD probability-weighted, mean population dose risks from Table 1B-1 in Appendix 1B and the base-case maximum attainable benefit listed in Table 1B-4 are the metrics used by the NRC staff to determine whether the Turkey Point site characteristics are within the site parameters specified in Appendix 1B of the AP1000 DCD (Westinghouse 2011-TN261).

Table 5-21 presents a comparison of Turkey Point site-specific values (FPL 2014-TN4058) with the generic values from Appendix 1B of the AP1000 DCD (Westinghouse 2008-TN496). Table 5-21 shows that the population dose risk for the Turkey Point site is approximately 6 times larger than the DCD Appendix 1B value, while the maximum attainable benefit for the Turkey Point site is approximately 2 to 3 times greater than the DCD Appendix 1B value. The population dose risk and the maximum attainable benefit are higher than the value reported in DCD Appendix 1B because of the large population of the surrounding areas of Turkey Point site. The NRC staff confirmed these assertions by examining the population and the property value estimates from the latest census data of 2010 and the results of case runs made by using the latest version of SECPOP 2010 software (NRC 2003 (NUREG/CR-6525); Bixler et al. 2003-TN3636). The NRC staff also examined the sensitivity of the maximum attainable benefit at the Turkey Point site to a higher plant capacity factor in replacement power costs and higher property values surrounding the Turkey Point site.

The generic AP1000 SAMDA analysis is presented in Appendix 1B of the DCD (Westinghouse 2011-TN261). Design alternatives considered by Westinghouse and their estimated implementation costs are presented in Table 5-22 (Westinghouse 2011-TN261, Table 1B-5). In the base-case analysis, the benefit-cost methodology of NUREG/BR-0184 (NRC 1997-TN676) is used to calculate the maximum attainable benefit. The analysis assumes that the implementation of the design alternative completely eliminates all potential for core damage. For the AP1000, the maximum attainable benefit was valued at $21,000 (Westinghouse 2011-TN261, Appendix 1B, Section 1B.1.8). Only one design alternative in

Table 5-22—the self-actuating containment isolation valves—has a cost ($33,000) comparable to the maximum attainable benefit. To evaluate the benefit of this SAMDA, the design change was assumed to eliminate the Containment Isolation severe accident release category, which is only a small contributor to the total CDF. Therefore, this design alternative provides almost no benefit in reducing the AP1000 CDF.

Table 5-21. Comparison of the Turkey Point Site SAMDA Characteristics with Parameters Specified in Appendix 1B of the AP1000 DCD

	Population Dose Risk, Person-rem/Ryr	Maximum Attainable Benefit
DCD Appendix 1B (internal events)	4.3×10^{-2}	$21,000
Turkey Point site (internal events)	2.7×10^{-1}	$55,513
Turkey Point site risk as fraction of DCD risk (%)	628	264

Source: FPL 2014-TN4058, Table 7.2-2

Table 5-22. Alternatives Considered for the SAMDA in the AP1000 DCD

No.	Design Alternative	Cost ($)
1	Upgrade chemical, volume, and control system for small loss-of-coolant accident	1,500,000
2	Containment filtered vent	5,000,000
3	Self-actuating containment isolation valves	33,000
4	Safety grade passive containment spray	3,900,000
6	Steam generator shell-side heat removal	1,300,000
7	Steam generator relief flow to in-containment refueling water storage tank (IRWST)	620,000
8	Increased steam generator pressure capability	8,200,000
9	Secondary containment ventilation with filtration	2,200,000
10	Diverse IRWST injection valves	570,000
12	Ex-vessel core catcher	1,660,000
13	High-pressure containment design	50,000,000
14	More reliable diverse actuation system	470,000

Source: Westinghouse 2011-TN261, Table 1B-5.

For SAMDA analysis, the base-case CDF, dose risk, and cost risk for internal events were escalated to account for external events, both at power and at shutdown, by using the ratio of the total annual CDF to the annual CDF from internal events $(5.0 \times 10^{-7})/(2.40 \times 10^{-7})$. The monetized value for reducing the base-case CDF to zero for an AP1000 reactor at the Turkey Point site was estimated. The basic assumptions used in monetizing the accident risk were consistent with those delineated in NUREG/BR-0184 (NRC 1997-TN676), such as $2,000 per person-rem for internal and external dose estimated by MACCS code, 60-year plant life, and the 1993 economic discount rates.

The FPL ER (FPL 2014-TN4058) updates the SAMDA analysis conducted for AP1000 design certification using the results of the Turkey Point site-specific consequence analysis (MACCS) discussed in Section 7.2 of the ER and Section 5.11.2 of this EIS. The results of the FPL analysis indicate that the maximum potential benefit if the total risk for the AP1000 at Turkey Point site could be reduced to zero has a value of about $55,513. Similar to the finding in the AP1000 DCD SAMDA analysis, only the self-actuating containment isolation valves design alternative (Table 5-22) has a value comparable to the maximum attainable benefit for the Turkey Point site. To evaluate the maximum benefit of implementing this SAMDA, it was assumed that the Containment Isolation severe accident release category would be eliminated and its contribution would be added to the Intact Containment release category. The frequency contribution of failure of Containment Isolation severe accident release category is small, as shown in Table 5-14. Therefore, the benefit associated with the implementation of this SAMDA is only $994 (FPL 2014-TN4058). Table 5-22 identifies the cost associated with various design alternatives considered for SAMDA in the AP1000 DCD.

In a Commission ruling in the Indian Point license renewal proceeding, the Commission required sensitivity analyses regarding two MACCS decontamination input parameter values in the context of the severe accident mitigation alternative (SAMA) evaluation. *See Entergy Nuclear Operations, Inc.*, (Indian Point Nuclear Generating Units 2 and 3), CLI-16-07, 83 NRC ___ (May 4, 2016) (NRC 2016-TN4631). In view of the Commission decision in CLI-16-07, the staff determined that a sensitivity study would be appropriate for the Turkey Point Units 6 and 7 COL SAMDA assessments. The two MACCS input parameters are decontamination cost of non-farmland (CNDFRM) and decontamination duration (TIMDEC). The staff performed this sensitivity study as described in Appendix G, Section G.4. The sensitivity study accounts for higher input parameter values as described in Appendix G, and the results demonstrate that the original staff conclusion that no SAMDA is cost-beneficial set forth in the draft EIS remains valid.

FPL is required by regulation to update the PRA prior to fuel loading. The NRC staff expects the site-specific PRA to be more realistic than the generic (design-specific) PRA, which uses bounding assumptions. The NRC staff considers it unlikely that the PRA would change sufficiently to cause the NRC staff to conclude that any SAMDA considered in the design-certification process would become cost-beneficial.

The SAMDA issue is a subset of the SAMA review. FPL has not yet addressed the other attributes of the SAMA review (i.e., procedural modifications and training activities). However, FPL has stated that risk insights would be considered in the development of plant procedures and training (FPL 2014-TN4058). Because the maximum attainable benefit is relatively low, a SAMA based on procedures or training for an AP1000 reactor at the Turkey Point site would almost have to eliminate risk entirely to become cost-beneficial. Based on its evaluation, the NRC staff concludes that it is unlikely that any of the SAMAs based on procedures or training would reduce the CDF or risk sufficiently. Therefore, the staff further concludes it is unlikely that these SAMAs would be cost-effective. The NRC staff considers it to be unlikely for the site-specific PRA results to change sufficiently to cause any of the SAMDAs that are considered in the design-certification process to become cost-beneficial. In addition, based on statements by FPL in the ER (FPL 2014-TN4058), the staff expects that FPL will consider risk insights in the development of procedures and training. However, this expectation is not crucial to the staff’s conclusions because the staff already concluded procedural and training SAMAs would be unlikely to be cost-effective. Therefore, the NRC staff concludes that SAMAs have been appropriately considered.

5.11.4 Summary of Postulated Accident Impacts

The NRC staff evaluated the environmental impacts from DBAs and severe accidents for an AP1000 at the Turkey Point site. Based on the information provided by FPL and NRC's own independent review, the NRC staff concludes that the potential environmental impacts (risks) from a postulated accident from the operation of the proposed Turkey Point Units 6 and 7 would be SMALL, and no further mitigation would be warranted.

5.12 Measures and Controls to Limit Adverse Impacts during Operation

In its evaluation of environmental impacts during operation of proposed Turkey Point Units 6 and 7, the review team relied on FPL's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts;
- compliance with applicable requirements of permits or licenses required for operation of the new units (e.g., NPDES permit);
- compliance with existing Turkey Point Units 1–5 processes and/or procedures applicable to proposed Units 6 and 7 environmental compliance activities for the Turkey Point site;
- compliance with FDEP final Conditions of Certification; and
- implementation of BMPs.

The review team considered these measures and controls in its evaluation of the impacts of plant operation. Table 5-23, which is the staff's adaptation from sections of FPL's ER Table 5.10-1 (FPL 2014-TN4058), lists a summary of measures and controls to limit adverse impacts during operation proposed by FPL.

Table 5-23. Summary of Proposed Measures and Controls to Limit Adverse Impacts during Operation

Impact Category	Specific Measures and Control
Land-Use Impacts	
The Site and Vicinity	FPL did not propose any additional measures or controls.
Transmission Line Corridors and Offsite Areas	**Environmental impacts of T-Lines:** **Terrestrial** – Maintenance procedures have previously been established. Consultations would be held with appropriate Federal, State, and local agencies about mitigation actions for the known populations of multiple threatened and endangered species, as needed. **Aquatic** – Environmental Best Management Practices (BMPs) would be used to reduce soil erosion and sedimentation. Corridor vegetation-management and line-maintenance programs and procedures have been established to minimize impacts. The same procedures establish strict guidelines for use of herbicides application according to Federal, State, and local regulations. In addition, environmental BMPs would be used to reduce soil erosion and sedimentation vegetation management in forested wetlands would be in full compliance with Florida Statute 403.814 General Permits.

Table 5-23. (contd)

Impact Category	Specific Measures and Control
Water-Related Impacts	
Water-Use Impacts	A monitoring well system would be installed near the location of the RCW caissons that would be used to monitor the groundwater elevation and quality during operation of the radial collector wells.
Water-Quality Impacts	The use of environmental BMPs along with a spill prevention plan would prevent or minimize the potential impacts of sediment transport or releases to the environment. Monitoring wells could be installed and used to monitor the groundwater level and water quality inshore of the radial collector well locations. Environmental BMPs and a spill prevention plan would be used to minimize and prevent impacts. Any minor spills of diesel fuel, hydraulic fluid, lubricants, or other pollutants would be cleaned up quickly to prevent them from moving into the groundwater. Mitigation for water quality would not be warranted beyond the FDEP final Conditions of Certification.
Ecological Impacts	
Terrestrial Ecosystems	Light pollution during facility operation could affect wildlife residing on or migrating through the Turkey Point site. Possible mitigation measures include minimizing upward lighting, reduced lighting from 11 p.m. to sunrise, providing light only where needed. Vegetation control for transmission line maintenance would follow a site-specific maintenance program that accounts for local conditions and resources. Herbicide use would be in accordance with manufacturer specifications and carried out by licensed applicators. Stormwater from the newly developed facilities could affect local resources. Mitigation includes use of retention basins and oil-water separation and riprap aprons. Cooling-tower noise could affect local wildlife. Splash guards and stacks on mechanical fans would reduce and divert noise. Uncertainty exists regarding the potential for increased vehicle collision mortality to sensitive species. Roads developed during construction would be returned to previous condition. Unavoidable wetland impacts would be mitigated in compliance with Federal and State permitting processes. FPL has drafted a mitigation plan that would compensate for the loss or impairment of wetland functions affected by operation of the Turkey Point site and the associated offsite facilities. FPL has committed to developing a final wetland mitigation plan that would provide at least as many Uniform Mitigation Assessment Methodology functional lift units as the actual Turkey Point site project losses incurred. A Condition of Certification by the Florida Department of Environmental Protection would require protocol surveys for listed species (excluding plants) that may occur on the Turkey Point site and associated offsite facilities prior to land "clearing and construction." If listed species are detected and operational impacts cannot be avoided, appropriate mitigation may be

Table 5-23. (contd)

Impact Category	Specific Measures and Control
	required on a case-by-case basis as determined through consultation with the Florida Fish and Wildlife Conservation Commission.
	Uncertainty exists regarding potential wood stork mortality and loss of foraging from transmission line operation. FPL would fund a Mitigation Effectiveness Study to determine mortality from collision with transmission lines and loss of foraging habitat within core foraging areas.
Aquatic Ecosystems	Environmental BMPs would be used to reduce to minimize impacts on onsite and offsite aquatic resources, including listed species and the Mangrove Rivulus, a State and Federal Species of Special Concern. Transmission line corridor vegetation-management and line-maintenance programs and procedures would also be employed by FPL to minimize impacts. These procedures would include adherence to strict guidelines established by Federal, State, and local resource agencies regarding the use of herbicides.
Socioeconomic Impacts	
Physical Impacts	FPL would improve roads and control speed limits to minimize noise impacts.
	FPL would comply with the State of Florida PSD permit limits and regulations for operating air emission sources.
Social and Economic Impacts	FPL would communicate with local and regional governmental and nongovernmental organizations to disseminate project information and enable organizations to plan accordingly for changes in land-use patterns, housing markets, water and wastewater demand and public school enrollment.
Environmental Justice Impacts	No mitigating measures or controls are considered to be required.
Historic and Cultural Resources Impacts	FPL would develop an unanticipated discovery plan for the treatment of cultural resources inadvertently discovered during operation activities, such as maintenance.
Air-Quality Impacts	Obtain air permits, operate systems within permit limits, and monitor emissions as required.
Radiological Impacts of Normal Operation	
Radiation Doses to Members of the Public	The radiological monitoring program requires that radiological releases be monitored. If conditions warrant, the pertinent operating/control procedures would be enacted.
Occupational Doses	The radiological monitoring program requires that radiological releases be monitored. If conditions warrant, the pertinent operating/control procedures would be enacted. Transportation impact – For workers whose job functions have the risk of large exposures, the radiological protection programs are configured to limit and manage those doses.
Radiation Doses to Biota Other than Humans	The radiological monitoring program requires that radiological releases be monitored. If conditions warrant, the pertinent operating/control procedures would be enacted.

Table 5-23. (contd)

Impact Category	Specific Measures and Control
Nonradioactive Waste Impacts	
Nonradioactive Waste System Impacts	Proposed practices for recycling, minimizing, managing, and disposing of wastes and the requirement to obtain regulatory approvals for waste disposal and discharges would help minimize impacts from waste generation.
Mixed-Waste Impacts	Mixed waste would be handled and managed in accordance with the applicable Federal, State, and local requirements. The packaged waste would be stored in the auxiliary and radwaste buildings until being shipped offsite to a licensed disposal facility.
Impacts of Postulated Accidents	
Design Basis Accidents	The calculated dose consequences of design basis accidents for an AP1000 were found to be within regulatory limits.
Severe Accidents	The calculated probability-weighted consequences of severe accidents for the AP1000 at the Turkey Point site were found to be lower than the probability-weighted consequences for current operating reactors and the Commission's reactor safety goals.
Nonradiological Health Impacts	• Monitor and maintain reclaimed water (i.e., tertiary) treatment facility to minimize levels of microbial and chemical agents in the cooling tower and condenser. • Comply with OSHA standards for Turkey Point operational workers. • Monitor the release of nonradiological waste emissions and effluents.

5.13 Summary of Operational Impacts

The review team's evaluation of the environmental impacts of operations of proposed Turkey Point Units 6 and 7 is summarized in Table 5-24. Impact levels are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts. Socioeconomic categories for which the impacts are likely to be beneficial are noted as such in the Impact Level column.

Table 5-24. Summary of Operational Impacts for the Proposed Turkey Point Units 6 and 7

Category	Comments	Impact Level
Land-Use Impacts	Operational activities would be compatible with other land uses on the Turkey Point site. Operation and maintenance of transmission lines in urban areas and near National Parks could pose land-use compatibility issues.	MODERATE
Water-Related Impacts		
Water Use – Surface Water	Operational activities would have negligible impacts on surface-water availability.	SMALL

Table 5-24. (contd)

Category	Comments	Impact Level
Water Use – Groundwater	Operational activities would have negligible impacts on groundwater availability because the primary source of cooling water would be reclaimed wastewater. The backup water supply (radial collector wells) would be used infrequently (60 d/yr or less) so the impact of the backup water-supply system on groundwater availability would also be SMALL.	SMALL
Water Quality – Surface Water	Operational activities would have negligible impacts on surface-water quality.	SMALL
Water Quality – Groundwater	Operational activities would have negligible impacts on groundwater quality.	SMALL
Ecological Impacts		
Terrestrial Ecosystems	Operational activities have the potential of increased vehicle collision mortality to the Florida panther, vegetation-control effects on listed plants, and transmission-system impacts on wood storks and Everglade snail kites.	MODERATE
Aquatic Ecosystems	During permitted radial collector well operation (60 d/yr or less), there would be no noticeable change in salinity above or below normal background variation. The use of reclaimed water from Miami-Dade County to operate the cooling system would not result in noticeable impacts on onsite and offsite aquatic resources.	SMALL
Socioeconomic Impacts		
Physical	Physical impacts of operations on workers and the local public, buildings, and aesthetics near the Turkey Point site would be SMALL.	SMALL
Demography	Demographic impacts of operation in Miami-Dade County would be SMALL.	SMALL
Economic Impacts on Community	The economic impacts of operating Turkey Point Units 6 and 7 would be SMALL and beneficial in Miami-Dade County as well as in Homestead and Florida City.	SMALL and Beneficial
Infrastructure and Community Services	The operational impacts on the regional infrastructure and community services would be SMALL with the exception of impacts on traffic, which would be MODERATE.	SMALL to MODERATE

Table 5-24. (contd)

Category	Comments	Impact Level
Environmental Justice Impacts	No environmental pathways or health and other preconditions of the minority and low-income populations were found that would lead to disproportionately high and adverse impacts.	NONE[(a)]
Historic and Cultural Resources Impacts	Based on (1) no known significant cultural resources within the Areas of Potential Effect, (2) the review team's cultural resource analysis and consultation, (3) FPL's commitment to develop procedures that would be in place if ground-disturbing or maintenance activities discover historic or cultural resources, and (4) the NRC's and FPL's consultation with the Florida SHPO that concluded a finding of "no historic properties affected" (FDHR 2010-TN1455; FPL 2014-TN4058), the review team concludes that the impacts from operation would be SMALL.	SMALL
Meteorological and Air-Quality Impacts	The impacts of operating proposed Units 6 and 7 on air quality from emissions of criteria pollutants, CO_2 emissions, and cooling-system emissions would be SMALL and warrant no further mitigation.	SMALL
Nonradiological Health Impacts	Risks from etiological and chemical agents would be minimal. Noise impacts would be minimal, complying with all Federal, State, and County regulations. Occupational safety and health impacts would be limited by compliance with OSHA standards. Acute effects of electromagnetic fields would be avoided by compliance with National Electrical Safety Code standards. Transportation impacts would be minimal.	SMALL
Radiological Health Impacts		
Members of Public	Doses to members of the public would be below NRC and U.S. Environmental Protection Agency standards and there would be no observable health impacts (10 CFR Part 20 [TN283], Appendix I to 10 CFR Part 50 [TN249], 40 CFR Part 190 [TN739]).	SMALL
Plant Workers	Occupational doses to plant workers would be below NRC standards and a program to maintain doses as low as reasonably achievable would be implemented.	SMALL
Biota Other than Humans	Doses to biota other than humans would be well below National Council on Radiation Protection and Measurements and International Atomic Energy Agency guidelines.	SMALL

Table 5-24. (contd)

Category	Comments	Impact Level
Nonradioactive Waste Impacts	Proposed practices for recycling, minimizing, managing, and disposing of wastes and the requirement to obtain regulatory approvals for waste disposal and discharges would help minimize impacts from waste generation at Turkey Point Units 6 and 7.	SMALL
Impacts of Postulated Accidents		
Design Basis Accidents	Impacts of design basis accidents would be well below regulatory limits.	SMALL
Severe Accidents	Probability-weighted consequences of severe accidents would be lower than the probability-weighted consequences for currently operating reactors.	SMALL

(a) A determination of "NONE" for Environmental Justice analyses does not mean there are no adverse impacts on minority or low-income populations from the proposed project. Instead, an indication of "NONE" means that while there are adverse impacts, those impacts do not affect minority or low-income populations in any disproportionate manner, relative to the general population.

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 Turkey Point Nuclear Power Plant (Turkey Point) Units 6 and 7 in Miami-Dade County, Florida.

In its evaluation of uranium fuel-cycle impacts from proposed Units 6 and 7 at the Turkey Point site, Florida Power & Light Company (FPL) used the AP1000 pressurized water reactor design. The capacity factor reported by FPL for the AP1000 reactor design is 93 percent (FPL 2014-TN4058). 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 fuel cycle 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 (TN250).

The regulations in 10 CFR 51.51(a) (TN250) state that

> Under § 51.50, 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 Turkey Point site are LWRs that would use uranium dioxide fuel; therefore, Table S–3 (10 CFR Part 51) (TN250) can be used to assess environmental impacts of the uranium fuel cycle. The values provided in Table S–3, which are reproduced in Table 6-1, are normalized for a reference 1,000 MW(e) LWR at an 80 percent capacity factor.

The gross electrical power output for each of the two AP1000 reactors proposed for the Turkey Point site is 1,115 MW(e) (FPL 2014-TN4058), and the capacity factor is 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 wastes and low-level wastes (LLWs), 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 for use in new fuel. 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 the 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) (TN250), Table of Uranium Fuel-Cycle Environmental Data[(a)]

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 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 metric tons [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 1,000 MW(e) LWR with cooling tower.
Discharged to waterbodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MW(e) with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MWh)	323	<5 percent of model 1,000 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 1,000 MW(e) energy output.
Effluents – Chemical (MT)		
Gases (including entrainment):[(c)]		
SO_x	4,400	
NO_x[(d)]	1,190	Equivalent to emissions from a 45 MW(e) coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MW(e) LWR
Other gases:		
F	0.67	Principally from uranium hexafluoride (UF_6) production, enrichment, and reprocessing. Concentration within 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 transuranic elements	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	
Th-234	0.01	From fuel fabrication plants – concentration 10 percent of 10 CFR Part 20 (TN283) 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 waste (shallow)	11,300	9,100 Ci comes from low-level reactor wastes and 1,500 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.
Transuranic and high-level waste (deep)	1.1×10^7	Buried at Federal repository.

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MW(e) LWR
Effluents – thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 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, other areas 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-TN23); the *Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle*, NUREG–0116 (Supp.1 to WASH-1248) (NRC 1976-TN292); 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 1977-TN1255); 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 (AEC 1974-TN23).
(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 1 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 (22 U.S.C. § 3201 et seq.) (TN737) 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. Even though the ban on the reprocessing of spent fuel was lifted in October 1981, economic circumstances changed, reserves of uranium ore increased, and the stagnation of the nuclear power industry in the United States provided little incentive for industry to resume reprocessing. In 2005, the Energy Policy Act of 2005 (42 U.S.C. § 15801 et seq.) (TN738) 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 government and commercial efforts would be necessary 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 U_3O_8 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 uranium dioxide (UO_2). The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies, which ultimately will be placed in a reactor to produce power. When the content of the uranium-235 reaches a point at which 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 short-lived fission product decay to occur 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.

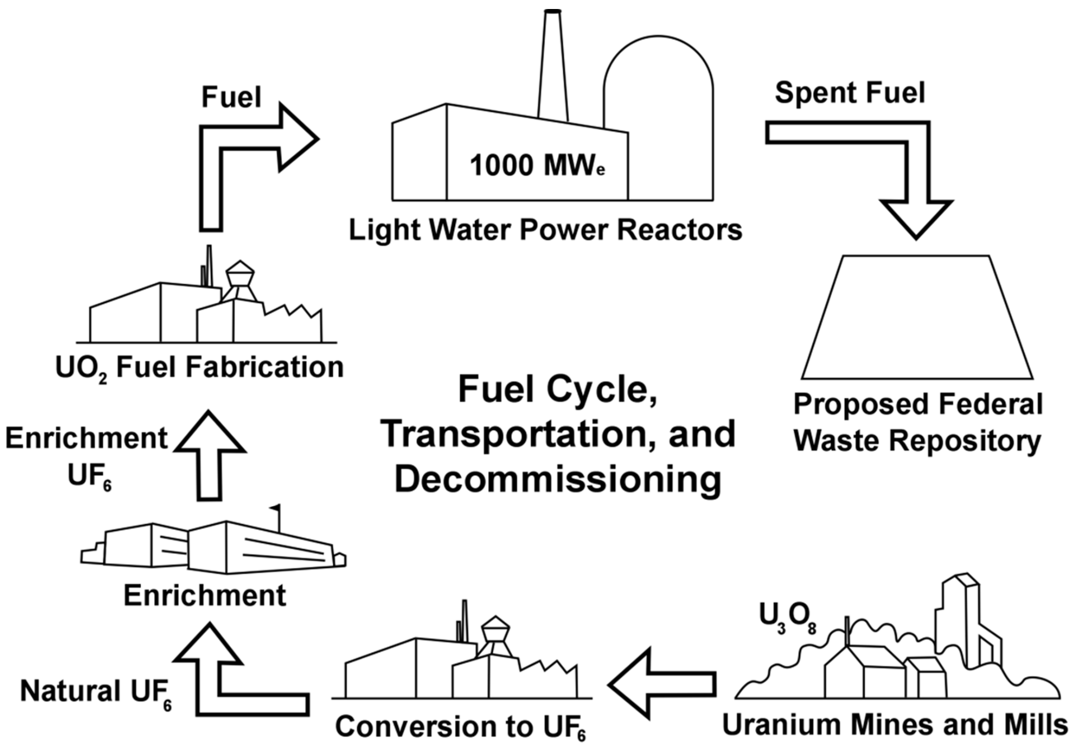

Figure 6-1. The Uranium Fuel Cycle: No-Recycle Option (Derived from NRC 1999-TN289)

The following assessment of the environmental impacts of the fuel cycle related to the operation of the proposed project is based on the values given in Table S–3 (see 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-TN288; NRC 1999-TN289; NRC 2013-TN2654),[1] 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

(1) NUREG–1437 was originally issued in 1996 (NRC 1996-TN288). Addendum 1 to NUREG–1437 was issued in 1999 (NRC 1999-TN289). NUREG–1437, Revision 1 (NRC 2013-TN2654), was issued in June 2013. The version of NUREG–1437 cited, whether 1996 or 2013, is the one in which the technical information is discussed. In some cases, the technical information is discussed in both documents. For those instances, NUREG–1437, Revision 1, is cited.

because the advanced LWR design considered here uses the same type of fuel; the staff's analyses in NUREG–1437 are summarized and provided here.

The fuel-cycle impacts in Table S–3 are based on a reference 1,000 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 gross electrical power output of 1,115 MW(e) for each AP1000 reactor and the capacity factor of 93 percent, which together yield a net electrical power output of 1,037 MW(e) per reactor, or a total of 2,074 MW(e) for the two proposed units at the Turkey Point site (FPL 2014-TN4058). This total output is about 2.6 times (i.e., 2,074 MW(e) divided by 800 MW(e) yields 2.6) the impact values provided in Table S–3 (see Table 6-1). Throughout this chapter, this will be referred to as the 1,000 MW(e) LWR-scaled model.

Recent changes in the uranium fuel cycle may have some bearing on environmental impacts; however, as discussed below, the NRC staff is confident that contemporary fuel-cycle impacts are less than those identified in Table S–3. This is true in light of the recent uranium fuel-cycle trends in the United States identified below:

- The increased use of in situ leach uranium mining, which does not produce mine tailings and would lower the release of radon gas. A detailed discussion of this subject is provided in Section 6.1.5 below.
- The transition of U.S. uranium enrichment technology from gaseous diffusion to gas centrifugation. The centrifuge process uses only a small fraction of the electrical energy per separation unit compared to gaseous diffusion (U.S. gaseous-diffusion plants relied on electricity derived mainly from the burning of coal).
- Current LWRs that use nuclear fuel more efficiently through 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.
- Discharge of fewer spent fuel assemblies per reactor year; hence, the waste storage/ repository impact is lessened.

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 1,000 MW(e) LWR operating at 80 percent capacity with a 12-month fuel-reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a "reference reactor year" (NRC 2013-TN2654). If approved, the combined construction permit and operating licenses (combined licenses or COLs) for the two proposed units at the Turkey Point site would allow 40 years of operation. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by a 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain the average annual fuel requirements for both boiling water reactors and pressurized water reactors. This approach was followed in the original GEIS for license renewal (NRC 1996-TN288) and carried forward into Revision 1 (NRC 2013-TN2654). The higher annual fuel requirement for a boiling water reactor, 35 MT of uranium, was chosen in the GEIS, Revision 1, as the basis for the reference reactor year (NRC 2013-TN2654). If the lifetime was limited to the 40-year initial license term, the average annual fuel requirement would be increased by only 2 percent. A number of fuel-management improvements have been adopted by nuclear power plant operators to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. Since the mid-1970s when Table S–3 was promulgated (AEC 1974-TN23; NRC 1976-TN292), these improvements have reduced the annual fuel requirement, which means the Table S–3 assumptions remain bounding as applied to the proposed two units.

Another change supporting the bounding nature of the Table S–3 assumptions with respect to the impacts of the new capacity at the Turkey Point site is the elimination of 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. In the 1980s, the economic conditions of the uranium market resulted in the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from uranium-mining activities. More recently, there is renewed interest in uranium recovery in the United States. Between 2007 and 2014, the NRC received 10 license applications for uranium recovery facilities (NRC 2014-TN4054). All but two of these applications were for facilities using the in situ recovery process, which does not produce mill tailings that would have released radon to the environment. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and mill tailings could drop to levels less than those given in Table S–3; therefore, Table S–3 estimates remain bounding as applied to the proposed new units.

In summary, these reasons highlight why Table S–3 is likely to overestimate impacts from the proposed Turkey Point Units 6 and 7, and therefore remains adequate for use in the bounding approach used in this analysis. Section 4.12.1.1 of NUREG–1437, Revision 1 (NRC 2013-TN2654), and Section 6.2.3 of NUREG–1437 (NRC 1996-TN288) discuss in greater detail the sensitivity to changes in the uranium fuel cycle since issuance of Table S–3 on the environmental impacts.

6.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1,000 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 (TN283), 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 producing the same megawatt-electric output as the LWR-scaled model and using strip-mined coal would disturb approximately 520 ac/yr of land for fuel alone. The NRC staff concludes that the impacts on land use to support the 1,000 MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the fuel cycle supporting a 1,000 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 29,580 million gal, about 28,830 million gal are required for the removal of waste heat if the power stations use once-through cooling. 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 gal/yr and discharge to the ground (e.g., mine drainage) of about 330 million gal/yr.

Annual thermal discharges from power plants supporting the uranium fuel cycle are about 4 percent of those from operation of the supported LWR. If the thermal power plants supporting the fuel cycle use once-through cooling, the fuel-cycle consumptive water use is primarily from process cooling and equals about 2 percent of the cooling-tower evaporative losses during LWR operation, assuming that the LWR uses cooling towers. If all the power plants supplying electrical energy to the uranium fuel cycle use cooling towers, the consumptive water use increases to about 6 percent of that of the LWR 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

As indicated in Appendix J of this environmental impact statement (EIS), the largest source of greenhouse gas (GHG) emissions associated with nuclear power is from the fuel cycle, not operation of the plant. The largest source of GHGs in the fuel cycle is production of electric energy and process heat required during various phases of the fuel-cycle process, such as enrichment. The electric energy is often produced by the combustion of fossil fuel at conventional power plants.

Table S–3 in 10 CFR 51.51 (TN250) presents data for evaluating the environmental effects of a reference 1,000 MW(e) light water-cooled nuclear power reactor resulting from the uranium fuel cycle. Table S–3 does not provide an estimate of GHG emissions associated with the uranium fuel cycle, but does state that 323,000 MWh is the assumed annual electric energy use associated with the uranium fuel cycle for the reference 1,000 MW(e) nuclear power plant and this 323,000 MWh of annual electric energy is assumed to be generated by a 45 MW(e) coal-fired power plant burning 118,000 MT of coal. Table S–3 also assumes approximately 135,000,000 standard cubic feet (scf) of natural gas is also required per year to generate process heat for certain portions of the uranium fuel cycle.

In Appendix J of this EIS, the NRC used these fossil fuel use assumptions presented in Table S–3 to estimate that the GHG footprint of the fuel cycle to support a reference 1,000 MW(e) LWR with an 80 percent capacity factor for a 40-year operational period is on the order of 10,100,000 MT of carbon dioxide (CO_2) equivalent. Scaling this footprint to the power level and capacity factor of the two proposed AP1000 reactor units using the scaling factor of

2.6 discussed earlier, the review team estimates the GHG footprint for 40 years of fuel-cycle emissions to be approximately 26,000,000 MT of CO_2 equivalent (CO_2e). This rate of GHG production equals 657,000 MT of CO_2e per year, less than 0.2 percent of Florida's annual CO_2 emission rate (FDEP 2010-TN2997).

The largest use of electricity in the fuel cycle comes from the enrichment process. The development of Table S–3 assumed that the gaseous-diffusion process is used to enrich uranium. The gaseous-diffusion technology is no longer used for uranium enrichment. The last gaseous-diffusion enrichment facility in the United States ceased operations recently (USEC 2013-TN2765). Current enrichment facilities use gas-centrifuge technologies, and recent applications for new uranium enrichment facilities are based on gas-centrifuge and laser-separation technologies. The same amount of enrichment from gas centrifuge and laser separation uses less electricity and therefore results in lower amounts of air emissions such as CO_2 than gaseous-diffusion enrichment. In addition, U.S. electric utilities have begun to switch from coal to cheaper, cleaner-burning natural gas (DOE/EIA 1995-TN2996); therefore, the Table S–3 assumption that a 45 MW(e) coal-fired plant is used to generate the 323,000 MWh of annual electric energy for the uranium fuel cycle also results in conservative air emission estimates. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S–3 continue to be appropriately bounding values.

On this basis, the NRC staff concludes that the fossil-fuel impacts, including GHG 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 (see Table 6-1) for the reference 1,000 MW(e) LWR and, according to WASH-1248 (AEC 1974-TN23), result from the generation of electricity for fuel-cycle operations. The principal effluents are sulfur oxides, nitrogen oxides, and particulates. Table 6-1 states that the fuel cycle for the reference 1,000 MW(e) LWR requires 323,000 MWh of electricity. Therefore, the fuel cycle for the 1,000 MW(e) LWR-scaled model would require 840,000 MWh of electricity, or 0.02 percent of the 4.1 billion MWh of electricity generated in the United States in 2012 (DOE/EIA 2013-TN2540). Therefore, the gaseous and particulate chemical effluents from fuel-cycle processes to support the operation of the 1,000 MW(e) LWR-scaled model 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 usually are present in dilute concentrations so only small amounts of dilution water are required to reach concentration levels that are within established standards. Table S–3 (see 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 facilities associated with fuel-cycle operations would be subject to requirements and limitations set by 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 listed in Table S–3 (see Table 6-1). Using these effluents in NUREG–1437, Revision 1 (NRC 2013-TN2654), the NRC staff calculated the 100-year environmental dose commitment to the U.S. population from the fuel cycle for 1 year of operation of the reference 1,000 MW(e) LWR using the radioactive effluents in Table 6-1. 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 1,000 MW(e) LWR-scaled model would result in whole body dose commitment estimates of 1,040 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 1,600 person-rem for the 1,000 MW(e) LWR-scaled model.

Currently, 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. FPL provided an assessment of radon-222 and technetium-99 in its Environmental Report (ER) (FPL 2014-TN4058). FPL's evaluation relied on the information discussed in NUREG–1437 (NRC 2013-TN2654).

In Section 6.2 of the 1996 version of NUREG–1437 (NRC 1996-TN288), the NRC staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operations of the reference 1,000 MW(e) LWR. The estimated release of radon-222 for the reference reactor year for the 1,000 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 tailings 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-TN288) estimate for the reference reactor year). The major risks from radon-222 are from exposure to the bone and the lung, although a small risk from exposure to the whole body exists. The organ-specific dose weighting factors from 10 CFR Part 20 (TN283) 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 1,000 MW(e) LWR-scaled model) would be approximately 2,400 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 control comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in NUREG–1437 (NRC 1996-TN288).

Also, as discussed in NUREG–1437, Revision 1 (NRC 2013-TN2654), 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 1,000 MW(e) LWR-scaled model are 0.018 Ci from chemical processing of recycled UF_6 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 (TN283) 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 1,000 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 2006 report by the National Research Council (National Research Council 2006-TN296), 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 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 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, non-fatal 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 International Commission on Radiological Protection (ICRP) Publication 103 (ICRP 2007-TN422).

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 4,300 person-rem/yr) to calculate that the U.S. population would incur a total of approximately 2.4 fatal cancers, non-fatal cancers, and severe hereditary effects annually.

Both the Council on Radiation Protection and Measurements (NCRP) and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (i.e., less than 1/0.00057, which is less than 1,754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995-TN728; NCRP 2009-TN420; ICRP 2007-TN422). The estimated collective whole body dose value of 4,300 person-rem/yr to the U.S. population is not significantly larger than the 1,754 person-rem value that the ICRP and NCRP suggest would most likely result in zero excess health effects (NCRP 1995-TN728; NCRP 2009-TN420; ICRP 2007-TN422). Thus, it is not expected that the 2.4 expected health effects would be observable.

Radon-222 releases from tailings are indistinguishable from background radiation levels at a few miles from the tailings pile (at less than 0.6 mi in some cases) (NRC 1996-TN288). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR 190.10 (TN739), 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) (TN294).

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 (Jablon et al. 1990-TN1257). 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" (Jablon et al. 1990-TN1257). The contribution to the annual average dose received by an individual from fuel-cycle–related radiation and other sources as reported by the NCRP (2009-TN420) is listed in Table 6-2. The nuclear fuel-cycle contribution to an individual's annual average radiation dose is extremely small (about 0.1 mrem/yr) compared to the annual average background radiation dose (approximately 311 mrem/yr).

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
	Uranium fuel cycle	0.05[c]	0.01
	Total	**624**	**100**

(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.

Source: Report 160, *Ionizing Radiation Exposure of the Population of the United States* (NCRP 2009-TN420)

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

6.1.6 Radiological Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) generated by the reference 1,000 MW(e) LWR 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.

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, and therefore, FPL would not be able to dispose of these wastes at the Barnwell facility. FPL currently has a contract with Studsvik, Inc. for processing, storage, and disposal of Class B and C LLW from Turkey Point Units 3 and 4 (77 FR 20059) (TN1001) and they expect to establish a similar contract with a third party to process, store, and dispose of LLW produced by Units 6 and 7 as a result of operations (FPL 2014-TN4058). If FPL has not entered into an agreement with an NRC-licensed facility that would accept LLW from proposed Turkey Point Units 6 and 7, FPL would implement measures to reduce the generation of Class B and C wastes (FPL 2014-TN4058). If needed, FPL also would construct additional storage facilities onsite and has indicated (FPL 2014-TN4058) that such facilities would be designed and operated to meet the guidance standards in Appendix 11.4-A of the *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition* (NUREG–0800) (NRC 2007-TN613). Because FPL would have to choose one or a combination of these three options, the NRC staff considered the environmental impacts of each of these three options.

Table S–3 addresses the environmental impacts if FPL 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 FPL, 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 very similar to the estimates in Table S–3, and the environmental impacts would not be significantly different (FPL 2014-TN4058).

In most circumstances, the NRC's regulations (10 CFR 50.59) (TN249) 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 power block 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) (TN283) and EPA (40 CFR Part 190) (TN739) dose limitations would apply both for public and occupational radiation exposure. The radiological environmental monitoring programs around nuclear power plants that operate such facilities show that the increase in radiation dose at the site boundary is not significant; the radiation doses continue to be less than 25 mrem/yr, the dose limit of 40 CFR Part 190 (TN739). 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-TN288). The types and amounts of LLW generated by the proposed reactors at the Turkey Point site would be very similar to those generated by currently operating nuclear power plants, and the construction and operation of these interim LLW storage facilities would be very 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 small.

Current national policy, as found, for example, in the Nuclear Waste Policy Act (42 U.S.C. § 10101 et seq.) (TN740), mandates that high-level and transuranic wastes are to be buried in deep geologic repositories. No release to the environment is expected to be associated with deep geologic disposal, because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG–0116 (NRC 1976-TN292), which provides background and context for the Table S–3 values established by the Commission, the NRC staff indicates that these high-level 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 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 and Electric Co. v. Natural Resources Defense Council, Inc. 1983-TN1054).

Environmental impacts from onsite spent fuel storage have been studied extensively and are well understood. In the context of operating license renewal, the staff provides descriptions of the storage of spent fuel during the licensed lifetime of reactors operations. Specifically, NUREG-1437, "Generic Environmental Impact Statement for License Renewal," supports a conclusion that the impacts of building and operating an ISFSI on the site would be minor (NRC 2013-TN2654). Radiological impacts are well within regulatory limits; thus, radiological impacts of onsite storage during operations meet the standard for a conclusion of small impact. Nonradiological environmental impacts have been shown to be not significant (NRC 1989-TN3714); thus, they are classified as small. However, the U.S. Army Corps of Engineers may require additional mitigation measures for any disturbance to wetland resources. The overall conclusion for onsite storage of spent fuel during the licensed lifetime of reactor operations is that the environmental impacts will be small (NRC 2013-TN2654).

On August 26, 2014, the Commission issued a revised rule at 10 CFR 51.23 (TN250) and associated *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel: Final Report, Volumes 1 and 2* (NUREG–2157) (NRC 2014-TN4117). The revised rule adopts the generic impact determinations made in NUREG–2157 and codifies the NRC's generic determinations regarding the environmental impacts of continued storage of spent nuclear fuel beyond a reactor's operating license (i.e., those impacts that could occur as a result of the storage of spent nuclear fuel at at-reactor or away-from-reactor sites after a reactor's licensed life for operation and until a permanent repository becomes available).

In CLI-14-08, the Commission held that the revised 10 CFR 51.23 (TN250) and associated NUREG–2157 cure the deficiencies identified by the court in New York v. NRC, 681 F.3d 471 (D.C. Cir. 2012) and stated that the rule satisfies the NRC's NEPA obligations with respect to continued storage for actions such as the Turkey Point Units 6 and 7 COL application. As directed by 10 CFR 51.23(b), the impacts assessed in NUREG–2157 are deemed incorporated into this EIS.

The staff's evaluation of the potential environmental impacts of continued storage of spent fuel presented in NUREG–2157 identifies an impact level, or a range of impacts, for each resource area for a range of site conditions and timeframes. The timeframes analyzed in NUREG–2157 include the short-term timeframe (60 years beyond the licensed life of a reactor), the long-term timeframe (an additional 100 years after the short-term timeframe), and an indefinite timeframe (see Section 1.8.2 of NUREG–2157).

The analysis in Section 4.20 of NUREG–2157 concludes that the potential impacts of spent fuel storage at the reactor site in both a spent fuel pool and in an at-reactor independent spent fuel storage installation would be SMALL during the short-term timeframe. However, for the longer timeframes for at-reactor storage, and for all timeframes for away-from-reactor storage, Sections 4.20 and 5.20 of NUREG–2157 have determined a range of potential impacts in some resource areas. These ranges reflect uncertainties that are inherent in analyzing environmental impacts on some resource areas over long timeframes. Those uncertainties exist, however, regardless of whether the impacts are analyzed generically or site-specifically.

Appendix B of NUREG–2157 provides an assessment of the technical feasibility of a deep geologic repository and continued safe storage of spent fuel. That assessment concluded that a deep geologic repository is technically feasible and that a reasonable timeframe for its development is approximately 25 to 35 years. The assessment in NUREG–2157 noted that DOE's goal is to have sited, constructed, and commenced operations of a repository by 2048. If the current proposed action is approved and no renewals are granted in the future, the short-term period will end 60 years after the end of the licensed period. The licensed period plus the short-term timeframe is more than twice as long as the time estimated to develop a deep geologic repository.

The most likely impacts of the continued storage of spent fuel are those considered for at-reactor storage in the short-term timeframe. In the unlikely event that fuel remains on site into the long-term and indefinite timeframes, the ranges in NUREG–2157 reflect factors that lead to uncertainties regarding the potential impacts over these very long periods of time. Based on the analysis and impact determination in NUREG–2157, and taking into account the impacts that the NRC can predict with certainty, which are SMALL; the uncertainty reflected by the ranges in the long-term and indefinite timeframes, and the relative likelihood of the timeframes, the staff finds that the impacts for at-reactor storage for Turkey Point Units 6 and 7 are likely to be minor.

Spent fuel could also be moved to an away-from-reactor storage facility. However, there is uncertainty about whether an away-from-reactor storage facility would be constructed, uncertainty about where it might be located, and uncertainty about the impacts in the short-term and the longer timeframes. As a result, these impacts provide limited insights to the decision-maker in the overall picture of the environmental impacts from the proposed action and do not change the staff's overall conclusion regarding the environmental impacts of radiological wastes from the fuel cycle (which includes the impacts associated with spent fuel storage).

The NRC staff concludes, based on Table S–3 and the above conclusions regarding storage and disposal of LLW and spent fuel, that the environmental impacts from radioactive waste storage and disposal associated with the operation of Turkey Point Units 6 and 7 would be SMALL.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the 1,000 MW(e) LWR-scaled model is about 1,560 person-rem. This dose is based on a 600 person-rem occupational dose estimate attributable to all phases of the fuel cycle for the reference 1,000 MW(e) LWR (NRC 2013-TN2654). 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 (TN283) Subpart C, which is 5 rem/yr.

6.1.8 Transportation

The transportation dose to workers and the public related to the uranium fuel cycle totals about 2.5 person-rem annually for the reference 1,000 MW(e) LWR, according to Table S–3 (Table 6-1). This corresponds to a dose of 6.5 person-rem per year for the 1,000 MW(e) LWR-scaled model. For purposes of comparison, the estimated collective dose from natural background radiation to the current population within 50 mi of the Turkey Point site is about 907,000 person-rem/yr (FPL 2014-TN4058). 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 (10 CFR 51.51) (TN250) (see Table 6-1), considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1,000 MW(e) LWR-scaled model. The NRC staff also evaluated the environmental impacts of GHG emissions from the uranium fuel cycle and appropriately scaled the impacts for the 1,000 MW(e) LWR-scaled model. The NRC staff also evaluated the environmental impacts of storage of LLW and spent fuel. 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 Turkey Point site and the alternative sites, (2) shipment of irradiated (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 site in Nevada as a surrogate destination for a permanent repository. The impacts evaluated in this section for two new nuclear generating units at the Turkey Point site are appropriate for characterizing the alternative sites discussed in Section 9.3 of this EIS. Alternative sites evaluated in this EIS include the existing Turkey Point site (proposed), and the Martin, Glades, Okeechobee, and St. Lucie sites. As discussed in this section, there is no meaningful differentiation among the proposed and alternative sites regarding the radiological and nonradiological environmental impacts from normal operating and accident conditions and are not discussed further in Chapter 9.

The NRC performed generic analyses 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-TN22) and in a supplement to WASH-1238, NUREG–75/038 (NRC 1975-TN216). Based on these analyses, the environmental impacts of transportation of fuel and waste to and from LWRs were found to be SMALL. These documents provided the basis for Table S–4 in 10 CFR 51.52 (TN250) that summarizes the environmental impacts of transportation of fuel and waste to and from one LWR with a generating capacity of 3,000 to 5,000 MW(t) (1,000 to 1,500 MW(e)). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1,100 MW(e) LWR. 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.

Normal transportation dose estimates have been re-examined several times since publication of WASH-1238, basically to determine the adequacy of NRC's transportation regulations (i.e., 10 CFR Part 71 [TN301]). In 1977, the NRC published NUREG–0170, which concluded that average radiation doses to the public from normal transportation of radioactive materials is a small fraction of natural background radiation. In 2000, the NRC published NUREG/CR–6672 (Sprung et al. 2000), which indicated the normal transportation doses were lower than those calculated in NUREG–0170. Recently, in early 2014, the NRC published NUREG–2125 (NRC 2014-TN3231). This document concluded that the collective doses from normal transportation were higher than those calculated in NUREG–0170 (NRC 1977-TN417) and NUREG/CR–6672 (Sprung et al. 2000-TN222), but were still a small fraction of natural background dose. Therefore, use of the normal transportation dose models employed in NUREG–2125 (NRC 2014-TN3231) may result in somewhat higher normal transportation dose estimates that those shown in this EIS, but they will still be a small fraction of natural background radiation doses.

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 reactor years and one non-fatal injury in 10 reference reactor years.

Transportation accident risks have been re-examined several times since WASH-1238 to determine the adequacy of NRC's transportation regulations. NUREG–0170 used refined computer models to estimate the risk of transportation accidents. The modeling results indicated that the risks were much smaller than the nonradiological risks of accidents involving large trucks or freight trains. Based on the results, the NRC determined that the risks were sufficiently small to allow continued transport of radioactive materials by all modes. In 1987, the NRC published the Modal Study (NUREG/CR-4829) (Fischer et al. 1987-TN4105), which provided further refinements to the computer models used to estimate radiological risks from transportation accidents. The Modal Study's refined modeling techniques resulted in smaller risk estimates than those presented in NUREG–0170 (NRC 1977-TN417). In 2000, further refined risk models were developed and published in NUREG/CR–6672 (Sprung et al. 2000-TN222). The modeling enhancements developed for NUREG/CR–6672 resulted in smaller accident risk estimates than those presented in NUREG–0170 and the Modal Study. Finally, NUREG–2125 (NRC 2014-TN3231) was recently published by the NRC. The resulting accident risk estimates were smaller than those presented in NUREG–0170, the Modal Study, and NUREG/CR–6672. Therefore, if the accident risk models provided in NUREG–2125 were to be used in this EIS, even smaller accident risks would be estimated.

In accordance with 10 CFR 51.52(a) (TN250), 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 conditions:

- The reactor has a core thermal power level not exceeding 3,800 MW(t).
- Fuel is in the form of sintered uranium oxide pellets having a uranium-235 enrichment not exceeding 4 percent by weight; and the pellets are encapsulated in zircaloy-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, rail, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or rail.

The environmental impacts of transporting fuel and radioactive wastes to and from LWR nuclear power facilities were resolved generically in 10 CFR 51.52 (TN250), provided that the specific conditions in the rule (see above) are met; if not, a full description and detailed analysis are required for initial licensing. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis; for example, at higher burnup levels (greater than 33,000 MWd/MTU), enrichment levels (greater than 4 percent uranium-235), or thermal power levels (greater than 3,800 MW(t)). Departures from the conditions itemized in 10 CFR 51.52(a) (TN250) are to be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b) (TN250). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing for new reactors.

In its application, FPL requested COLs for two additional reactors at its Turkey Point site in Miami-Dade County, Florida. The reactor design proposed by FPL—the AP1000—has a design thermal power rating of 3,400 MW(t) and a net electrical output of approximately 1,000 MW(e). The thermal power rating does not exceed the 3,800 MW(t) condition specified in 10 CFR 51.52(a) (TN250). The AP1000 reactor is expected to operate with a 93 percent capacity factor (FPL 2014-TN4058), resulting in a net electrical output (annualized) of about 930 MW(e). Fuel for the plants would be enriched up to about 4.54 weight percent uranium-235 for core reloads, which exceeds the 10 CFR 51.52(a) (TN250) condition. In addition, the average irradiation level of about 50,533 MWd/MTU (FPL 2014-TN4058) is also greater than the 10 CFR 51.52(a) (TN250) condition. Because the enrichment and irradiation levels exceed the 10 CFR 51.52(a) (TN250) conditions, a full description and detailed analysis of transportation impacts is required.

In its ER (FPL 2014-TN4058), FPL 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 Turkey Point site and alternative sites were calculated using the RADTRAN 5.6 computer code (Weiner et al. 2008-TN302). RADTRAN 5.6, which was used in this EIS, is the most commonly used transportation impact analysis software used in the nuclear industry. An update to the RADTRAN computer code, RADTRAN 6, is currently available (Weiner et al. 2013-TN3390). Preliminary comparisons of RADTRAN 5.6 and RADTRAN 6 outputs for identical cases indicated that RADTRAN 6 would produce identical incident-free impacts and slightly lower accident impacts than RADTRAN 5.6. In addition, the RADTRAN 5.6 computer code was used by FPL in its application. As a result, for consistency with the FPL application, the RADTRAN 5.6 computer code was used in the NRC's confirmatory analysis.

Based on comments about previous nuclear power plant EISs, an explicit analysis of the nonradiological impacts of transporting workers and construction materials to and from the Turkey Point site and alternative sites is included in this EIS. Nonradiological impacts of transporting construction workers and materials and operations workers are addressed in Sections 4.8.3 and 5.8.6, respectively. Publicly available information about traffic accidents, 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 Turkey Point site and the alternative sites. Radiological impacts of normal operating conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts on populations and MEIs are presented. The specific location of the fuel fabrication plant for Turkey Point unirradiated fuel is not known at this time. Therefore, the NRC staff's independent and confirmatory analyses assume "representative" routes between the fuel fabrication facility and the Turkey Point site and alternative sites. This means that there are no substantive differences between the impacts calculated, for the purposes of Chapter 9, for the Turkey Point site and the four alternative sites. The site-specific differences are minor because the radiation doses from unirradiated fuel transport are small. In addition, the differences in shipping distances from the proposed and alternative sites to a fuel fabrication facility are less than 320 km (200 mi), which is less than 10 percent of the representative shipping distance assumed by the NRC staff. Therefore, because transportation impacts are approximately proportional to shipping distance, the differences in impacts among the alternative sites will be less than 10 percent.

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 Turkey Point site; (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 AP1000 reactor compared to those of the reference 1,100 MW(e) reactor specified in

WASH-1238 (AEC 1972-TN22) operating at 80 percent capacity (880 MW(e)), herein the reference LWR. In the ER, the applicant estimated the initial core would be loaded with 157 AP1000 unirradiated fuel assemblies and an additional 43 assemblies per year for refueling. Shipping cask capacities were assumed to be 7 fuel assemblies per shipment for the initial core and 9 assemblies per shipment for core reloads. This results in a total of about 209 shipments over the assumed 40-year life of the reactor (i.e., initial core plus 39 years of core reloads). After normalization to the annual electrical capacity of the reference LWR, the NRC staff found that the number of truck shipments of unirradiated fuel to the proposed Turkey Point site is less than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238 (AEC 1972-TN22).

Table 6-3. Number of Truck Shipments of Unirradiated Fuel for the Reference LWR and the AP1000 Reactor

Reactor Type	Number of Shipments per Reactor	Unit Electric Generation, MW(e)[(b)]	Capacity Factor[(b)]	Normalized, Shipments per 1,100 MW(e)[(c)]
	Total[(a)]			
Reference LWR (WASH-1238)	252	1,100	0.8	252
Turkey Point and Alternative Sites AP1000 reactor	209	1,000	0.93	199

(a) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(b) Unit capacities and capacity factors were taken from WASH-1238 (AEC 1972-TN22) for the reference LWR and the ER (FPL 2014-TN4058) for the AP1000 reactor.
(c) Normalized to net electric output for WASH-1238 (AEC 1972-TN22) reference LWR (i.e., 1,100 MW(e) plant at 80 percent or net electrical output of 880 MW(e)).

Shipping Mode and Weight Limits

In 10 CFR 51.52 (TN250) a condition is identified that states all unirradiated fuel will be shipped to the reactor by truck. FPL specifies that unirradiated fuel would be shipped to the proposed reactor site by truck. Section 10 CFR 51.52 (TN250), 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. FPL states in its ER that the unirradiated fuel shipments would comply with applicable weight restrictions (FPL 2014-TN4058).

Radiological Doses to Transport Workers and the Public

Section 10 CFR 51.52 (TN250), 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. 2008-TN302).

One of the key assumptions in WASH-1238 (AEC 1972-TN22) for unirradiated fuel shipments for the reference LWR is that the radiation dose rate at 3.3 ft from the transport vehicle would be approximately 0.1 mrem/hr. This assumption also was used in the NRC staff's confirmatory analysis of the AP1000 unirradiated fuel shipments and is lower than the maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle; see 10 CFR 71.47) (TN301). This assumption is reasonable because the AP1000 fuel materials would be low-dose−rate uranium radionuclides and would be packaged similarly to the practice described in WASH-1238 (AEC 1972-TN22) (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 (listed in metric units) used in the radiation dose analysis for unirradiated fuel are shown in Table 6-4.

Table 6-4. RADTRAN 5.6 Input Parameters for Unirradiated Fuel Shipments

Parameter	RADTRAN 5.6 Input Value	Source
Shipping distance, km	3,200	AEC 1972-TN22[(a)]
Travel fraction – rural	0.90	NRC 1977-TN417
Travel fraction – suburban	0.05	
Travel fraction – urban	0.05	
Population density – rural, persons/km^2	10	DOE 2002-TN418
Population density – suburban, persons/km^2	349	
Population density – urban, persons/km^2	2,260	
Vehicle speed – km/hr	88.49	Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – rural, vehicles/hr	530	DOE 2002-TN418
Traffic count – suburban, vehicles/hr	760	
Traffic count – urban, vehicles/hr	2,400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC 1972-TN22
Shipment length, m	9.1	Approximate length of two AP1000 fuel assemblies placed end to end (INEEL 2003-TN71)
Number of truck crew	2	AEC 1972-TN22, NRC 1977-TN417, and DOE 2002-TN418
Stop time, hr/trip	4	Based on one 30-minute stop per 4-hour driving time (Johnson and Michelhaugh 2003-TN1234)
Population density at stops, persons/km^2	See Table 6-8 for truck stop parameters	

(a) AEC 1972-TN22 provides a range of shipping distances between 40 km (25 mi) and 4,800 km (3,000 mi) for unirradiated fuel shipments. A 3,200 km (2,000 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): 3.62×10^{-3} person-rem/shipment

- general public dose (along route/persons living near a highway or truck stop): 5.12×10^{-5} person-rem/shipment.

These values were combined with the average annual shipments of unirradiated fuel for the AP1000 reactor to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological impacts on workers, public onlookers (i.e., persons at stops and on 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 Turkey Point site. The cumulative annual dose estimates in Table 6-5 were normalized to 1,100 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.

Table 6-5. Radiological Impacts under Normal Conditions of Transporting Unirradiated Fuel to the Turkey Point Site or the Alternative Sites

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose, person-rem/yr per 1,100 MW(e)[(a)] (880 MW(e) net)		
		Workers	Public Onlookers	Public Along Route
Reference LWR (WASH-1238) (AEC 1972-TN22)	6.3	0.011	0.023	0.00032
Turkey Point and Alternative Sites AP1000 reactor	5.0	0.009	0.018	0.00025
10 CFR 51.52 (TN250), Table S–4 Condition	<1 per day	4	3	3

(a) Multiply person-rem/yr times 0.01 to obtain doses in person-Sv/yr.

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 to health such as cancer induction. A report by the National Research Council (2006-TN296), 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, non-fatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), which is equal to 0.00057 effects per person-rem. The coefficient is taken from ICRP Publication 103 (ICRP 2007-TN422).

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 1,754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995-TN728; ICRP 2007-TN422). The NRC staff estimated that the largest annual collective dose estimate for transporting unirradiated fuel to the Turkey Point site and the alternative sites was 0.018 person-rem, which is less than the 1,754 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-TN420). Using this average effective dose, the collective population dose from natural background radiation to the population along this representative route would be approximately 2.2×10^5 person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the Turkey Point 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

The NRC staff performed a scenario-based analysis to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the Turkey Point site and alternative sites. The following discussion applies to unirradiated fuel shipments to, and spent fuel and radioactive waste shipments from, any of the alternative sites. The NRC staff's analysis is based on data in DOE's *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002-TN1236) 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. For the analyses of MEIs, the NRC staff assumed that the dose rate emitted from the shipping containers would be 10 mrem/hr at a distance 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 (10 CFR Part 71) (TN301). Most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (AEC 1972-TN22; DOE 2002-TN418). An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the Turkey Point site and the alternative sites. The analysis is described below.

<u>Truck Crew Member</u>

Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period. The analysis assumed that crew member doses are limited to 2 rem/yr, which is the administrative control level presented in DOE-STD-1098-2008, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2009-TN1426). The NRC staff anticipates this limit will apply to spent nuclear fuel shipments to a disposal facility, because DOE would take title to the spent fuel at the reactor site. Because the capacities of spent fuel shipping casks are limited by their substantial radiation shielding and accident resistance requirements, there would be more shipments of spent nuclear fuel from the Turkey Point site (or the alternative sites) than there would be shipments of unirradiated fuel to, and radioactive waste other than spent fuel from, these sites. Spent fuel shipments also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002-TN418). 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 (i.e., 2 rem/yr; see DOE 2009-TN1426) is less than the NRC limit for occupational exposures (i.e., 5 rem/yr; see 10 CFR Part 20 [TN283]).

The DOT does not regulate annual occupational exposures but recommends limits to air crew members that are a 5-year effective dose of 2 rem/yr with no more than 5 rem in a single year (DOT 2003-TN419). As a result, a 2 rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the Turkey Point site.

Inspector

Radioactive shipments are inspected by Federal or State vehicle inspectors, for example, at State ports of entry. DOE (2002-TN1236) assumed that inspectors would be exposed for 1 hour at a distance of 1 m (3.3 ft) from the shipping containers. Also, DOE conservatively assumed that the external dose rate at 2 m (6.6 ft) is the maximum allowed by regulations (i.e., 10 mrem/hr), the dose rate at 1 m (3.3 ft) is about 14 mrem/hr (Weiner et al. 2008-TN302). 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 Turkey Point site and the alternative sites, the annual doses to vehicle inspectors were calculated by the NRC staff to be about 1 rem/yr, based on a combined total of 72 shipments of unirradiated fuel, spent fuel, and radioactive waste per year. This value is less than the DOE administrative control level of 2 rem/yr (DOE 2009-TN1426) on individual doses and is also less than the 5 rem/yr NRC occupational dose limit.

Resident

The analysis assumed that a resident lives adjacent to a highway where a shipment would pass and would be exposed to all shipments along a particular route. Exposures to residents on a per-shipment basis were obtained from the NRC staff's RADTRAN 5.6 output files. These dose estimates are based on a stationary individual located 100 ft from the shipments as the shipments are traveling past at 15 mph. The potential radiation dose to the maximally exposed resident is about 0.04 mrem/yr for shipments of fuel and waste to and from the Turkey Point site and the alternative sites.

Individual 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. These are the same assumptions applied by DOE (2002-TN1236). The dose to the MEI was calculated to be 16 mrem.

Person at a Truck Service Station

This scenario estimates the annual doses to an employee at a service station where all truck shipments to and from the Turkey Point site and alternative sites are assumed to stop. The

NRC staff's analysis assumed this person would be exposed for 1 year. The NRC staff also applied a per exposure time of 49 minutes at a distance of 52 ft from the loaded shipping container based on the observations discussed by Griego et al. (1996-TN69). This results in a dose of about 0.34 mrem/shipment and an annual dose of about 24 mrem/yr for the Turkey Point site and alternative sites, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the Turkey Point site and alternative sites.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Because of improvements in highway safety and security and an overall reduction in traffic accident, injury, and fatality rates since WASH-1238 was published, accident frequencies for transportation of unirradiated fuel to the Turkey Point site and the alternative sites are expected to be lower than those used in the analysis in WASH-1238 (AEC 1972-TN22), which forms the basis for Table S–4 of 10 CFR 51.52 (TN250). There is no significant difference in consequences of transportation accidents severe enough to result in a release of unirradiated fuel particles to the environment between the AP1000 reactor 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-TN22), the impacts of accidents during transport of unirradiated fuel for the AP1000 reactor at the Turkey Point site and alternative sites are expected to be less than those listed in Table S–4 for current-generation LWRs.

6.2.1.3 Nonradiological Impacts of Transportation Accidents

Nonradiological impacts are the human health impacts projected to result from traffic accidents involving shipments of unirradiated fuel to the Turkey Point site and the alternative sites; that is, the analysis does not consider radiological or hazardous characteristics of the cargo.

Nonradiological impacts include the projected number of traffic accidents, injuries, and fatalities that could result from shipments of unirradiated fuel to the site and return shipments of empty containers from the site.

Nonradiological impacts are calculated using accident, injury, and fatality rates from published sources. The rates (i.e., impacts per vehicle-km traveled) are then multiplied by estimated travel distances for workers and materials. The general formula for calculating nonradiological impacts is:

$$\text{Impacts} = (\text{unit rate}) \times (\text{round-trip shipping distance}) \times (\text{annual number of shipments})$$

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-TN81). 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 heavy truck shipments similar to those to be used to transport unirradiated fuel to the Turkey Point site and the alternative sites. In addition, the DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999-TN81) 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-TN81) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI) (Blower and Matteson 2003-TN410). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used in the report (ANL/ESD/TM-150) by Saricks and Tompkins (1999-TN81), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 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 Turkey Point site and the alternative sites are shown in Table 6-6. The nonradiological impacts associated with the WASH-1238 (AEC 1972-TN22) reference LWR also are shown for comparison purposes. Note that there are only small differences between the impacts calculated for an AP1000 reactor at the Turkey Point site and the alternative sites and the reference LWR in WASH-1238 (AEC 1972-TN22) due entirely to the estimated annual number of shipments. Overall, the impacts are minimal, and there are no substantive differences among the alternative sites.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the Turkey Point Site and the Alternative Sites Normalized to Reference LWR

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance, km	Round-Trip Distance, km/yr	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238) (AEC 1972-TN22)	6.3	3,200	4.0×10^{4}	1.9×10^{-2}	9.3×10^{-3}	5.8×10^{-4}
AP1000 Reactors at Turkey Point and the Alternative Sites	5.0	3,200	3.2×10^{4}	1.5×10^{-2}	7.4×10^{-3}	4.6×10^{-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 proposed Turkey Point site and the 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, the 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. Note: on March 3, 2010, DOE (2010-TN1239) 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.

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). Because of 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-TN289). These assumptions are conservative because the alternative transportation methods involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999-TN289), thus reducing impacts. 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 (i.e., spent fuel approximately 120 days out of reactor). Future shipping casks would be designed to transport longer-cooled fuel (i.e., more 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 larger 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. 2008-TN302). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the TRAGIS routing code (Johnson and Michelhaugh 2003-TN1234). 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-TN81) in addition to route information from TRAGIS (Johnson and Michelhaugh 2003-TN1234). 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" conditions, are transportation activities in which shipments reach their destination without an accident occurring. 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 Turkey Point site and the alternative sites and the proposed repository location; (2) persons in vehicles traveling the same route as a spent fuel shipment; (3) persons at stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers (drivers). For the 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 Turkey Point site and the alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the AP1000 reactor. Information in *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003-TN71) 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 AP1000 spent fuel shipments. The NRC staff assumed that the capacity of a truck shipment of AP1000 spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH-1238 (AEC 1972-TN22). In its ER (FPL 2014-TN4058), FPL 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-TN1234) for representative highway routes from the proposed Turkey Point site and the alternative sites to the proposed Yucca Mountain disposal facility. The resulting information regarding route characteristics is shown in Table 6-7. Note that, for truck shipments, all the spent fuel is assumed to be shipped to the proposed Yucca Mountain disposal facility over designated controlled-quantity highway routes. In addition, TRAGIS data were used in RADTRAN 5.6 on a state-by-state basis. This approach increases precision and could allow the results to be presented for each state along the route between the Turkey Point site and the alternative sites and the proposed geologic repository at Yucca Mountain, if desired.

Table 6-7. Transportation Route Information for Shipments from the Turkey Point Site and the Alternative Sites to the Proposed Geologic Repository at Yucca Mountain, Nevada[(a)]

Advanced Reactor Site	One-Way Shipping Distance, km				Population Density, persons/km^2			Stop Time Per Trip, hr
	Total	Rural	Suburban	Urban	Rural	Suburban	Urban	
Turkey Point Site	4,977	3,777	988	212	9.8	367.1	2,422	5
Martin Alternative Site	4,775	3,761	890	124	9.8	342.2	2,304	5
Glades Alternative Site	4,795	3,775	903	116	9.9	333.6	2,324	5
Okeechobee Alternative Site	4,788	3,788	876	124	9.6	344.8	2,304	5
St. Lucie Alternative Site	4,739	3,728	884	127	9.7	346.6	2,308	5

(a) This table presents aggregated route characteristics provided by TRAGIS (Johnson and Michelhaugh 2003-TN1234), including estimated distances from the alternative sites to the nearest TRAGIS highway node. Input to the RADTRAN 5.6 computer code was disaggregated to a state-by-state level.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate, packaging dimensions, number of individuals 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 6-8. RADTRAN 5.6 Normal (Incident-Free) Exposure Parameters

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle speed, km/hr	88.49	Based on average speed in rural areas given in DOE's *A Resource Handbook on DOE Transportation Risk Assessment* (DOE 2002-TN418). Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – rural, vehicles/hr	State-specific	Weiner et al. 2008-TN302
Traffic count – suburban, vehicles/hr		
Traffic count – urban, vehicles/hr		
Vehicle occupancy, persons/vehicle	1.5	DOE 2002-TN418
Dose rate at 1 m from vehicle, mrem/hr	14	DOE 2002-TN418; DOE 2002-TN1236) – approximate dose rate at 1 m that is equivalent to maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle.
Packaging dimensions, m	Length – 5.2 Diameter – 1.0	DOE 2002-TN418
Number of truck crew	2	AEC 1972-TN22; NRC 1977-TN417; DOE 2002-TN418; DOE 2002-TN1236
Stop time, hr/trip	Route-specific	See Table 6-5
Population density at stops, persons/km^2	30,000	Sprung et al. 2000-TN222. Equivalent to 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-TN222
Shielding factor applied to annular area surrounding vehicle at stops, dimensionless	1 (no shielding)	Sprung et al. 2000-TN222
Population density surrounding truck stops, persons/km^2	340	Sprung et al. 2000-TN222
Min/max radius of annular area surrounding truck stop, m	10 to 800	Sprung et al. 2000-TN222
Shielding factor applied to annular area surrounding truck stop, dimensionless	0.2	Sprung et al. 2000-TN222

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. 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 estimate 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 extends from 10 to 800 m from the vehicle. This scheme is similar to that used in NUREG/CR–6672 (Sprung et al. 2000-TN222). Population densities and shielding factors were also taken from NUREG/CR–6672 (Sprung et al. 2000-TN222), which were based on the observations of Griego et al. (1996-TN69).

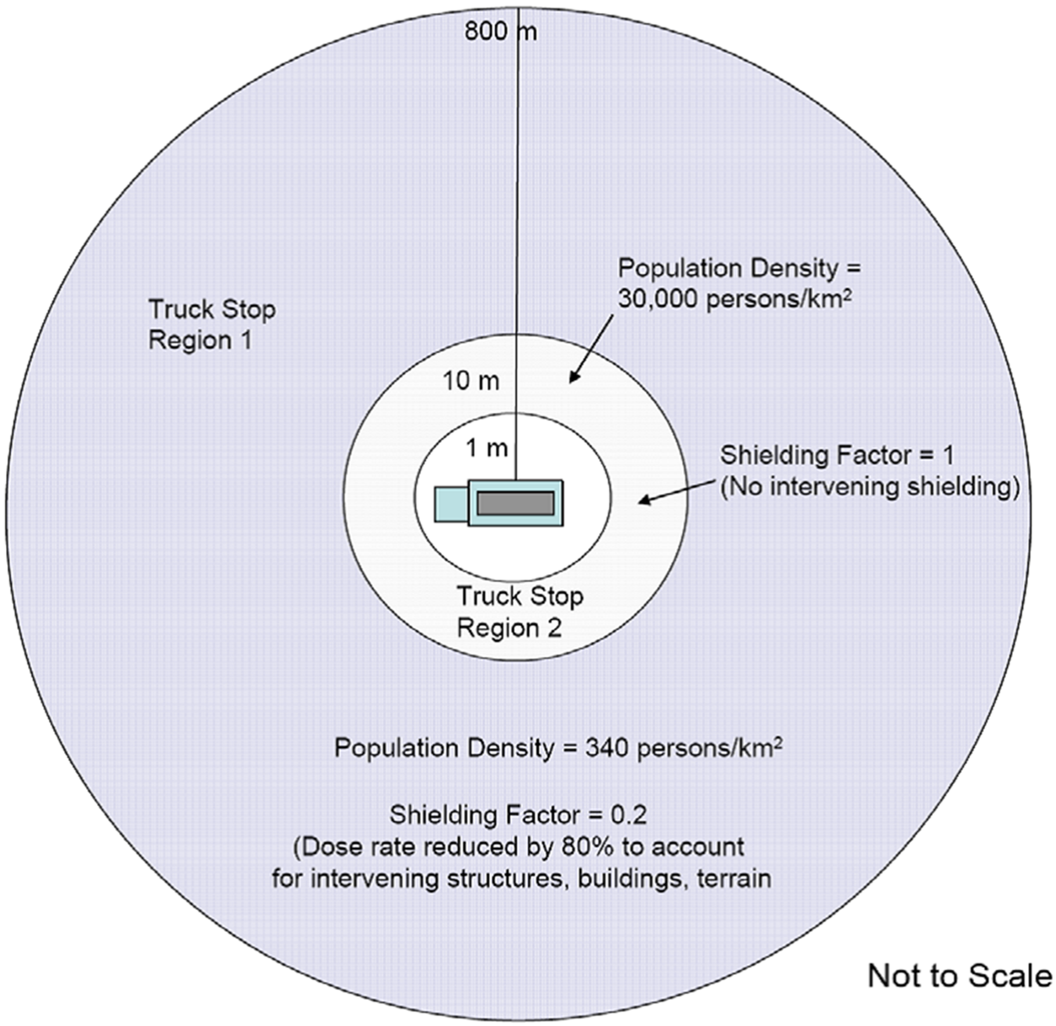

Figure 6-2. Illustration of Truck Stop Model

The results of these normal (incident-free) exposure calculations are shown in Table 6-9 for the proposed Turkey Point site and the alternative sites. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at stops and on highways exposed to the spent fuel shipment), and persons along the route (persons living near the highway).

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

	Worker (Crew), person-rem/yr[(a)]	Along Route, person-rem/yr[(a)]	Onlookers, person-rem/yr[(a)]
Reference LWR (WASH-1238) (AEC 1972-TN22)	1.4×10^{1}	8.2×10^{-1}	2.5×10^{1}
AP1000 Reactor at Turkey Point Site	9.9×10^{0}	5.9×10^{-1}	1.8×10^{1}
Martin Alternative Site	9.5×10^{0}	5.1×10^{-1}	1.8×10^{1}
Glades Alternative Site	9.5×10^{0}	5.2×10^{-1}	1.8×10^{1}
Okeechobee Alternative Site	9.5×10^{0}	5.2×10^{-1}	1.8×10^{1}
St. Lucie Alternative Site	9.4×10^{0}	5.1×10^{-1}	1.8×10^{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.

Shipping schedules for spent fuel generated by the proposed new unit have not been determined. The NRC staff determined that assuming the annual number of spent fuel shipments to be equivalent to the annual refueling requirements was reasonable for calculating annual doses. Population doses were normalized to the reference LWR in WASH-1238 (880 net MW[e]) (AEC 1972-TN22). This corresponds to an 1,100 MW(e) LWR operating at 80 percent capacity.

The differences in transportation impacts among the four alternative sites evaluated are not significant. In general, impacts at the Turkey Point site are slightly higher than those at the alternative sites, primarily because of the longer shipping distance to Yucca Mountain. However, 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

- 4 person-rem/reactor year to transport workers
- 3 person-rem/reactor year to the 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 Turkey Point site and the 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-TN22). WASH-1238 assumed that each spent fuel shipment would travel a “typical” distance of 1,000 mi, whereas the shipping distances used in this assessment were between 2,900 and 3,100 mi. If the shorter distance were used to calculate the impacts for Turkey Point spent fuel shipments, the doses could be reduced by about 60 to 70 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:

- Use of the regulatory maximum dose rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 calculations. The shipping casks assumed in the EIS prepared by DOE in support of the application for a geologic repository at the proposed Yucca Mountain repository (DOE 2002-TN1236) would transport spent fuel that has cooled for a minimum of 5 years (see 10 CFR Part 961 [TN300], 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 assumption, shipments from the Turkey Point site and alternative sites are also expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 would be further reduced if more realistic dose rate projections and shipping cask capacities are used.
- Use of the shipping cask capacity used in WASH-1238. 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-TN1237), 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-TN69) 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-TN69) 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-TN222) 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 3.5 person-rem/yr or about 36 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 4.9 person-rem/yr (27 percent) and the annual doses to persons along the route were reduced to 0.22 person-rem/yr (37 percent).

In its ER (FPL 2014-TN4058), FPL described the results of a RADTRAN 5.6 analysis of the impacts of incident-free transport of spent fuel to Yucca Mountain. Although the overall approaches are the same (e.g., use of TRAGIS and RADTRAN 5.6), there are some differences in the modeling details. The NRC staff concluded that the results produced by FPL are similar to those calculated by the NRC staff 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 Turkey Point site or the alternative sites to Yucca Mountain are about 19 person-rem, which is less than the 1,754 person-rem value that ICRP (2007-TN422) and NCRP (1995-TN728) suggest would most likely result in no excess health effects. This dose is very small compared to the estimated 4.5×10^5 person-rem that the same population along the route from the proposed Turkey Point site to Yucca Mountain would incur annually from exposure to natural sources of radiation. Note that the estimated population dose along the Turkey Point-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 representative route was 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 waste under normal conditions are presented in Section 6.2.1.1.

6.2.2.2 Radiological Impacts of Transportation Accidents

As discussed previously, the NRC staff used the RADTRAN 5.6 computer code to estimate 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 NRC staff used the radionuclide inventories from the FPL ER (FPL 2014-TN4058). These spent fuel inventories are presented in Table 6-10. The list of radionuclides in the table includes all of the radionuclides that were included in the analysis conducted by Sprung et al. (2000-TN222). The analysis also included the inventory of crud—radioactive material deposited on the external surfaces of LWR spent fuel rods. Crud is deposited from corrosion products generated elsewhere in the reactor cooling system. Because the AP1000 is a new reactor design and has no operating experience, there is uncertainty about the quantities and characteristics of crud that will be deposited on AP1000 spent fuel. This uncertainty will be reduced over time as operating experience with AP1000 reactors increases. For this EIS, Turkey Point AP1000 spent fuel transportation accident impacts were calculated by the NRC staff assuming the cobalt-60 inventory in the form of crud is 4.1 Ci/MTU and the antimony-125 inventory in the form of crud is 0.11 Ci/MTU, based on information provided by Westinghouse.

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for an AP1000 Reactor(a)

Radionuclide	Ci/MTU	Physical-Chemical Group
Am-241	727	Particulate
Am-242m	13	Particulate
Am-243	33	Particulate
Ce-144	8,870	Particulate
Cm-242	28	Particulate
Cm-243	31	Particulate
Cm-244	7,750	Particulate
Cm-245	1.2	Particulate
Co-60[(b)]	4.1	Crud
Cs-134	48,000	Cesium
Cs-137	93,000	Cesium
Eu-154	9,130	Particulate
Eu-155	4,620	Particulate
Kr-85[(c)]	8,900	Gas
Pm-147	17,600	Particulate
Pu-238	6,070	Particulate
Pu-239	255	Particulate
Pu-240	543	Particulate
Pu-241	69,600	Particulate
Pu-242	1.8	Particulate
Ru-106	15,500	Ruthenium
Sb-125[(b)]	0.11	Crud
Sr-90	61,900	Particulate
Y-90	61,900	Particulate

(a) The source of the spent fuel inventories is FPL (2014-TN4058), Table 7.4-3, except as noted in footnote (b).
(b) Cobalt-60 and antimony-125 are the primary radioactive constituents in fuel assembly crud, or radioactive material deposited on the external surfaces of fuel assemblies.
(c) The Kr-85 source term was taken from INEEL (2003) and was included to ensure that potential releases of gaseous radionuclides were considered in the transportation accident risk analysis.

Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71 (TN301). Spent fuel shipping casks must be certified as 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 the spent fuel remains subcritical under both normal and accident conditions. According to Sprung et al. (2000-TN222), 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 spent fuel from an AP1000 reactor would provide equivalent mechanical and thermal protection of the spent fuel cargo.

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-TN81) 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 (i.e., 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-TN222).

The RADTRAN 5.6 accident risk calculations were performed using the radionuclide inventories given in Table 6-10. The resulting risk estimates then were multiplied by assumed annual spent fuel shipments to derive estimates of the annual accident risks associated with spent fuel shipments from the Turkey Point site and the 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-TN222) were used to approximate the impacts from the AP1000 spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding and 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.[(1)]

The four pathways used in the NRC calculations are listed below:

1. External dose from exposure to the passing cloud of radioactive material (cloudshine).
2. External dose from the radionuclides deposited on the ground by the passing plume (groundshine). The 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.
3. Internal dose from inhalation of airborne radioactive contaminants (inhalation).
4. Internal dose from resuspension of radioactive materials that were deposited on the ground (resuspension). The 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.

Table 6-11 presents the environmental consequences of transportation accidents when shipping spent fuel from the Turkey Point site and the 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 (AEC 1972-TN22) reference reactor (i.e., 880 MW(e) net electrical generation, 1,100 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 the alternative sites, none of the alternative sites would be clearly favored over the Turkey Point site.

(1) Internal dose from ingestion of contaminated food was not considered because the staff assumed evacuation and subsequent interdiction of foodstuffs following a postulated transportation accident.

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for an AP1000 Reactor at the Turkey Point Site and the Alternative Sites, Normalized to Reference 1,100 MW(e) LWR Net Electrical Generation

	Normalized Population Impacts, Person-rem/Reference Reactor Year[(a)]
Reference LWR (WASH-1238)	7.2×10^{-5}
AP1000 Reactor at Turkey Point Site	5.2×10^{-5}
Martin Alternative Site	4.5×10^{-5}
Glades Alternative Site	4.5×10^{-5}
Okeechobee Alternative Site	4.5×10^{-5}
St. Lucie Alternative Site	4.6×10^{-5}

(a) To convert person-rem to person-Sv, divide by 100.

Using the linear no-threshold dose-response relationship discussed in Section 6.2.1.1, the annual collective public dose estimates for transporting spent fuel from the Turkey Point site and the alternative sites to Yucca Mountain are on the order of 1×10^{-4} person-rem, which is less than the 1,754 person-rem value that ICRP (2007-TN422) and NCRP (1995-TN728) suggest would most likely result in zero excess health effects. This risk is very small compared to the estimated 4.5×10^{5} person-rem/yr that the same population would incur annually along the route from the proposed Turkey Point site to Yucca Mountain from exposure to natural sources of radiation.

6.2.2.3 Nonradiological Impact of Spent Fuel Shipments

The general approach used to calculate nonradiological impacts of spent fuel shipments is the same as that used for unirradiated fuel shipments. The main difference is that the spent fuel shipping route characteristics are better defined so the State-level accident statistics in Saricks and Tompkins (1999-TN81) may be used. State-by-state shipping distances were obtained from the TRAGIS output file and combined with the annual number of shipments and accident, injury, and fatality rates by State from Saricks and Tompkins (1999-TN81) to calculate nonradiological impacts. In addition, the accident, injury, and fatality rates from Saricks and Tompkins (1999-TN81) were adjusted to account for under-reporting (see Section 6.2.1.3). The results are shown in Table 6-12. 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 Turkey Point Site and the Alternative Sites to Yucca Mountain, Normalized to Reference LWR

Site	One-Way Shipping Distance, km	Nonradiological Impacts, per Year		
		Accidents/yr	Injuries/yr	Fatalities/yr
Turkey Point (proposed site)	3,093	1.5×10^{-1}	9.8×10^{-2}	6.8×10^{-3}
Martin Alternative Site	2,967	1.5×10^{-1}	9.7×10^{-2}	6.6×10^{-3}
Glades Alternative Site	2,980	1.5×10^{-1}	9.7×10^{-2}	6.6×10^{-3}
Okeechobee Alternative Site	2,975	1.5×10^{-1}	9.7×10^{-2}	6.6×10^{-3}
St. Lucie Alternative Site	2,944	1.5×10^{-1}	9.7×10^{-2}	6.5×10^{-3}

Note: The number of shipments of spent fuel assumed in the calculations is 60 shipments/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 Turkey Point site and the alternative sites. The environmental conditions listed in 10 CFR 51.52 (TN250) that apply to shipments of radioactive waste are listed below:

- Radioactive waste (except spent fuel) would be packaged and in solid form.
- Radioactive waste (except spent fuel) would be shipped from the reactor by truck or rail.
- The weight limitation of 73,000 lb per truck and 100 tons per cask per railcar would be met.
- Traffic density would be less than one truck shipment per day or three railcars per month.

Radioactive waste other than spent fuel from the Turkey Point AP1000 reactors is expected to be capable of being shipped in compliance with Federal and/or State weight restrictions. Table 6-13 presents estimates of annual waste volumes and annual waste shipment numbers for an AP1000 reactor normalized to the reference 1,100 MW(e) LWR defined in WASH-1238 (AEC 1972-TN22). The expected annual shipped waste volumes for the AP1000 reactor are estimated at 1,964 ft^3/yr (Westinghouse 2011-TN261), and the annual number of waste shipments was estimated at 23 shipments per year after normalization to the reference LWR in WASH-1238 (AEC 1972-TN22). The annual waste volume and annual number of shipments are less than those for the 1,100 MW(e) reference reactor that was the basis for Table S–4. The annual shipment estimates could also be reduced if more efficient packaging is used to transport waste from the Turkey Point site than is assumed in WASH-1238 (AEC 1972-TN22). The NRC staff reviewed the radioactive waste generation and shipment data in the ER (FPL 2014-TN4058) and concluded that the information is consistent with current LWR operating experience.

Table 6-13. Summary of Radioactive Waste Shipments from the Turkey Point Site and Alternative Sites

Reactor Type	Waste Generation Information	Annual Waste Volume, m^3/yr per Unit	Electrical Output, MW(e) per Unit	Normalized Rate, m^3/1,100 MW(e) Unit (880 MW(e) Net)[(a)]	Shipments/ 1,100 MW(e) (880 MW(e) Net) Electrical Output[(b)]
Reference LWR (WASH-1238)	3,800 ft^3/yr per unit	108	1,100	108	46
Turkey Point AP1000 (ER volume)	1,964 ft^3/yr per unit[(c)]	56	1,000	53	23

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-TN22) and 93 percent for the Turkey Point AP1000 reactor (FPL 2014-TN4058). Waste generation for the AP1000 reactor is normalized to 880 MW(e) net electrical output (1,100 MW(e) unit with an 80 percent capacity factor).
(b) The number of shipments per 1,100 MW(e) was calculated by dividing the normalized rate by the assumed shipment capacity used in WASH-1238 (AEC 1972-TN22) (2.34 m^3/shipment).
(c) This value was taken from the *AP1000 Design Control Document* (Westinghouse 2011-TN261).

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste for an AP1000 reactor located at the Turkey Point site and the alternative sites is less than the one-truck-shipment-per-day condition given in 10 CFR 51.52 (TN250), Table S–4.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and waste under normal conditions are presented in Section 6.2.1.1.

Nonradiological impacts of radioactive waste shipments were calculated using the same general approach as unirradiated and spent fuel shipments. For this EIS, the shipping distance was assumed to be 500 mi one way (AEC 1972-TN22). Because the actual destination is uncertain, national median accident, injury, and fatality rates were used in the calculations (Saricks and Tompkins 1999-TN81). 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 Turkey Point site and alternative sites to waste disposal facilities are less than the impacts calculated for the reference LWR in WASH-1238 (AEC 1972-TN22).

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from the Turkey Point Site

	Normalized Shipments per Year	One-Way Distance, Km	Accidents per Year	Injuries per Year	Fatalities per Year
Reference LWR (WASH-1238) (AEC 1972-TN22)	46	800	3.4×10^{-2}	1.7×10^{-2}	1.1×10^{-3}
Turkey Point AP1000 Reactor	23	800	1.7×10^{-2}	8.5×10^{-3}	5.3×10^{-4}

6.2.4 Conclusions for Transportation

The NRC staff conducted independent confirmatory analyses of potential impacts under normal operating and accident conditions of transportation of fuel and wastes to and from AP1000 reactors to be located at the proposed Turkey Point site and the alternative sites. 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-TN22) by multiplying the AP1000 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 transportation of fuel and radioactive wastes to and from the Turkey Point site and the alternative sites site would be SMALL, and would be consistent with the environmental impacts associated with transportation of fuel and radioactive wastes to and from current-generation reactors presented in Table S–4 of 10 CFR 51.52 (TN250).

The NRC staff concludes that transportation impacts are approximately proportional to the distance from the reactor site to the repository site, in this case from South Florida to Nevada. The distance from the Turkey Point site or any of the alternate sites to any new planned repository in the contiguous United States would be no more than double the distance from the Turkey Point 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 for NEPA purposes (42 U.S.C. § 4321 et seq.) (TN661). The NRC staff concludes that the environmental impacts of these doubled estimates would not be significant and, therefore, would still be SMALL.

6.3 Decommissioning Impacts

At the end of the operating life of a nuclear power reactor, NRC regulations require that the facility be decommissioned. The NRC defines decommissioning as the safe removal of a facility from service and the reduction of residual radioactivity to a level permitting termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75 and 10 CFR 50.82 (TN249). The radiological criteria for termination of the NRC license are in 10 CFR Part 20 (TN283), Subpart E. Minimization of contamination and generation of radioactive waste requirements for facility design and procedures for operation are addressed in 10 CFR 20.1406 (TN283).

An applicant for a COL is required to certify that sufficient funds will be available to provide for radiological decommissioning at the end of power operations. As part of its COL application for the proposed Units 6 and 7 on the Turkey Point site, FPL included a Decommissioning Funding Assurance Report (FPL 2014-TN4103). FPL 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-TN665). 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 AP1000 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.

The GEIS-DECOM does not specifically address the GHG 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 GHG footprint of decommissioning to be of the order of 7.0×10^4 MT (i.e., 2.7×10^4 MT for the reference 1,000 MW(e) LWR multiplied by the scaling factor of 2.6) for two units without SAFSTOR. This footprint is about one-third decommissioning workforce transportation and two-thirds equipment usage. The details of the NRC staff’s estimate are presented in Appendix J for a single unit. A 40-year SAFSTOR period would increase the GHG footprint of decommissioning by about

40 percent. These GHG footprints are roughly three orders of magnitude less than the GHG footprint presented in Section 6.1.3 for the uranium fuel cycle.

Therefore, the 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. The 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 would minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.
6. The ecological impacts of decommissioning are expected to be negligible.
7. The socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

For the proposed new units at Turkey Point, the impacts from decommissioning are expected to be within the bounds described in the GEIS-DECOM for both the Turkey Point site and the alternative sites. On the basis of the GEIS-DECOM and the evaluation of air-quality impacts from GHG emissions above, the NRC staff concludes that, as long as the regulatory requirements for decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

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11. ABSTRACT (200 words or less)
This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Florida Power and Light Company (FPL) for two combined construction permits and operating licenses) combined licenses or COLs). The proposed actions related to the FPL application are (1) NRC issuance of COLs for two new power reactor units (Units 6 & 7) at the Turkey Point Nuclear Power Plant site in Miami-Dade County, Florida, and (2) U.S. Army Corps of Engineers (USACE) decision to issue, deny, or issue with modifications a Department of the Army (DA) permit to perform certain dredge and fill activities in waters of the United States and to construct structures in navigable waters of the United States related to the project.
This EIS documents the review team's analysis, which considers and weighs the environmental impacts of constructing and operating two new nuclear units at the Turkey Point site and at alternative sites, including measures potentially available for reducing or avoiding adverse impacts.
After considering the environmental aspects of the proposed action before the NRC, 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 FPL; (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the consideration of public comments received on the environmental review; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS.

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