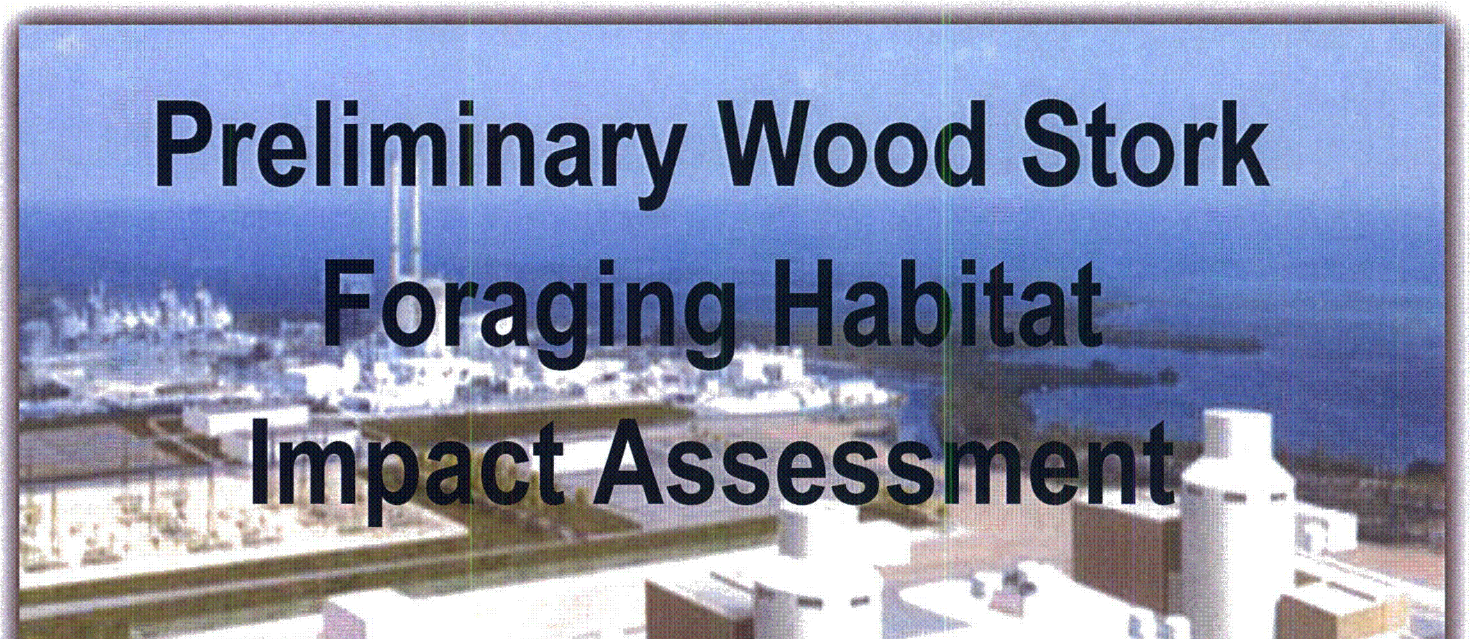
APPENDIX A

PRELIMINARY WOOD STORK FORAGING HABITAT ASSESSMENT

Turkey Point Units 6 & 7



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1.0 INTRODUCTION

On April 11, 2008, the Florida Public Service Commission (PSC) issued the need determination order for the Florida Power & Light Company (FPL) Turkey Point Units 6 & 7 Project (Project) including transmission facilities to interconnect and integrate the new generation facility to the transmission grid. New 500- and 230-kilovolt (kV) electric transmission lines are needed to connect the proposed Clear Sky substation within the Turkey Point Units 6 & 7 Site to various other existing FPL substations in Miami-Dade County. Approximately 88.7 miles of preferred transmission corridors are being proposed (52 miles West Preferred Corridor and 36.7 miles East Preferred Corridor), as illustrated on Figure 1.[1]

FPL is seeking certification of corridors for the transmission lines associated with Turkey Point Units 6 & 7 through the Florida Electrical Power Plant Siting Act (PPSA), as described in the Site Certification Application (SCA) submitted in June 2009 (FPL, 2009). As such, design details such as right-of-way (ROW) location and width within the corridor, transmission structure locations, structure heights, and access road locations cannot be finalized until after the corridors are certified. FPL has provided a conservative estimate of wetland impact acreage for the transmission corridors based on the best available information and a reasonable worst-case scenario of wetland impacts of the eventual ROWs. Based on the worst-case evaluation, construction of the transmission facilities could result in as much as approximately 308 acres of wetland impact associated with the West Preferred Corridor and <0.5 acres of wetland impact associated with the East Preferred Corridor.

The areas designated as Core Foraging Areas (CFAs) for the endangered wood stork (*Mycteria americana*) in relation to the proposed transmission facilities within the West Preferred Corridor are shown in Figure 2. The U.S. Fish and Wildlife Service (USFWS) and the Florida Fish and Wildlife Conservation Commission (FWC) consider the area within 18.6 miles (30 km) of a wood stork nesting colony as the CFA for wood storks (DOI, 2010a, 2010b). The USFWS believes loss of suitable wetlands within these CFAs may reduce foraging opportunities for the wood stork.

As part of the U.S. Army Corps of Engineers (USACE) wetland permitting process under Section 404(b)(1) of the Clean Water Act and in accordance with 40 Code of Federal Regulations (CFR) Part 230 and 33 CFR Part 320, impacts to wetlands within a wood stork colony CFA are assessed in consultation with the USFWS under Section 7 of the Endangered Species Act. Under the South

[1] This report does not address the FPL West Secondary Corridor. In the event the FPL West Secondary Corridor is the option certified under the Florida Electrical Power Plant Siting Act, this report will be revised.

Florida Programmatic Concurrence for the wood stork between the USFWS and USACE, the USFWS has developed a Wood Stork Effect Determination Key (see Attachment A) to facilitate USACE's evaluation of potential adverse effects upon wood storks associated with a particular project. The USFWS routinely concurs with USACE's "may affect, not likely to adversely affect" (NLAA) determination for individual project effects to the wood stork when project effects are insignificant due to scope or location, or if assurances are given that wetland impacts have been avoided, minimized, and adequately compensated such that there is no net loss in foraging potential. Impacts to wetlands within a CFA that provides wood stork foraging habitat must be compensated through provision of mitigation that provides for equal or greater wood stork foraging habitat value, measured as the estimated prey biomass available on an annual basis.

An evaluation of the loss of wood stork foraging habitat within the CFAs associated with the West Preferred Corridor was conducted, as well as an evaluation of the foraging habitat compensation resulting from the Project's proposed purchase of wetland mitigation credits from the Hole in the Donut (HID) mitigation bank within the Everglades National Park (ENP). The impact evaluation was performed in accordance with the wood stork foraging assessment methodology contained within the USFWS South Florida Wood Stork Effect Determination Key, and was based upon the worst-case estimate of wetland impacts within CFAs associated with the West Preferred Corridor, the vegetative community composition of impacted wetlands relative to suitable wood stork foraging habitat, and the approximate hydroperiods of impacted wetlands. The impacts are quantified as the total loss of fish biomass (kg) associated with loss of foraging habitat. The assessment of mitigation was conducted in accordance with the USFWS guidance based upon the acreage of wetland restoration, evaluation of the pre-restoration and post-restoration condition of vegetative communities and hydroperiods relative to suitable wood stork foraging habitat, and the resulting increase in prey biomass available for wood storks. The results will be revised after detailed transmission line design and location to refine wetland impact location, type, and extent as well as identification of specific mitigation parcels within the HID to refine restoration acreage by hydroperiod classes.

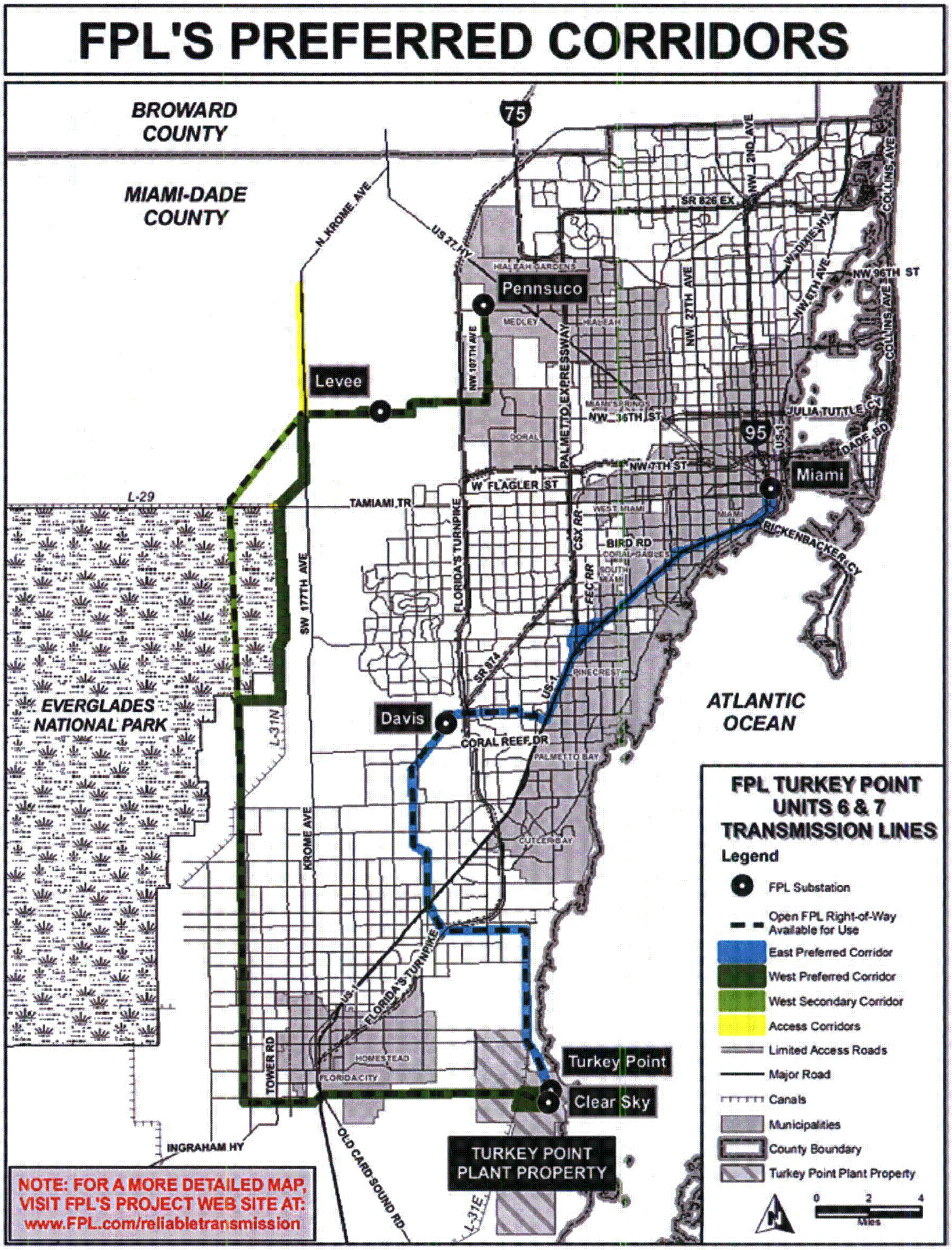


Figure 1. Proposed Transmission Corridor Locations

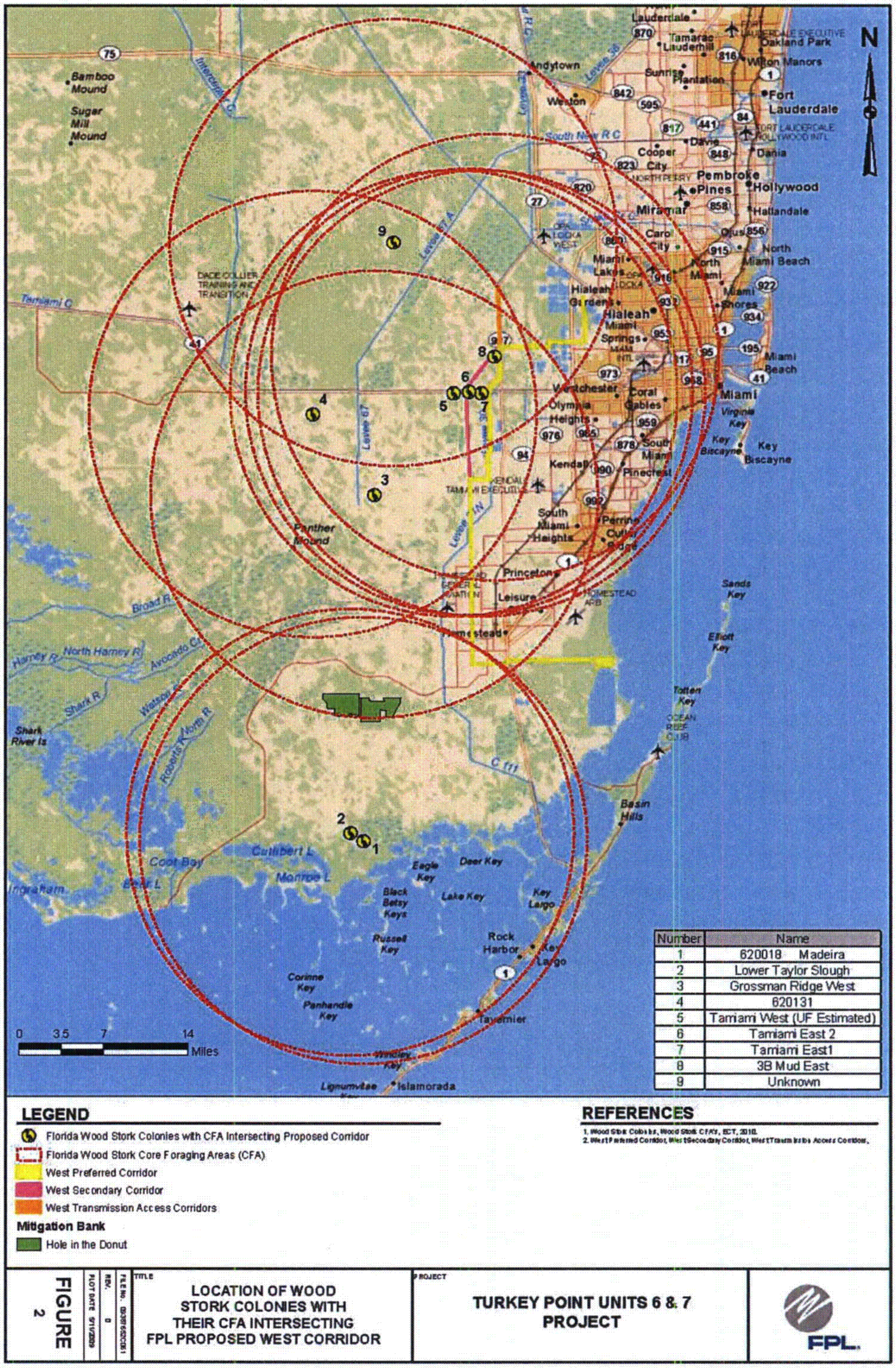


Figure 2. Location of Wood Stork Colonies and CFAs relative to the West Preferred Corridor

2.0 PROPOSED TRANSMISSION FACILITIES

The new transmission facilities will deliver approximately 2,200 megawatts (MW) of new generation from the Clear Sky substation within the Turkey Point Units 6 & 7 Site (Site) located on FPL's Turkey Point plant property to several of FPL's existing transmission substations in Miami-Dade County (Figure 1). The proposed corridors follow FPL rights-of-way or other existing linear facilities from the Site to the various substations. For connection to the western substations, FPL has proposed the West Preferred Corridor and the West Secondary Corridor, both of which include access corridors. For connection to the eastern substations, FPL has proposed the East Preferred Corridor.

FPL is seeking certification of preferred corridors for the transmission lines associated with Turkey Point Units 6 & 7 through the PPSA, as described in the Site Certification Application (SCA) submitted in June 2009 (FPL 2009). Design details such as ROW location and width within the corridor, transmission structure locations, structure heights, and access road locations cannot be finalized until after the corridors are certified. The corridors proposed for the Project provide the flexibility to accommodate reasonably foreseeable design options. Final design of the transmission facilities will comply with conditions of certification and will be determined based on local conditions and prudent technological options available at the time design is finalized. Typical transmission structures, pad, and access road designs currently available that could be used where appropriate are depicted in Chapter 9 of the SCA.

2.1 Proposed Transmission Lines within the West Preferred Corridor

2.1.1 Clear Sky-Levee #1 and #2 500-kV Transmission Lines

From the proposed onsite Clear Sky substation, FPL is proposing two 500-kV lines extending west and then north to the existing Levee substation located in unincorporated Miami-Dade County east of State Road (SR) 997/Krome Avenue and north of U.S. Highway 41 (U.S. 41)/Tamiami Trail (Figure 1). FPL currently has available ROW (either in fee or easement) for a significant portion of this distance. The total length of this transmission corridor to the Levee substation is approximately 43.6 miles.

2.1.2 Clear Sky-Pennsuco 230-kV Transmission Line

From the proposed Clear Sky substation, FPL will extend a 230-kV transmission line to the west and then north to the existing Pennsuco substation located along NW 106th Street, south of U.S. Highway 27 (U.S. 27) near Medley in unincorporated Miami-Dade County (Figure 1). This line is proposed to be largely constructed in the same ROW as the previously described 500-kV lines within the West

Preferred Corridor. However, the Clear Sky-Pennsuco 230-kV line will not connect to but rather bypass the Levee substation. From the Levee substation to the Pennsuco substation, FPL has an existing multi-circuit transmission line ROW that will be used in part for the proposed Clear Sky-Pennsuco 230-kV transmission line. This 230-kV-only portion of the West Preferred Corridor is approximately 8.4 miles long.

2.2 Proposed Transmission Lines within the East Preferred Corridor

2.2.1 Clear Sky-Davis 230-kV and Davis-Miami 230-kV Transmission Lines

From the proposed Clear Sky substation, FPL will require a single-circuit 230-kV transmission line connecting to the existing Davis substation and another 230-kV transmission line connecting the Davis substation to the existing Miami substation (Figure 1). The Davis substation is located in unincorporated Miami-Dade County at the intersection of SW 136th Street and SW 127th Avenue. The Miami substation is located in the City of Miami at the northeast intersection of SW 2nd Avenue and the Miami River.

The Clear Sky to Davis portion of the East Preferred Corridor allows for the collocation of the new transmission line within an existing multi-circuit FPL transmission line ROW. This existing ROW (approximately 19 miles long) has the space to accommodate the proposed single-circuit 230-kV line without the need for additional ROW. From Davis to Miami, new ROW will be required for this Project; however, most of the corridor includes existing transmission or transportation ROWs [U.S. Highway 1 (U.S. 1), Busway, Metrorail]. The Davis-Miami portion of the East Preferred Corridor is approximately 17.7 miles long.

2.2.2 Clear Sky-Turkey Point 230-kV Transmission Line

FPL is also seeking certification of a short 230-kV transmission line from the proposed Clear Sky substation to its existing Turkey Point substation. Both substations are located on FPL's Turkey Point plant property, approximately 0.4 mile apart. This short section of 230-kV line will be constructed within the boundaries of the East Preferred Corridor.

3.0 ASSESSMENT AREA DESCRIPTION

For purposes of the wood stork foraging habitat assessment, the assessment area includes those portions of the proposed transmission facilities that will result in unavoidable wetland impacts within CFAs. The East Preferred Corridor is proposed to be constructed within an existing multi-circuit FPL transmission line ROW, which can accommodate the proposed single-circuit 230-kV line without the need for additional ROW, access roads, or transmission structure pads. The estimated unavoidable wetland impact associated with the East Preferred Corridor is <0.5 acre and is located outside the boundary of any wood stork colony CFA; therefore, this wood stork foraging habitat assessment is focused upon the West Preferred Corridor.

3.1 West Preferred Corridor Assessment Area

A total of nine wood stork colony CFAs encompass portions of the West Preferred Corridor, as identified on Figure 2: Colony #620018 Madeira (1), Lower Taylor Slough (2), Grossman Ridge West (3), Colony #620131 (4), Tamiami West (5), Tamiami East 2 (6), Tamiami East 1 (7), 3B Mud East (8), and an un-named colony (9). The CFAs associated with these nine colonies include approximately 1,411,711 acres of suitable wood stork foraging habitat.

The existing land use and vegetation cover types were identified for the West Preferred Corridor using FDOT's Florida Land Use, Cover, and Forms Classification System (FLUCFCS) published in 1999 as modified by the South Florida Water Management District (SFWMD) in 2004. The FLUCFCS data were obtained from SFWMD and updated based upon field surveys to reflect current conditions. Maps illustrating the location of vegetative communities within the West Preferred Corridor, classified in accordance with the FLUCFCS, are provided in Attachment B (SCA Figure W9.1.0-4 - Map Sheets 1 through 38).

Most of the land use/cover classifications identified along the portion of the West Preferred Corridor within the CFAs reflects human-induced changes within the landscape. That is, much of the historical vegetation that occurred within the corridor and in the region has been cleared for residential, agricultural, or industrial uses. Although much of the area within the West Preferred Corridor has been altered, a variety of upland and wetland plant communities of varying quality exist within the corridor. Aquatic communities within the West Preferred Corridor include canals, ditches, channelized river/stream/waterways, reservoirs, and reservoirs less than 10 acres. Most are vegetated by a variety of native and exotic floating or emergent herbs, many of which are considered nuisance species by the Florida Exotic Plant Pest Council.

Forested and herbaceous wetlands in the West Preferred Corridor are dominated by freshwater marsh, wet prairies, exotic wetland hardwoods, and mixed wetland hardwoods. The quality of wetlands ranges from relatively undisturbed communities supporting native vegetation and providing valuable wildlife habitat to those that have been so impacted by drainage or location within/next to intensive agricultural or developed areas that inherent functional values such as wildlife habitat, water quality, and flood attenuation have been severely degraded. The extensive drainage system (canals/ditches) constructed in the region has drastically altered the historical hydrology of the wetland communities in the corridors with a concomitant change to structure and functional attributes. This is often manifested by the proliferation of transitional or even upland species, as well as nuisance exotics in many wetlands within the region.

Areas of potential wood stork foraging habitat within the West Preferred Corridor assessment area are described below.

3.1.1 West Preferred Corridor Assessment Area Habitat Descriptions

Canals/Channelized River, Stream, Waterway (FLUCFCS 510) – Several canals are crossed by the West Preferred Corridor. These manmade canals are typically sparsely vegetated by a variety of floating and emergent hydrophytes. Common plants include water lettuce (*Pistia stratiotes*), water hyacinth (*Eichhornia crassipes*), Cuban bulrush (*Scirpus cubensis*), primrose willow (*Ludwigia* sp.), Mexican primrose willow (*Ludwigia octovalvis*), smartweeds (*Polygonum* spp.), torpedo grass (*Panicum repens*), duck potato (*Sagittaria lancifolia*), pickerelweed (*Pontederia cordata*), and common reed (*Phragmites australis*). Most of the linear waterways are periodically maintained by the spraying of herbicides to maintain flow. Much of the vegetation in these canals is considered nuisance species, either native or exotic. The banks (spoil areas) along these linear water bodies are also dominated by weedy, often nuisance, native and exotic plants. No fill is proposed to be placed within canals during construction of the transmission facilities.

Mixed Wetland Hardwoods (FLUCFCS 617) – This community occurs throughout the West Preferred Corridor, with most areas occurring near or in the ENP. Mixed wetland hardwood forests are typically dominated by sweet bay (*Magnolia virginiana*), swamp laurel oak (*Quercus laurifolia*), and swamp red bay (*Persea palustris*) in association with other hardwoods including buttonwood (*Conocarpus erectus*), Australian pine (*Casuarina equisetifolia*), cocoplum (*Chrysobalanus icaco*), red mangrove (*Rhizophora mangle*), Brazilian pepper (*Schinus terebinthifolius*), and Carolina willow (*Salix caroliniana*). The shrub stratum is typically sparse, comprised of scattered individuals of wax myrtle (*Myrica cerifera*) and buttonbush (*Cephalanthus occidentalis*), among others. The stratum density varies with degree of shading. Typically, lizard's tail (*Saururus cernuus*), pickerelweed, beakrushes (*Rhynchospora* spp.), royal fern (*Osmunda regalis*), and swamp fern (*Blechnum serrulatum*) are found. These forests are characteristically flooded or saturated for much of the year, drying only for short periods during the dry winter season. Construction of ditches and canals has shortened the hydroperiod of many of these forests.

Exotic Wetland Hardwoods (FLUCFCS 619) – Areas dominated by Brazilian pepper, melaleuca (*Melaleuca quinquenervia*), Australian pine, or a combination thereof, classified as exotic wetland hardwoods, are common within the West Preferred Corridor. Subdominant species include primrose willow, wild taro (*Colocasia esculenta*), Johnson grass (*Sorghum halepense*), and beggarticks (*Bidens* sp.).

Wetland Scrub (FLUCFCS 631) – Wetland scrub habitat rarely occurs within the corridor and is dominated by a mixture of exotic and nuisance species such as napier grass (*Pennisetum purpureum*), cattail (*Typha* sp.), Carolina willow, wild taro, and Brazilian pepper.

Freshwater Marshes (FLUCFCS 641) – Freshwater marshes occur throughout the West Preferred Corridor and dominate areas of the ENP. They are vegetated with a wide assortment of herbaceous plant species growing on sandy or organic soils in areas of variable water depths and inundation regimes. Species characteristic of the marshes in the West Preferred Corridor assessment area include sawgrass (*Cladium jamaicense*), pickerelweed, maidencane (*Panicum hemitomon*), fireflag (*Thalia geniculata*), cattail, smartweeds, and sedges (*Cyperus haspan, C. odoratus,* and *C.* spp.). In more disturbed areas, primrose willows, Brazilian pepper, poisonwood (*Metopium toxiferum*), Australian pine, shoebutton ardisia (*Ardisia elliptica*), musky mint (*Hyptis alata*), woman's tongue (*Albizia lebbeck*), nettletree (*Trema micranthum*), and torpedo grass are abundant. The best quality marshes exhibit zonation and a variety of desirable, native herbs. Many marshes within the West Preferred Corridor have been impacted by drainage and agricultural practices to varying degrees.

Wet Prairies (FLUCFCS 643) – Wet prairies are similar to freshwater marshes with the exception that they typically do not flood as deeply nor exhibit as long a hydroperiod as do freshwater marshes. Typically, wet prairies are dominated by grasses and sedges including sawgrass, fall panicgrass (*Panicum dichotomiflorum*), redtop panicum (*Panicum rigidulum*), bluejoint panicum (*Panicum tenerum*), yellow-eyed grasses (*Xyris* spp.), doll's daisy (*Boltonia diffusa*), love grasses, and torpedograss. As for freshwater marshes, wet prairies have been impacted by drainage and agricultural practices to some degree.

3.2 HID Mitigation Bank Assessment Area

The Hole-in-the-Donut Mitigation Bank (HID) is an approximately 6,250-acre area of former wetlands within the ENP that were significantly altered for agricultural purposes, resulting in modified hydrology and soils, and dominance by the nuisance/exotic species Brazilian pepper. A total of three wood stork colony CFAs encompass some portion of the HID (see Figure 2). The HID service area includes all of Miami-Dade County; the nine wood stork colony CFAs that encompass portions of the West Preferred Corridor all occur within the HID mitigation service area boundaries.

Restoration goals are focused towards permanent removal of exotic vegetation, restoration of natural soil conditions, and returning the area to a marl prairie wetland. Historic farming activities utilized rock-plowing to break up the original limestone surface and mix it with the surficial marl soil, which increased ground surface elevations and in turn decreased the hydroperiod such that 1985 National Wetland Inventory surveys mapped the area as uplands.

The return of wetland functions within the HID involves the complete removal of all existing exotic vegetation and complete removal of historical rock-plowed agricultural soils high in phosphorus. Early attempts at restoration of native vegetation through seeding, planting, mechanical removal of exotics, herbicide application, fire, and mowing or discing of farmed areas proved unsuccessful for exotic vegetation control. In order to prevent re-establishment of Brazilian pepper, complete removal of anthropogenic soils was required. The removal of rock-plowed material reduced the land elevation, allowing restoration of a more typical wetland hydroperiod to support the target marl prairie wetland community. In May 2008, vegetation within restored wetlands included a cumulative total of 96 species, dominated by herbaceous species bushy bluestem (Andropogon glomeratus), spadeleaf (Centella asiatica), sawgrass, hairawn muhly (Muhlenbergia capillaris), and broomsedge bluestem (Andropogon virginicus).

The target marl prairie wetland community contains both short hydroperiod wetlands that concentrate wood stork prey as well as longer hydroperiod wetlands that provide drought resistant foraging opportunities. This mosaic of restored wetland communities with varying hydroperiods has created valuable wood stork foraging habitat within close proximity to multiple breeding colonies. Over the course of nine years of wildlife monitoring, a total of fifteen species of wading birds have been observed at the HID, with the number of individuals observed during any one year ranging between 363 and 2,631, and wood storks occurring in every year (O'Hare, 2009).

4.0 WOOD STORK FORAGING HABITAT ASSESSMENT METHODOLOGY

There are essentially four variables in the assessment wood stork foraging habitat: the density of exotic vegetation within habitats suitable for wood stork foraging, the hydroperiods of the wetlands affected, the fish and crayfish density (prey biomass) available to the wood stork from the biomass of the wetlands affected, and the likelihood that the wood stork is the wetland species that actually consumes the concentrated prey. The acreage of wetland impact resulting from the Project relative to these four parameters is used to calculate an estimate of wood stork foraging losses in terms of fish biomass. The increase in wood stork foraging habitat resulting from the Project's proposed mitigation activities is calculated similarly, comparing the pre-restoration condition to the post-restoration condition in terms of fish biomass. The following wood stork foraging habitat analysis follows the guidelines contained in the USFWS South Florida Wood Stork Key (Attachment A).

4.1 Wetland Impact Assessment

FPL is seeking certification of corridors for the transmission lines associated with Turkey Point Units 6 & 7 under the PPSA. As such, design details such as ROW location and width within the corridor, transmission structure locations, structure heights, and access road locations cannot be finalized until after the corridors are certified. In order to accommodate future design options, FPL has provided a conservative estimate of wetland impact acreage for the transmission corridors based on the best available information and a reasonable worst-case scenario of wetland impacts of the eventual ROWs. Conceptual designs for transmission access roads and structure pads (presented in SCA Chapter W9.0) were used to estimate wetland impacts; avoidance and minimization efforts incorporated into the final engineering design are anticipated to reduce the worst-case wetland impact estimates.

The West Preferred Corridor was divided into segments defined by construction engineering requirements, as illustrated in Attachment C and Figure 3, and overall wetland impacts estimated for each segment. With the exception of Segments 1A, 1B, 1C, and a portion of Segment 1D, all West Preferred Corridor Segments are located within wood stork CFAs. The total estimated acreage of wetland fill, approximate wetland functional assessment scores, and corresponding amount of wetland functional loss for each segment is summarized in Table 4-1 below.

Table 4-1. West Preferred Corridor Conceptual Wetland Impact Summary

Segment	Impacted Wetland Types (FLUCFCS Codes)	Estimated Wetland Fill Impact (Acres)	Approximate UMAM Score	Estimated Functional Loss (UMAM Credits)
1A[a]	612-B	4.91	0.80	3.93
1B[a]	617, 641	23.65	0.83	19.63
1C[a]	617, 641	19.89	0.83	16.51
1D[b]	617, 619, 641, 643	44.76	0.70	31.33
2	641	2.70	0.60	1.62
3A	617, 619, 641	15.33	0.80	12.26
3B	617, 619, 641, 643	102.63	0.80	82.10
3C	617, 618, 619, 641	55.95	0.83	46.44
4	617, 619, 641, 643	27.69	0.70	19.38
5A	619, 631, 641, 643	1.06	0.70	0.74
5B	619, 641, 643	0.28	0.70	0.20
Levee Substation	619, 641	7.50	0.70	5.25
Tamiami Trail Access Corridor	641	1.63	0.80	1.30
Krome Avenue Access Corridor	619, 641	0.20	0.70	0.14
	TOTAL	**308**		**241**

[a]Segment not located within wood stork CFA
[b]Portion of segment not located within wood stork CFA
Source: SCA Appendix 10.4

In order to determine approximate acreage of impact by wetland type (FLUCFCS code), field-verified FLUCFCS maps (Attachment B) were used to determine the relative occurrence of each wetland type within each segment (Table 4-2).

Table 4-2. Relative Occurrence of Wetlands by FLUCFCS within West Preferred Corridor Segments

Segment	Relative Occurrence by Wetland Type (FLUCFCS Codes)						Estimated Total Wetland Impact (Acres)
	617	618	619	631	641	643	
1D	4.70%		38.40%		40.62%	16.28%	23.72*
2					100%		2.70
3A	30.17%		13.12%		56.71%		15.33
3B	42.55%		7.08%		41.74%	8.64%	102.63
3C	7.11%	0.43%	11.43%		64.39%		55.95
4	16.28%		32.44%		38.25%	13.03%	27.69
5A			25.44%	1.79%	68.74%	4.04%	1.06
5B			26.82%		71.12%	2.06%	0.28
Levee Substation			60.18%		39.82%		7.50
Tamiami Trail Access Corridor					100%		1.63
Krome Ave. Access Corridor			28.37%		71.63%		0.20

*For segment 1D, only the portion located within the wood stork CFA was included.

The estimated acreage of impact by wetland type (FLUCFCS code) was then derived by multiplying the relative occurrence (percent) of each wetland type by the total impact acreage for each segment of the corridor (Table 4-3).

Table 4-3. Estimated Acreage of Wetland Impact by FLUCFCS Within Wood Stork CFAs for West Preferred Corridor Segments

Segment	Estimated Fill Impact (acres) by Wetland FLUCFCS						Estimated Total Wetland Impact (Acres)
	617	618	619	631	641	643	
1D	1.12		9.11		9.63	3.86	23.72*
2					2.70		2.70
3A	4.63		2.01		8.69		15.33
3B	43.66		7.26		42.84	8.87	102.63
3C	4.77	0.29	7.67		43.22		55.95
4	4.51		8.98		10.59	3.61	27.69
5A			0.27	0.02	0.73	0.04	1.06
5B			0.07		0.20	0.01	0.28
Levee Substation			4.51		2.99		7.50
Tamiami Trail Access Corridor					1.63		1.63
Krome Avenue Access Corridor			0.06		0.14		0.20
TOTAL	**58.69**	**0.29**	**39.94**	**0.02**	**123.36**	**16.39**	**238.69**

*For segment 1D, only the portion located within the wood stork CFA was included.

4.2 Impacts to Foraging Habitat

Researchers have shown that wood storks forage most efficiently in habitats where prey densities are high, the water is shallow, and the canopy is open enough to hunt successfully (Ogden et al., 1978; Browder, 1984; Coulter, 1987). Prey availability to wood storks is dependent upon fish and crayfish density (biomass/m^2) and physical access to the foraging site, including tree canopy cover, water depth, and density of submerged vegetation. Studies suggest that wood storks prefer ponds and marshes, and utilize areas with little or no canopy more frequently (Coulter and Bryan, 1993).

In accordance with the USFWS guidance, the quantification of wood stork foraging habitat impact is based upon both the amount (acreage) of wetland impact and the corresponding quality of those wetlands with respect to characteristics preferred by wood storks as foraging habitat. Factors evaluated in the determination of foraging habitat quality include the density of exotic vegetation, hydroperiod, fish and crayfish density per hydroperiod, prey biomass per hydroperiod, wood stork suitable prey base (biomass per hydroperiod), and estimates of actual biomass consumed by wood storks.

Wetland suitability for wood stork foraging is partially dependent on vegetation density. Melaleuca and Brazilian pepper are dense-stand growth plant species, effectively producing a closed canopy and dense understory growth pattern that generally limits a site's accessibility to foraging wading birds. These and other exotic vegetation are considered to limit the suitability of an area for wood stork foraging. Table 4-4 (below) is used by the USFWS to adjust the value of a foraging habitat based upon the percent cover of exotic vegetation.

Table 4-4. Wood Stork Foraging Habitat Suitability

Exotic Percentage	Foraging Suitability (Percent)
Between 0 and 25 percent exotics	100
Between 25 and 50 percent exotics	64
Between 50 and 75 percent exotics	37
Between 75 and 90 percent exotics	3
Between 90 and 100 percent exotics	0

Source: USFWS, 2010.

Wetland suitability for wood stork foraging is also dependent upon hydroperiod; both fish and crayfish density and subsequent biomass have been shown to increase with increasing hydroperiod. SFWMD has defined seven hydroperiod classes for wetlands within the Everglades Protection Area as part of a modeling effort of restoration efforts. The USFWS wood stork foraging habitat analysis utilizes the SFWMD hydroperiod classes (Table 4-5) to categorize potential foraging areas according to the average annual days of inundation.

Table 4-5. SFWMD Hydroperiod Classes

Hydroperiod Class	Days Inundated
Class 1	0-60
Class 2	60-120
Class 3	120-180
Class 4	180-240
Class 5	240-300
Class 6	300-330
Class 7	330-365

Source: USFWS, 2010.

USFWS extrapolated data from Trexler et al. (2002) to determine approximate fish density by hydroperiod class (Attachment A, Appendix 3, Table 6), and estimated mean annual fish biomass by hydroperiod class based on studies by Turner et al. (1999), Turner and Trexler (1997), and Carlson and Duever (1979) (Attachment A, Appendix 3, Table 7). The mean annual fish biomass data were analyzed with respect to the primary fish species and size classes consumed by wood storks (Ogden et al., 1976) to derive the suitable prey base (fish biomass) per hydroperiod class potentially available to predation by wood storks (Attachment A, Appendix 3, Table 9).

According to the USFWS (DOI 2010a), although no definitive studies identify crayfish as an important component of the wood stork's diet, there is evidence that wood storks consume crayfish (Lauritsen; 2007, 2009; Depklin et al., 1992; Bryan and Gariboldi, 1998; Kahl, 1964). USFWS utilized data from Acosta and Perry (2002) regarding crayfish densities and biomass relative to months of inundation to estimate crayfish densities and biomasses for each SFWMD hydroperiod class. These data are combined with the fish biomass data to derive the total wood stork suitable prey biomass by hydroperiod class (Table 4-6).

Table 4-6. Wood Stork Suitable Prey Base (Fish and Crayfish) by SFWMD Hydroperiod Classes

Hydroperiod Class	Days Inundated	Biomass		Total Biomass
		Fish	Crayfish	
Class 1	0-60	0.26 gram/m^2	0.05 gram/m^2	0.31 gram/m^2
Class 2	60-120	0.52 gram/m^2	0.10 gram/m^2	0.62 gram/m^2
Class 3	120-180	1.19 grams/m^2	0.13 gram/m^2	1.32 grams/m^2
Class 4	180-240	2.18 grams/m^2	0.15 gram/m^2	2.34 grams/m^2
Class 5	240-300	2.70 grams/m^2	0.23 gram/m^2	2.93 grams/m^2
Class 6	300-330	3.12 grams/m^2	0.24 gram/m^2	3.36 grams/m^2
Class 7	330-365	3.38 grams/m^2	0.25 gram/m^2	3.63 grams/m^2

In accordance with the USFWS' revised assessment of Fleming's (1994) analysis of the effect of competition on foraging efficiency, a competition factor of 32.5% was used to derive estimates of the actual prey biomass consumed by wood storks for each hydroperiod class, as summarized below (Table 4-7).

Table 4-7. SFWMD Hydroperiod Classes and Corresponding Prey Biomass Consumed by Wood Storks

Hydroperiod Class	Days Inundated	Fish and Crayfish Biomass
Class 1	0-60	0.10 gram/m^2
Class 2	60-120	0.20 gram/m^2
Class 3	120-180	0.43 gram/m^2
Class 4	180-240	0.76 gram/m^2
Class 5	240-300	0.95 gram/m^2
Class 6	300-330	1.09 grams/m^2
Class 7	330-365	1.18 grams/m^2

The factors described above are used to calculate the amount of prey biomass lost resulting from unavoidable wetland impacts, using the following formula:

Impact area (m^2) × Actual Prey Biomass Consumed (Table 4-7) ×
Exotic Foraging Suitability Index (Table 4-4) = Biomass Lost (grams)

For the purpose of this preliminary assessment, hydroperiod classes for wetland impacts were assigned based upon available water level data and typical values from literature for various wetland types (Table 4-8). Marl prairie wetlands occur in the western portion of the corridor (Segment 1D) and typically exhibit a short hydroperiod ranging between three to seven months (Lodge, 2005); wetlands within this segment were assigned to hydroperiod class 3. Wet prairie systems occur within Segment 2; these are typically short-hydroperiod wetlands (<4 months) and were assigned to hydroperiod class 3. SFWMD monitoring stations L31NN and L31NS are located in close proximity to West Preferred Corridor Segments 3A, 3B, 3C, the Tamiami Trail access corridor, and the Krome Avenue access corridor (Figure 3); data from these SFWMD stations (Figures 4 and 5) were utilized to determine the approximate hydroperiod and corresponding SFWMD hydroperiod class for wetlands within these segments. Based on average days of inundation measured at two stations adjacent to the L31-N (183 and 268 days/yr), wetlands within Segments 3A and 3B were assigned hydroperiod class 4, while wetlands within Segment 3C were assigned hydroperiod class 5. Within Segment 4, an average wetland inundation of approximately 8 months/year (SFWMD hydroperiod class 5) was assigned based on typical of sawgrass marsh which ranges from less than 6 months to continuously inundated (Lodge, 2005). Wetlands within Segments 5A and 5B were assigned hydroperiod class 3, similar to wetlands within Segments 3A and 3B. Drainage canals (FLUCFCS 510) are typically too deep to allow for wood stork foraging and are also unlikely to be impacted during construction of the proposed transmission facilities.

The foraging habitat suitability values for wetlands classified as FLUCFCS 619 (exotic wetland hardwoods) correspond to wetlands with 75 to 90 percent exotics (3 percent foraging suitability). It was assumed that the foraging habitat suitability values for marsh, wetland scrub, and wet prairie systems within the West Preferred Corridor correspond to wetlands with < 25 percent exotics (100 percent foraging suitability).

These assumptions may be modified once specific impact areas are determined based upon post-certification design details such as ROW location and width within the corridor, transmission structure locations, structure heights, and access road locations.

Table 4-8. West Preferred Corridor Estimated Wetland Impacts Within Wood Stork CFAs by SFWMD Hydroperiod Classes

Segment	SFWMD Hydroperiod Class							Estimated Total Wetland Impact (Acres)
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	
1D			23.72					23.72*
2			2.70					2.70
3A				15.33				15.33
3B				102.63				102.63
3C					55.95			55.95
4					27.69			27.69
5A			1.06					1.06
5B			0.28					0.28
Levee Substation					7.50			7.50
Tamiami Trail Access Corridor				1.63				1.63
Krome Avenue Access Corridor					0.20			0.20
TOTAL			**27.76**	**119.59**	**91.34**			**238.69**

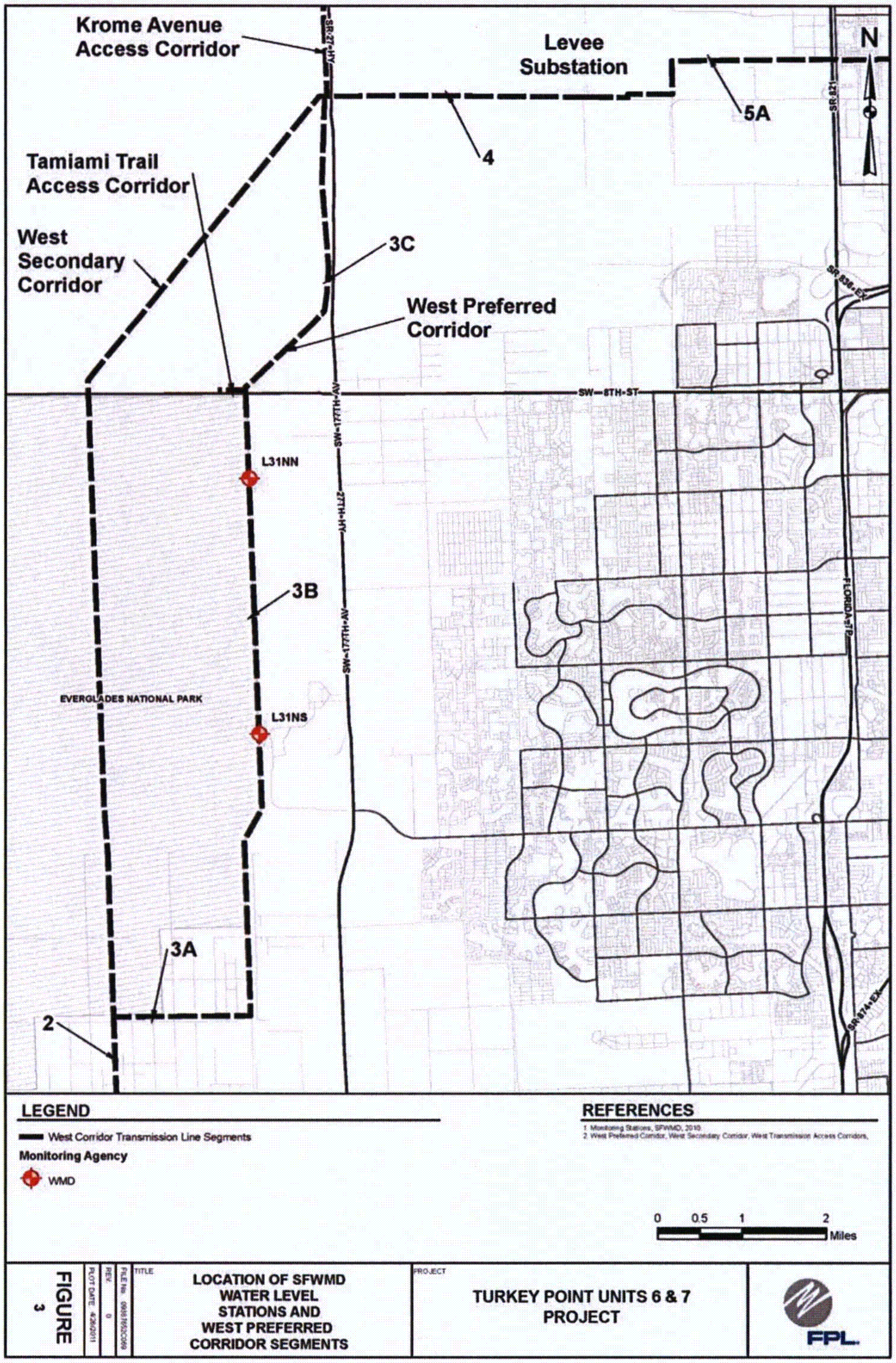
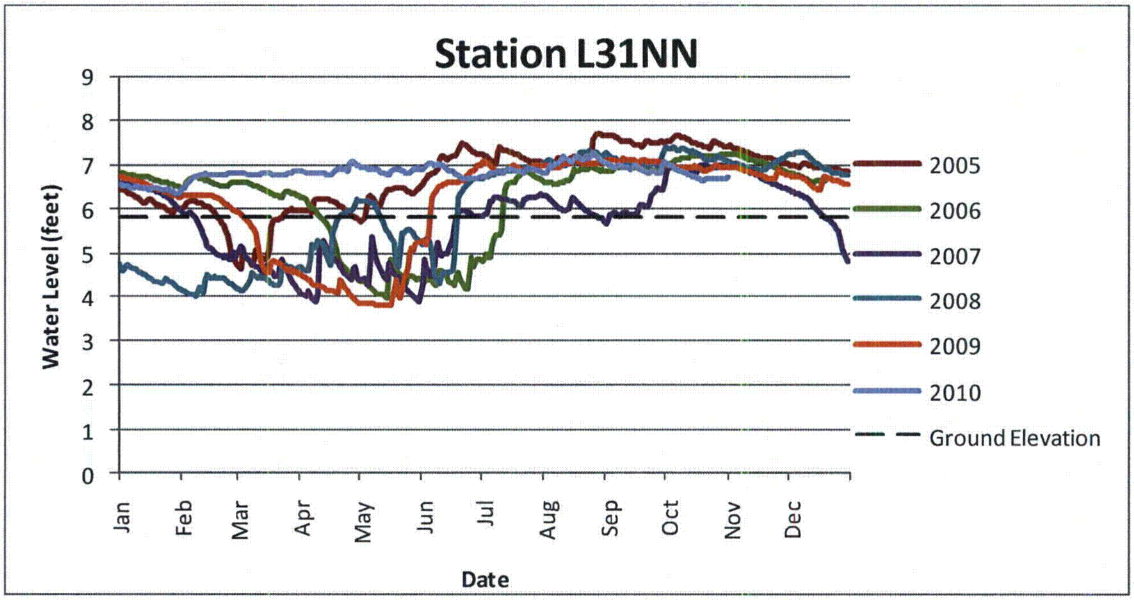


Figure 3. Location of SFWMD Monitoring Stations and West Preferred Corridor Segments



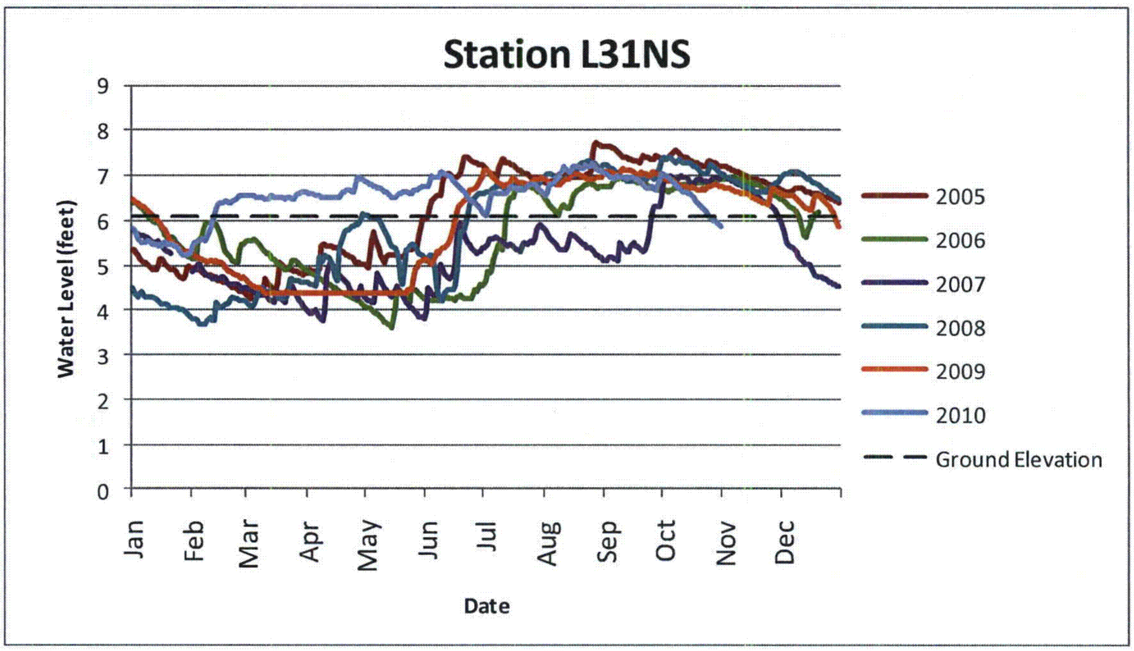


Figure 4. Annual Hydroperiod (2005 – 2010) Measured at SFWMD Monitoring Stations

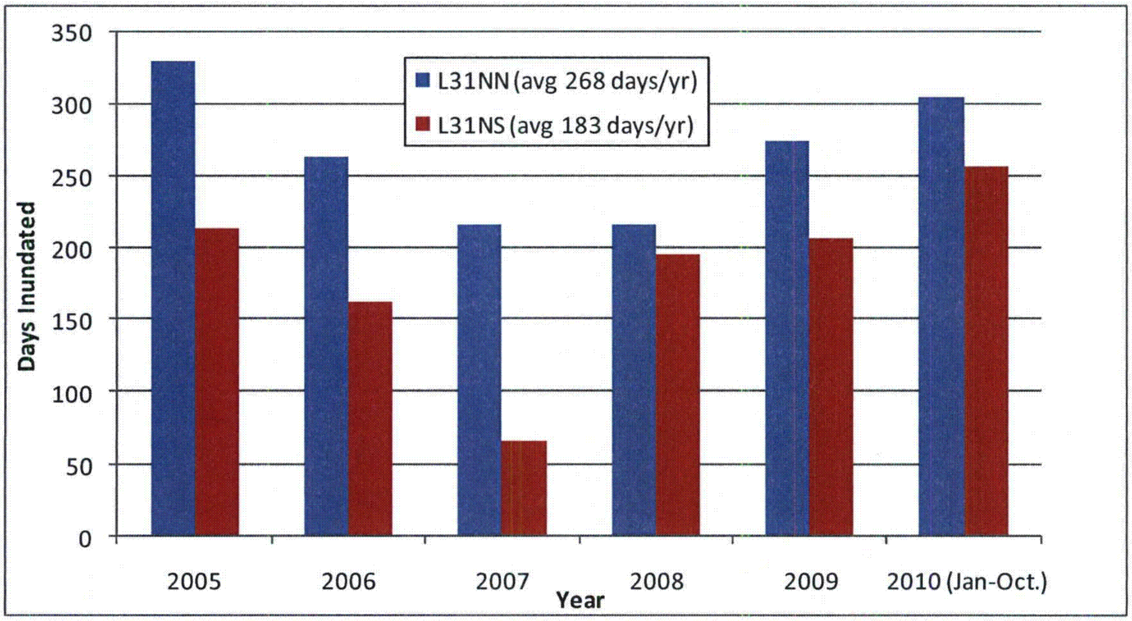


Figure 5. Average Hydroperiod (Days) Measured at SFWMD Monitoring Stations

4.3 Mitigation of Impacts to Foraging Habitat

In accordance with the South Florida Wood Stork Key, the net increase in wood stork foraging habitat resulting from mitigation activities is based upon the difference in value of the habitat before and after the mitigation activities are performed. The following methodology describes the assessment of the HID Mitigation Bank with respect to wood stork foraging habitat.

Historic farming activities within the HID utilized rock-plowing to break up the original limestone surface and mix it with the surficial marl soil, which increased ground surface elevations and in turn decreased the hydroperiod such that 1985 National Wetland Inventory surveys mapped the area as uplands.

Mitigation activities within the HID involve the removal of all existing exotic vegetation and rock-plowed agricultural soils, reducing the land elevation to the underlying limestone substrate in order to restore a more typical wetland hydroperiod. This process converts upland agricultural land that was not inundated outside of major storm events to wetlands supporting native vegetation with variable hydroperiods.

According to the HID Year 11 Final Annual Monitoring Report (ERG, 2009), hourly water stage level data are recorded at two permanent monitoring stations within the HID restoration sites. These data were used to derive the average hydroperiod for wetlands within various restoration sites of the HID, grouped by six hydroperiod classes. The relative area within each HID restoration site by hydroperiod class for an average hydrologic year is provided in Table 4-9. The acreage of restored wetlands within each site by hydroperiod class for an average hydrologic year is provided in Table 4-10.

Table 4-9. Percent Area of Each Restored Site in the HID by Hydroperiod

Hydroperiod (Days)	Restoration Site (Relative Percent)										
	Res89	Res97	98North	Res98	Res99	Res00	Res01	Res03	Res04E	Res04W	Res05
<30			99.9%		18.3%	31.0%	70.9%	22.6%			
31-90	0.8%	2.9%			56.3%	34.0%	20.3%	26.7%		3.8%	3.5%
91-180	49.6%	57.9%		31.6%	20.5%	29.3%	7.7%	30.9%	7.6%	34.3%	25.0%
181-270	49.0%	38.9%		67.3%	4.5%	4.1%	0.9%	18.7%	44.4%	57.2%	67.4%
271-365+						1.4%			34.5%	3.5%	3.6%

Source: ERG, 2009.

Table 4-10. Acreage of Each Restored Site in the HID by Hydroperiod

Hydro-period (Days)	Restoration Site (Acreage)											
	R89	R97	98N	R98	R99	R00	R01	R03	R04E	R04W	R05	Total
<30			29.97		24.34	74.40	234.68	204.98				568.37
31-90	0.42	5.45			74.88	81.60	67.19	242.17		6.35	34.86	512.92
91-180	25.79	108.85		50.24	27.27	70.32	25.49	280.26	43.55	57.28	249.00	938.05
181-270	25.48	73.13		107.01	5.99	9.84	2.98	169.61	254.41	95.52	671.30	1415.27
271-365+						3.36			197.69	5.85	35.86	242.75
TOTALS	**51.7**	**187.4**	**30.0**	**157.3**	**132.5**	**239.5**	**330.3**	**897.0**	**495.7**	**165.0**	**991.0**	**3677.4**

Source: ERG, 2009.

5.0 RESULTS

5.1 Impacts to Wood Stork Foraging Habitat

Based upon the assumptions outlined in the methodology and the assessment for calculating biomass loss described in Appendix 3 of the South Florida Wood Stork Key, the estimated loss of wood stork prey biomass by wetland type within wood stork CFAs for each segment of the West Preferred Corridor was calculated (Table 5-1). The total loss of prey biomass is estimated to be 643.47 kg.

Table 5-1. Estimated Loss of Prey Biomass by FLUCFCS Within Wood Stork CFAs for Each Segment of the West Preferred Corridor

Segment	Estimated Loss of Prey Biomass (kg) by Wetland FLUCFCS						Total Estimated Loss of Prey Biomass (kg)
	617	618	619	631	641	643	
1D*	1.95		0.48		16.76	6.72	25.90
2					4.70		4.70
3A	14.24		0.19		26.73		41.15
3B	134.29		0.67		131.76	27.28	294.00
3C	18.34	0.03	0.88		166.17		185.42
4	17.34		1.04		40.71	13.88	72.97
5A			0.01	0.03	1.27	0.07	1.39
5B			0.00		0.35	0.01	0.36
Levee Substation			0.52		11.50		12.02
Tamiami Trail Access Corridor					5.01		5.01
Krome Avenue Access Corridor			0.01		0.54		0.55
Total	**186.15**	**0.03**	**3.80**	**0.03**	**405.49**	**47.96**	**643.47**

*For segment 1D, only the portion within wood stork CFA was included.

5.2 Mitigation of Impacts to Wood Stork Foraging Habitat

Unavoidable wetland impacts associated with the proposed transmission facilities will be mitigated through purchase of credits from the HID. As specified in the HID permit (FDEP Permit No. 132416479, issued 2/15/95), mitigation for wetland impacts within the HID service area consists of a set dollar amount per acre of impact, equivalent to the cost to carry out the restoration and long-term maintenance of a corresponding acre of wetlands in the HID. One mitigation credit is assigned for each acre of wetlands to be restored pursuant to the FDEP permit. A total of 308 acres (credits) are proposed for purchase from the HID, based upon the conservative estimate of wetland impact acreage for the transmission corridors.

The amount of wood stork foraging habitat value associated with 308 acres within HID was determined utilizing the methodology for calculating prey biomass described in Appendix 3 of the South Florida Wood Stork Key. A comparison of the pre- and post-restoration condition with respect to quantity (acreage) and quality (habitat suitability, hydroperiod) of wood stork foraging habitat was utilized to calculate the increase of prey biomass per acre of restored habitat.

According to the HID Year 11 Final Annual Report (ERG, 2009), the total acreage of restored wetlands within the five hydroperiod classes is approximately 3,677, as detailed in Table 4-10. The hydroperiod ranges used to assess the HID (Table 4-9) are not consistent with SFWMD hydroperiod class ranges (Table 4-5); therefore the acreages within each HID hydroperiod class were adjusted as follows:

- HID <30 Days = SFWMD Hydroperiod Class 1
- HID 31-90 Days = 50% SFWMD Class 1; 50% SFWMD Class 2
- HID 90-180 Days = 33% SFWMD Class 2; 67% SFWMD Class 3
- HID 181-270 Days = 60% SFWMD Class 4; 40% SFWMD Class 5
- HID 271-365+ Days = 33% SFWMD Class 5; 33% SFWMD Class 6; 33% SFWMD Class 7

The estimated wood stork prey biomass to be gained from restoration activities in the HID was calculated using the acreage of restored wetlands and estimates of the actual biomass consumed by wood storks for each hydroperiod class (Table 4-7). Restored habitats within the HID are actively managed for removal of exotic vegetation, corresponding to the foraging habitat suitability class of 100% (Table 4-4).

The pre-restoration condition of the HID, Brazilian pepper-dominated uplands, does not provide wood stork foraging habitat, therefore the gain in foraging habitat resulting from restoration activities is calculated as follows for each hydroperiod class:

Restoration area (m^2) × Actual Prey Biomass Consumed (Table 4-7) × Exotic Foraging Suitability Index (Table 4-4) = Biomass Gained (grams)

The total prey biomass generated by restoration of approximately 3,677 acres of wetlands of various hydroperiod classes at the HID is approximately 7,724 kilograms per year (kg/yr) (Table 5-2).

Table 5-2. Wood Stork Prey Biomass Generated from HID Restoration by Hydroperiod Class

Hydroperiod Class	Days Inundated	Acres at HID	Fish and Crayfish Prey Biomass (kg/yr)
Class 1	0-60	824.83	333.81
Class 2	60-120	566.01	458.13
Class 3	120-180	628.49	1093.70
Class 4	180-240	851.16	2617.93
Class 5	240-300	646.22	2484.49
Class 6	300-330	80.11	353.38
Class 7	330-365	80.11	382.56
TOTAL		**3,677**	**7,724**
Short Hydroperiod (Class 1-3)	**0-180**	**2,019**	**1,886 (0.93 kg/yr/ac)**
Long Hydroperiod (Class 4-7)	**180-365**	**1,658**	**5,838 (3.52 kg/yr/ac)**

The restoration of 308 acres within the HID to be funded by FPL represents 8.4% of the total restoration acreage. The corresponding 8.4% of total prey biomass generated annually from the mitigation activities, approximately 649 kg/yr, is approximately 5 kg/yr more than the estimated loss resulting from construction of transmission facilities within the West Preferred Corridor. Table 5-3 summarizes the estimated biomass lost as a result of impacts and gained from the proposed mitigation. The HID restoration sites are considered to be uplands prior to restoration activities and therefore are not assigned a pre-restoration biomass value.

In accordance with guidance from USFWS, mitigation for loss of wood stork foraging habitat is focused on replacement of short and long hydroperiod wetlands with similar hydroperiod wetlands, to the greatest extent practicable. SFWMD hydroperiod classes 1 through 3 are considered short hydroperiod wetlands (inundation ≤180 days/year), while SFWMD hydroperiod classes 4 through 7 are considered long hydroperiod wetlands (inundation >180 days/year). Impacts within the West Preferred Corridor represent a loss of approximately 32.35 kg/yr and 611.12 kg/yr of prey biomass within short and long hydroperiod wetlands, respectively. The proposed mitigation will generate an overall increase of approximately 158.4 kg/yr and 490.4 kg/yr of prey biomass within short and long hydroperiod wetlands, respectively. This represents a net increase in prey biomass within short hydroperiod wetlands of approximately 126.04 kg/yr, and a deficit (approximately 120.69 kg/yr) in prey biomass within long hydroperiod wetlands. The increase in short hydroperiod wetlands is advantageous for the wood stork because the short hydroperiod wetlands historically were more extensive and met the foraging needs of pre-nesting storks and early-age nestlings (USFWS 2010). Short hydroperiod wetlands are crucial as the only available feeding sites during the wetter periods when longer-hydroperiod wetlands are too deeply flooded to be utilized by storks (Ogden 1990). Several researchers (Flemming et al., 1994; Ceilley and Borton, 2000) believe that the short hydroperiod wetlands provide a more important pre-nesting foraging food source and a greater early nestling survivor value for wood storks than the foraging base (grams of fish per square meter) than long hydroperiod wetlands provide. As noted by the USFWS (2010):

> *We believe that most wetland fill and excavation impacts permitted in south Florida are in short hydroperiod wetlands. Therefore, we believe that it is especially important that impacts to these short hydroperiod wetlands within CFAs are avoided, minimized, and compensated for by enhancement/restoration of short hydroperiod wetlands.*

Table 5-3. Summary of Wood Stork Prey Biomass Impacts and Mitigation

Hydroperiod	West Preferred Corridor Estimated Wetland Impacts Within Wood Stork CFAs		HID Mitigation Bank Pre-Restoration		HID Mitigation Bank Post-Restoration		Net Change	
	Acres	Biomass (kg/yr)	Acres	Biomass (kg/yr)	Acres	Biomass (kg/yr)	Acres	Biomass (kg/yr)
Class 1			69.41	0.00	69.41	28.04	69.41	28.04
Class 2			47.38	0.00	47.38	38.48	47.38	38.48
Class 3	27.76	32.35	52.61	0.00	52.61	91.87	24.85	64.18
Class 4	119.59	340.17	71.49	0.00	71.49	219.91	(48.10)	(62.86)
Class 5	91.34	270.95	54.10	0.00	54.10	208.70	(37.24)	(31.22)
Class 6			6.71	0.00	6.71	29.68	6.71	29.68
Class 7			6.71	0.00	6.71	32.14	6.71	32.14
TOTAL	**238.69**	**643.47**	**308.00**	**0.00**	**308.00**	**648.82**	**69.31**	**5.35**
Short Hydroperiod (Class 1-3)	27.76	**32.35**	169.41	0.00	169.41	**158.39**	141.65	**126.04**
Long Hydroperiod (Class 4-7)	210.93	**611.12**	139.01	0.00	139.01	**490.43**	(71.92)	**(120.69)**

6.0 SUMMARY AND CONCLUSIONS

An evaluation of the loss of wood stork foraging habitat within the CFAs associated with the West Preferred Corridor was conducted, as well as an evaluation of the foraging habitat compensation resulting from the Project's proposed purchase of wetland mitigation credits from the HID mitigation bank. The impact evaluation was performed in accordance with the wood stork foraging assessment methodology contained within the USFWS South Florida Wood Stork Effect Determination Key, based upon the worst-case estimate of wetland impacts within CFAs associated with the West Preferred Corridor, the vegetative community composition of impacted wetlands relative to suitable wood stork foraging habitat, and the approximate hydroperiod of impacted and restored wetlands. The results will be revised upon detailed transmission line design and location to refine wetland impact location, type, and extent, as well as to identify specific restoration parcels within the HID to refine restoration acreage by hydroperiod classes.

FPL is seeking certification of corridors for the transmission lines associated with Turkey Point Units 6 & 7 through the PPSA, as described in the SCA submitted in June 2009 (FPL, 2009). As such, design details such as right-of-way location within the corridor, width of ROW, transmission structure locations, structure heights, and access road locations cannot be finalized until after the corridors are certified. In order to accommodate final design options, FPL has provided a conservative estimate of wetland impact acreage for the transmission corridors based on the best available information and a reasonable worst-case scenario of wetland impacts of the eventual ROWs. Based on the worst-case evaluation, construction of the transmission facilities could result in up to approximately 308 acres of wetland impacts associated with the West Preferred Corridor and <0.5 acres of wetland impact associated with the East Preferred Corridor.

Approximately 239 acres of wetland impacts within the West Preferred Corridor would occur within areas designated as CFAs for the endangered wood stork, based on the worst-case conservative impact evaluation. The relative occurrence of wetlands by habitat type (FLUCFCS code) within each transmission segment was calculated, foraging habitat suitability values were assigned based upon amount of exotic vegetation/canopy closure, and approximate hydroperiod values (days of inundation/year) were applied to derive the approximate loss of wood stork foraging habitat (643 kg/yr) in terms of annual prey (fish and crayfish) biomass.

The assessment of mitigation was conducted in accordance with the USFWS guidance based upon restoration of 308 acres of wetlands within the HID, the existing condition of vegetative communities and hydroperiod relative to suitable wood stork foraging habitat, and analysis of the post-restoration condition with respect to increase in wood stork foraging habitat and the resulting increase in fish and crayfish biomass available compared to the pre-restoration condition. Data from the HID Year 11 Final Annual Biological Monitoring Report (ERG, 2009) was used to identify the acreage of restored wetlands by hydroperiod class (3,677 acres), which was used to quantify the total annual prey biomass generated within the HID restoration areas (7,724 kg/yr). The Turkey Point 6 & 7 Project's contribution to HID restoration (308 acres) represents approximately 8.4% of the total acreage restored, which corresponds to an increase of approximately 649 kg/yr of wood stork prey biomass. When compared to the impacts within the West Preferred Corridor, this represents a net increase in prey biomass within short hydroperiod wetlands of approximately 126 kg/yr, and a deficit (approximately 121 kg/yr) in prey biomass within long hydroperiod wetlands. The focus of restoration on short hydroperiod wetlands is advantageous, as short hydroperiod wetlands may provide a more important pre-nesting foraging food source and a greater early nestling survivor value for wood storks when compared to long hydroperiod wetlands (Flemming et al., 1994; Ceilley and Bortone, 2000), and because a larger percentage of wetland fill and excavation impacts permitted in South Florida are in short hydroperiod wetlands (USFWS, 2010). The proposed mitigation fully offsets the loss of wood stork foraging habitat resulting from construction of transmission facilities within the West Preferred Corridor, and provides a net increase in foraging habitat equivalent to approximately 5 kg/yr of wood stork prey biomass.

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ATTACHMENT A

USFWS SOUTH FLORIDA WOOD STORK EFFECT DETERMINATION KEY

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

May 18, 2010

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Service Federal Activity Code:	41420-2007-FA-1494
Service Consultation Code:	41420-2007-I-0964
Subject:	South Florida Programmatic Concurrence
Species:	Wood Stork

Dear Mr. Kinard:

This letter addresses minor errors identified in our January 25, 2010, wood stork key and as such, supplants the previous key. The key criteria and wood stork biomass foraging assessment methodology have not been affected by these minor revisions.

The Fish and Wildlife Service's (Service) South Florida Ecological Services Office (SFESO) and the U.S. Army Corps of Engineers Jacksonville District (Corps) have been working together to streamline the consultation process for federally listed species associated with the Corps' wetland permitting program. The Service provided letters to the Corps dated March 23, 2007, and October 18, 2007, in response to a request for a multi-county programmatic concurrence with a criteria-based determination of "may affect, not likely to adversely affect" (NLAA) for the threatened eastern indigo snake (*Drymarchon corais couperi*) and the endangered wood stork (*Mycteria americana*) for projects involving freshwater wetland impacts within specified Florida counties. In our letters, we provided effect determination keys for these two federally listed species, with specific criteria for the Service to concur with a determination of NLAA.

The Service has revisited these keys recently and believes new information provides cause to revise these keys. Specifically, the new information relates to foraging efficiencies and prey base assessments for the wood stork and permitting requirements for the eastern indigo snake. This letter addresses the wood stork key and is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The eastern indigo snake key will be provided in a separate letter.

Wood stork

<u>Habitat</u>

The wood stork is primarily associated with freshwater and estuarine habitats that are used for nesting, roosting, and foraging. Wood storks typically construct their nests in medium to tall trees that occur in stands located either in swamps or on islands surrounded by relatively broad expanses of open water (Ogden 1991, 1996; Rodgers et al. 1996). Successful colonies are those that have limited human disturbance and low exposure to land-based predators. Nesting colonies protected from land-based predators are characterized as those surrounded by large expanses of open water or where the nest trees are inundated at the onset of nesting and remain inundated throughout most of the breeding cycle. These colonies have water depths between 0.9 and 1.5 meters (3 and 5 feet) during the breeding season.

Successful nesting generally involves combinations of average or above-average rainfall during the summer rainy season and an absence of unusually rainy or cold weather during the winter-spring breeding season (Kahl 1964; Rodgers et al. 1987). This pattern produces widespread and prolonged flooding of summer marshes, which maximize production of freshwater fishes, followed by steady drying that concentrate fish during the season when storks nest (Kahl 1964). Successful nesting colonies are those that have a large number of foraging sites. To maintain a wide range of foraging sites, a variety of wetland types should be present, with both short and long hydroperiods. The Service (1999) describes a short hydroperiod as a 1 to 5-month wet/dry cycle, and a long hydroperiod as greater than 5 months. During the wet season, wood storks generally feed in the shallow water of the short-hydroperiod wetlands and in coastal habitats during low tide. During the dry season, foraging shifts to longer hydroperiod interior wetlands as they progressively dry-down (though usually retaining some surface water throughout the dry season).

Wood storks occur in a wide variety of wetland habitats. Typical foraging sites for the wood stork include freshwater marshes and stock ponds, shallow, seasonally flooded roadside and agricultural ditches, narrow tidal creeks and shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs. Because of their specialized feeding behavior, wood storks forage most effectively in shallow-water areas with highly concentrated prey. Through tactolocation, or grope feeding, wood storks in south Florida feed almost exclusively on fish between 2 and 25 centimeters [cm] (1 and 10 inches) in length (Ogden et al. 1976). Good foraging conditions are characterized by water that is relatively calm, uncluttered by dense thickets of aquatic vegetation, and having a water depth between 5 and 38 cm (5 and 15 inches) deep, although wood storks may forage in other wetlands. Ideally, preferred foraging wetlands would include a mosaic of emergent and shallow open-water areas. The emergent component provides nursery habitat for small fish, frogs, and other aquatic prey and the shallow, open-water areas provide sites for concentration of the prey during seasonal dry-down of the wetland.

Conservation Measures

The Service routinely concurs with the Corps' "may affect, not likely to adversely affect" determination for individual project effects to the wood stork when project effects are insignificant due to scope or location, or if assurances are given that wetland impacts have been avoided, minimized, and adequately compensated such that there is no net loss in foraging potential. We utilize our *Habitat Management Guidelines for the Wood Stork in the Southeast Region* (Service 1990) (Enclosure 1) (HMG) in project evaluation. The HMG is currently under review and once final will replace the enclosed HMG. There is no designated critical habitat for the wood stork.

The SFESO recognizes a 29.9 kilometer [km] (18.6-mile) core foraging area (CFA) around all known wood stork colonies in south Florida. Enclosure 2 (to be updated as necessary) provides locations of colonies and their CFAs in south Florida that have been documented as active within the last 10 years. The Service believes loss of suitable wetlands within these CFAs may reduce foraging opportunities for the wood stork. To minimize adverse effects to the wood stork, we recommend compensation be provided for impacts to foraging habitat. The compensation should consider wetland type, location, function, and value (hydrology, vegetation, prey utilization) to ensure that wetland functions lost due to the project are adequately offset. Wetlands offered as compensation should be of the same hydroperiod and located within the CFAs of the affected wood stork colonies. The Service may accept, under special circumstances, wetland compensation located outside the CFAs of the affected wood stork nesting colonies. On occasion, wetland credits purchased from a "Service Approved" mitigation bank located outside the CFAs could be acceptable to the Service, depending on location of impacted wetlands relative to the permitted service area of the bank, and whether or not the bank has wetlands having the same hydroperiod as the impacted wetland.

In an effort to reduce correspondence in effect determinations and responses, the Service is providing the Wood Stork Effect Determination Key below. If the use of this key results in a Corps determination of "no effect" for a particular project, the Service supports this determination. If the use of this Key results in a determination of NLAA, the Service concurs with this determination[1]. This Key is subject to revisitation as the Corps and Service deem necessary.

The Key is as follows:

A. Project within 0.76 km (0.47 mile)[2] of an active colony site[3] .... *"may affect[4]"*

Project impacts Suitable Foraging Habitat (SFH)[5] at a location greater than 0.76 km (0.47 mile) from a colony site.. ...."*go to* B"

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[1] With an outcome of "no effect" or "NLAA" as outlined in this key, and the project has less than 20.2 hectares (50 acres) of wetland impacts, the requirements of section 7 of the Act are fulfilled for the wood stork and no further action is required. For projects with greater than 20.2 hectares (50 acres) of wetland impacts, written concurrence of NLAA from the Service is necessary.

[2] Within the secondary zone (the average distance from the border of a colony to the limits of the secondary zone is 0.76 km (2,500 feet, or 0.47 mi).

[3] An active colony is defined as a colony that is currently being used for nesting by wood storks or has historically over the last 10 years been used for nesting by wood storks.

[4] Consultation may be concluded informally or formally depending on project impacts.

[5] Suitable foraging habitat (SFH) includes wetlands that typically have shallow-open water areas that are relatively calm and have a permanent or seasonal water depth between 5 to 38 cm (2 to 15 inches) deep. Other shallow non-wetland water bodies are also SFH. SFH supports and concentrates, or is capable of supporting and concentrating small fish, frogs, and other aquatic prey. Examples of SFH include, but are not limited to freshwater marshes, small ponds, shallow, seasonally flooded roadside or agricultural ditches, seasonally flooded pastures, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs.

Project does not affect SFH..."*no effect*[1]".

B. Project impact to SFH is less than 0.20 hectare (one-half acre)[6]............................*NLAA*[1]"

Project impact to SFH is greater in scope than 0.20 hectare (one-half acre)..........*go to* C

C. Project impacts to SFH not within the CFA (29.9 km, 18.6 miles) of a colony site ....*go to* D

Project impacts to SFH within the CFA of a colony site ....*go to* E

D. Project impacts to SFH have been avoided and minimized to the extent practicable; compensation (Service approved mitigation bank or as provided in accordance with Mitigation Rule 33 CFR Part 332) for unavoidable impacts is proposed in accordance with the CWA section 404(b)(1) guidelines; and habitat compensation replaces the foraging value matching the hydroperiod[7] of the wetlands affected and provides foraging value similar to, or higher than, that of impacted wetlands. See Enclosure 3 for a detailed discussion of the hydroperiod foraging values, an example, and further guidance[8]..................... *NLAA*[1]"

Project not as above.. "*may affect*[4]"

E. Project provides SFH compensation in accordance with the CWA section 404(b)(1) guidelines and is not contrary to the HMG; habitat compensation is within the appropriate CFA or within the service area of a Service-approved mitigation bank; and habitat compensation replaces foraging value, consisting of wetland enhancement or restoration matching the hydroperiod[7] of the wetlands affected, and provides foraging value similar

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[6] On an individual basis, SFH impacts to wetlands less than 0.20 hectare (one-half acre) generally will not have a measurable effect on wood storks, although we request that the Corps require mitigation for these losses when appropriate. Wood storks are a wide ranging species, and individually, habitat change from impacts to SFH less than one-half acre are not likely to adversely affect wood storks. However, collectively they may have an effect and therefore regular monitoring and reporting of these effects are important.

[7] Several researchers (Flemming et al. 1994; Ceilley and Bortone 2000) believe that the short hydroperiod wetlands provide a more important pre-nesting foraging food source and a greater early nestling survivor value for wood storks than the foraging base (grams of fish per square meter) than long hydroperiod wetlands provide. Although the short hydroperiod wetlands may provide less fish, these prey bases historically were more extensive and met the foraging needs of the pre-nesting storks and the early-age nestlings. Nest productivity may suffer as a result of the loss of short hydroperiod wetlands. We believe that most wetland fill and excavation impacts permitted in south Florida are in short hydroperiod wetlands. Therefore, we believe that it is especially important that impacts to these short hydroperiod wetlands within CFAs are avoided, minimized, and compensated for by enhancement/restoration of short hydroperiod wetlands.

[8] For this Key, the Service requires an analysis of foraging prey base losses and enhancements from the proposed action as shown in the examples in Enclosure 3 for projects with greater than 2.02 hectares (5 acres) of wetland impacts. For projects with less than 2.02 hectares (5 acres) of wetland impacts, an individual foraging prey base analysis is not necessary although type for type wetland compensation is still a requirement of the Key.

to, or higher than, that of impacted wetlands. See Enclosure 3 for a detailed discussion of the hydroperiod foraging values, an example, and further guidance[8] .... "*NLAA*[1]"

Project does not satisfy these elements .... "*may affect*[4]"

This Key does not apply to Comprehensive Everglades Restoration Plan projects, as they will require project-specific consultations with the Service.

Monitoring and Reporting Effects

For the Service to monitor cumulative effects, it is important for the Corps to monitor the number of permits and provide information to the Service regarding the number of permits issued where the effect determination was: "may affect, not likely to adversely affect." We request that the Corps send us an annual summary consisting of: project dates, Corps identification numbers, project acreages, project wetland acreages, and project locations in latitude and longitude in decimal degrees.

Thank you for your cooperation and effort in protecting federally listed species. If you have any questions, please contact Allen Webb at extension 246.

Sincerely yours,

Paul Souza
Field Supervisor
South Florida Ecological Services Office

Enclosures

cc: w/enclosures (electronic only)
Corps, Jacksonville, Florida (Stu Santos)
EPA, West Palm Beach, Florida (Richard Harvey)
FWC, Vero Beach, Florida (Joe Walsh)
Service, Jacksonville, Florida (Billy Brooks)

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HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION

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HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION

Introduction

A number of Federal and state laws and/or regulations prohibit, cumulatively, such acts as harrassing, disturbing, harming, molesting, pursuing, etc., wood storks, or destroying their nests (see Section VII). Although advisory in nature, these guidelines represent a biological interpretation of what would constitute violations of one or more of such prohibited acts. Their purpose is to mainain and/or improve the environmental conditions that are required for the survival and well-being of wood storks in the southeastern United States, and are designed essentially for application in wood stork/human activity conflicts (principally land development and human intrusion into stork use sites). The emphasis is to avoid or minimize detrimental human-related impacts on wood storks. These guidelines were prepared in consultations with state wildlife agencies and wood stork experts in the four southeastern states where the wood stork is listed as Endangered (Alabama, Florida, Georgia, South Carolina).

General

The wood stork is a gregarious species, which nests in colonies (rookeries), and roosts and feeds in flocks, often in association with other species of long-legged water birds. Storks that nest in the southeastern United States appear to represent a distinct population, separate from the nearest breeding population in Mexico. Storks in the southeastern U.S. population have recently (since 1980) nested in colonies scattered throughout Florida, and at several central-southern Georgia and coastal South Carolina sites. Banded and color-marked storks from central and southern Florida colonies have dispersed during non-breeding seasons as far north as southern Georgia, and the coastal counties in South Carolina and southeastern North Carolina, and as far west as central Alabama and northeastern Mississippi. Storks from a colony in south-central Georgia have wintered between southern Georgia and southern Florida. This U.S. nesting population of wood storks was listed as endangered by the U.S. Fish and Wildlife Service on February 28, 1984 (*Federal Register* 49(4):7332-7335).

Wood storks use freshwater and estuarine wetlands as feeding, nesting, and roosting sites. Although storks are not habitat specialists, their needs are exacting enough, and available habitat is limited enough, so that nesting success and the size of regional populations are closely regulated by year-to-year differences in the quality and quantity of suitable habitat. Storks are especially sensitive to environmental conditions at feeding sites; thus, birds may fly relatively long distances either daily or between regions annually, seeking adequate food resources.

All available evidence suggests that regional declines in wood stork numbers have been largely due to the loss or degradation of essential wetland habitat. An understanding of the qualities of good stork habitat should help to focus protection efforts on those sites that are seasonally important to regional populations of wood storks. Characteristics of feeding, nesting, and roosting habitat, and management guidelines for each, are presented here by habitat type.

I. Feeding habitat.

A major reason for the wood stork decline has been the loss and degradation of feeding habitat. Storks are especially sensitive to any manipulation of a wetland site that results in either reduced amounts or changes in the timing of food availability.

Storks feed primarily (often almost exclusively) on small fish between 1 and 8 inches in length. Successful foraging sites are those where the water is between 2 and 15 inches deep. Good feeding conditions usually occur where water is relatively calm and uncluttered by dense thickets of aquatic vegetation. Often a dropping water level is necessary to concentrate fish at suitable densities. Conversely, a rise in water, especially when it occurs abruptly, disperses fish and reduces the value of a site as feeding habitat.

The types of wetland sites that provide good feeding conditions for storks include: drying marshes or stock ponds, shallow roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, and depressions in cypress heads or swamp sloughs. In fact, almost any shallow wetland depression where fish tend to become concentrated, either through local reproduction or the consequences of area drying, may be used by storks.

Nesting wood storks do most of their feeding in wetlands between 5 and 40 miles from the colony, and occasionally at distances as great as 75 miles. Within this colony foraging range and for the 110-150 day life of the colony, and depending on the size of the colony and the nature of the surrounding wetlands, anywhere from 50 to 200 different feeding sites may be used during the breeding season.

Non-breeding storks are free to travel much greater distances and remain in a region only for as long as sufficient food is available. Whether used by breeders or non-breeders, any single feeding site may at one time have small or large numbers of storks (1 to 100+), and be used for one to many days, depending on the quality and quantity of available food. Obviously, feeding sites used by relatively large numbers of storks, and/or frequently used areas, potentially are the more important sites necessary for the maintenance of a regional population of birds.

Differences between years in the seasonal distribution and amount of rainfall usually mean that storks will differ between years in where and when they feed. Successful nesting colonies are those that have a large number of feeding site options, including sites that may be suitable only in years of rainfall extremes. To maintain the wide range of feeding site options requires that many different wetlands, with both relatively short and long annual hydroperiods, be preserved. For example, protecting only the larger wetlands, or those with longer annual hydroperiods, will result in the eventual loss of smaller, seemingly less important wetlands. However, these small scale wetlands are crucial as the only available feeding sites during the wetter periods when the larger habitats are too deeply flooded to be used by storks.

II. Nesting habitat.

Wood storks nest in colonies, and will return to the same colony site for many years so long as that site and surrounding feeding habitat continue to supply the needs of the birds. Storks require between 110 and 150 days for the annual nesting cycle, from the period of courtship until the nestlings become independent. Nesting activity may begin as early as December or as late as March in southern Florida colonies, and between late February and April in colonies located between central Florida and South Carolina. Thus, full term colonies may be active until June-July in south Florida, and as late as July-August at more northern sites. Colony sites may also be used for roosting by storks during other times of the year.

Almost all recent nesting colonies in the southeastern U.S. have been located either in woody vegetation over standing water, or on islands surrounded by broad expanses of open water. The most dominant vegetation in swamp colonies has been cypress, although storks also nest in swamp hardwoods and willows. Nests in island colonies may be in more diverse vegetation, including mangroves (coastal), exotic species such as Australian pine (*Casuarina*) and Brazilian Pepper (*Schinus*), or in low thickets of cactus (*Opuntia*). Nests are usually located 15-75 feet above ground, but may be much lower, especially on island sites when vegetation is low.

Since at least the early 1970's, many colonies in the southeastern U.S. have been located in swamps where water has been impounded due to the construction of levees or roadways. Storks have also nested in dead and dying trees in flooded phosphate surface mines, or in low, woody vegetation on mounded, dredge islands. The use of these altered wetlands or completely "artificial" sites suggests that in some regions or years storks are unable to locate natural nesting habitat that is adequately flooded during the normal breeding season. The readiness with which storks will utilize water impoundments for nesting also suggests that colony sites could be intentionally created and maintained through long-term site management plans. Almost all impoundment sites used by storks become suitable for nesting only fortuitously, and therefore, these sites often do not remain available to storks for many years.

In addition to the irreversible impacts of drainage and destruction of nesting habitat, the greatest threats to colony sites are from human disturbance and predation. Nesting storks show some variation in the levels of human activity they will tolerate near a colony. In general, nesting storks are more tolerant of low levels of human activity near a colony when nests are high in trees than when they are low, and when nests contain partially or completely feathered young than during the period between nest construction and the early nestling period (adults still brooding). When adult storks are forced to leave their nests, eggs or downy young may die quickly (<20 minutes) when exposed to direct sun or rain.

Colonies located in flooded environments must remain flooded if they are to be successful. Often water is between 3 and 5 feet deep in successful colonies during the nesting season. Storks rarely form colonies, even in traditional nesting sites, when they are dry, and may abandon nests if sites become dry during the nesting period. Flooding in colonies may be most important as a defense against mammalian predators. Studies of stork colonies in Georgia and

Florida have shown high rates of raccoon predation when sites dried during the nesting period. A reasonably high water level in an active colony is also a deterrent against both human and domestic animal intrusions.

Although nesting wood storks usually do most feeding away from the colony site (>5 miles), considerable stork activity does occur close to the colony during two periods in the nesting cycle. Adult storks collect almost all nesting material in and near the colony, usually within 2500 feet. Newly fledged storks, near the end of the nesting cycle, spend from 1-4 weeks during the fledging process flying locally in the colony area, and perched in nearby trees or marshy spots on the ground. These birds return daily to their nests to be fed. It is essential that these fledging birds have little or no disturbance as far our as one-half mile within at least one or two quadrants from the colony. Both the adults, while collecting nesting material, and the inexperienced fledglings, do much low, flapping flight within this radius of the colony. At these times, storks potentially are much more likely to strike nearby towers or utility lines.

Colony sites are not necessarily used annually. Regional populations of storks shift nesting locations between years, in response to year-to-year differences in food resources. Thus, regional populations require a range of options for nesting sites, in order to successfully respond to food availability. Protection of colony sites should continue, therefore, for sites that are not used in a given year.

III. Roosting habitat.

Although wood storks tend to roost at sites that are similar to those used for nesting, they also use a wider range of site types for roosting than for nesting. Non-breeding storks, for example, may frequently change roosting sites in response to changing feeding locations, and in the process, are inclined to accept a broad range of relatively temporary roosting sites. Included in the list of frequently used roosting locations are cypress "heads" or swamps (not necessarily flooded if trees are tall), mangrove islands, expansive willow thickets or small, isolated willow "islands" in broad marshes, and on the ground either on levees or in open marshes.

Daily activity patterns at a roost vary depending on the status of the storks using the site. Non-breeding adults or immature birds may remain in roosts during major portions of some days. When storks are feeding close to a roost, they may remain on the feeding grounds until almost dark before making the short flight. Nesting storks traveling long distances (>40 miles) to feeding sites may roost at or near the latter, and return to the colony the next morning. Storks leaving roosts, especially when going long distances, tend to wait for mid-morning thermals to develop before departing.

IV. Management zones and guidelines for feeding sites.

To the maximum extent possible, feeding sites should be protected by adherence to the following protection zones and guidelines:

A. There should be no human intrusion into feeding sites when storks are present. Depending upon the amount of screening vegetation, human activity should be no closer than between 300 feet (where solid vegetation screens exist) and 750 feet (no vegetation screen).

B. Feeding sites should not be subjected to water management practices that alter traditional water levels or the seasonally normal drying patterns and rates. Sharp rises in water levels are especially disruptive to feeding storks.

C. The introduction of contaminants, fertilizers, or herbicides into wetlands that contain stork feeding sites should be avoided, especially those compounds that could adversely alter the diversity and numbers of native fishes, or that could substantially change the characteristics of aquatic vegetation. Increase in the density and height of emergent vegetation can degrade or destroy sites as feeding habitat.

D. Construction of tall towers (especially with guy wires) within three miles, or high power lines (especially across long stretches of open country) within one mile of major feeding sites should be avoided.

V. Management zones and guidelines for nesting colonies.

A. Primary zone: This is the most critical area, and must be managed according to recommended guidelines to insure that a colony site survives.

1. Size: The primary zone must extend between 1000 and 1500 feet in all directions from the actual colony boundaries when there are no visual or broad aquatic barriers, and never less than 500 feet even when there are strong visual or aquatic barriers. The exact width of the primary zone in each direction from the colony can vary within this range, depending on the amount of visual screen (tall trees) surrounding the colony, the amount of relatively deep, open water between the colony and the nearest human activity, and the nature of the nearest human activity. In general, storks forming new colonies are more tolerant of existing human activity, than they will be of new human activity that begins after the colony has formed.

2. Recommended Restrictions:

a. Any of the following activities within the primary zone, at any time of the year, are likely to be detrimental to the colony:

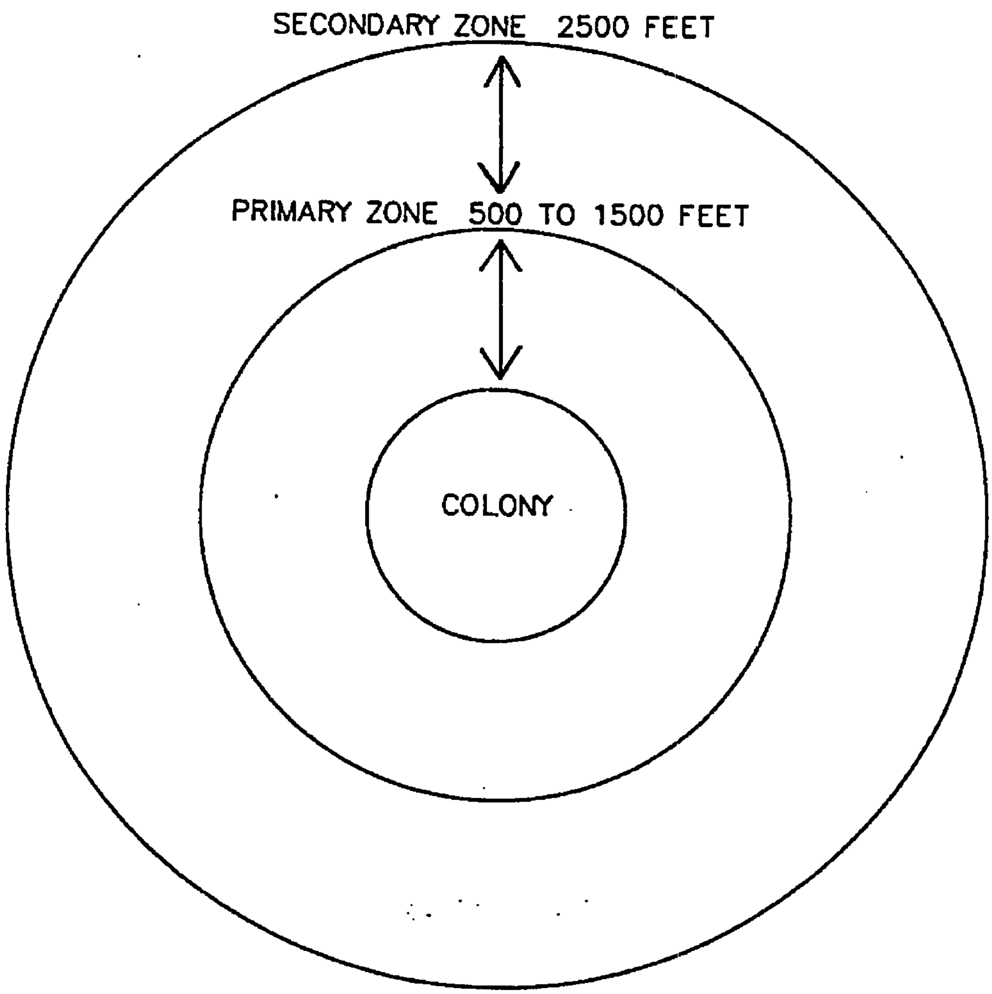
(1) Any lumbering or other removal of vegetation, and

(2) Any activity that reduces the area, depth, or length of flooding in wetlands under and surrounding the colony, except where periodic (less than annual) water control may be required to maintain the health of the aquatic, woody vegetation, and

(3) The construction of any building, roadway, tower, power line, canal, etc.

b. The following activities within the primary zone are likely to be detrimental to a colony if they occur when the colony is active:

(1) Any unauthorized human entry closer than 300 feet of the colony, and


SECONDARY ZONE 2500 FEET
PRIMARY ZONE 500 TO 1500 FEET
COLONY

(2) Any increase or irregular pattern in human activity anywhere in the primary zone, and

(3) Any increase or irregular pattern in activity by animals, including livestock or pets, in the colony, and

(4) Any aircraft operation closer than 500 feet of the colony.

B. Secondary Zone: Restrictions in this zone are needed to minimize disturbances that might impact the primary zone, and to protect essential areas outside of the primary zone. The secondary zone may be used by storks for collecting nesting material, for roosting, loafing, and feeding (especially important to newly fledged young), and may be important as a screen between the colony and areas of relatively intense human activities.

1. Size: The secondary zone should range outward from the primary zone 1000-2000 feet, or to a radius of 2500 feet of the outer edge of the colony.

2. Recommended Restrictions:

a. Activities in the secondary zone which may be detrimental to nesting wood storks include:

(1) Any increase in human activities above the level that existed in the year when the colony first formed, especially when visual screens are lacking, and

(2) Any alteration in the area's hydrology that might cause changes in the primary zone, and

(3) Any substantial (>20 percent) decrease in the area of wetlands and woods of potential value to storks for roosting and feeding.

b. In addition, the probability that low flying storks, or inexperienced, newly-fledged young will strike tall obstructions, requires that high-tension power lines be no closer than one mile (especially across open country or in wetlands) and tall trans-mission towers no closer than 3 miles from active colonies. Other activities, including busy highways and commercial and residential buildings may be present in limited portions of the secondary zone at the time that a new colony first forms. Although storks may tolerate existing levels of human activities, it is important that these human activities not expand substantially.

VI. Roosting site guidelines.

The general characteristics and temporary use-patterns of many stork roosting sites limit the number of specific management recommendations that are possible:

A. Avoid human activities within 500-1000 feet of roost sites during seasons of the year and times of the day when storks may be present. Nocturnal activities in active roosts may be especially disruptive.

B. Protect the vegetative and hydrological characteristics of the more important roosting sites--those used annually and/or used by flocks of 25 or more storks. Potentially, roosting sites may, some day, become nesting sites.

VII. Legal Considerations.

A. Federal Statutes

The U.S. breeding population of the wood stork is protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act). The population was listed as endangered on February 28, 1984 (49 Federal *Register* 7332); wood storks breeding in Alabama, Florida, Georgia, and South Carolina are protected by the Act.

Section 9 of the Endangered Species Act of 1973, as amended, states that it is unlawful for any person subject to the jurisdiction of the United States to take (defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.") any listed species anywhere within the United States.

The wood stork is also federally protected by its listing (50 CFR 10.13) under the Migratory Bird Treaty Act (167 U.S.C. 703-711), which prohibits the taking, killing or possession of migratory birds except as permitted.

B. State Statutes

1. State of Alabama

Section 9-11-232 of Alabama's Fish, Game, and Wildlife regulations curtails the possession, sale, and purchase of wild birds. "Any person, firm, association, or corporation who takes, catches, kills or has in possession at any time, living or dead, any protected wild bird not a game bird or who sells or offers for sale, buys, purchases or offers to buy or purchase any such bird or exchange same for anything of value or who shall sell or expose for sale or buy any part of the plumage, skin, or body of any bird protected by the laws of this state or who shall take or willfully destroy the nests of any wild bird or who shall have such nests or eggs of such birds in his possession, except as otherwise provided by law, shall be guilty of a misdemeanor...

Section 1 of the Alabama Nongame Species Regulation (Regulation 87-GF-7) includes the wood stork in the list of nongame species covered by paragraph (4). " It shall be unlawful to take, capture, kill, possess, sell, trade for anything of monetary value, or offer to sell or trade for anything of monetary value, the following nongame wildlife species (or any parts or reproductive products of such species) without a scientific collection permit and written permission from the Commissioner, Department of Conservation and Natural Resources,..."

2. State of Florida

Rule 39-4.001 of the Florida Wildlife Code prohibits "taking, attempting to take, pursuing, hunting, molesting, capturing, or killing (collectively defined as "taking"), transporting, storing, serving, buying, selling, possessing, or wantonly or willingly wasting any wildlife or freshwater fish or their nests, eggs, young, homes, or dens except as specifically provided for in other rules of Chapter 39, Florida Administrative Code.

Rule 39-27.011 of the Florida Wildlife Code prohibits "killing, attempting to kill, or wounding any endangered species." The "Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida" dated 1 July 1988, includes the wood stork, listed as "endangered" by the Florida Game and Fresh Water Fish Commission.

3. State of Georgia

Section 27-1-28 of the Conservation and Natural Resources Code states that "Except as otherwise provided by law, rule, or regulation, it shall be unlawful to hunt, trap, fish, take, possess, or transport any nongame species of wildlife..."

Section 27-1-30 states that, "Except as otherwise provided by law or regulation, it shall be unlawful to disturb, mutilate, or destroy the dens, holes, or homes of any wildlife; "

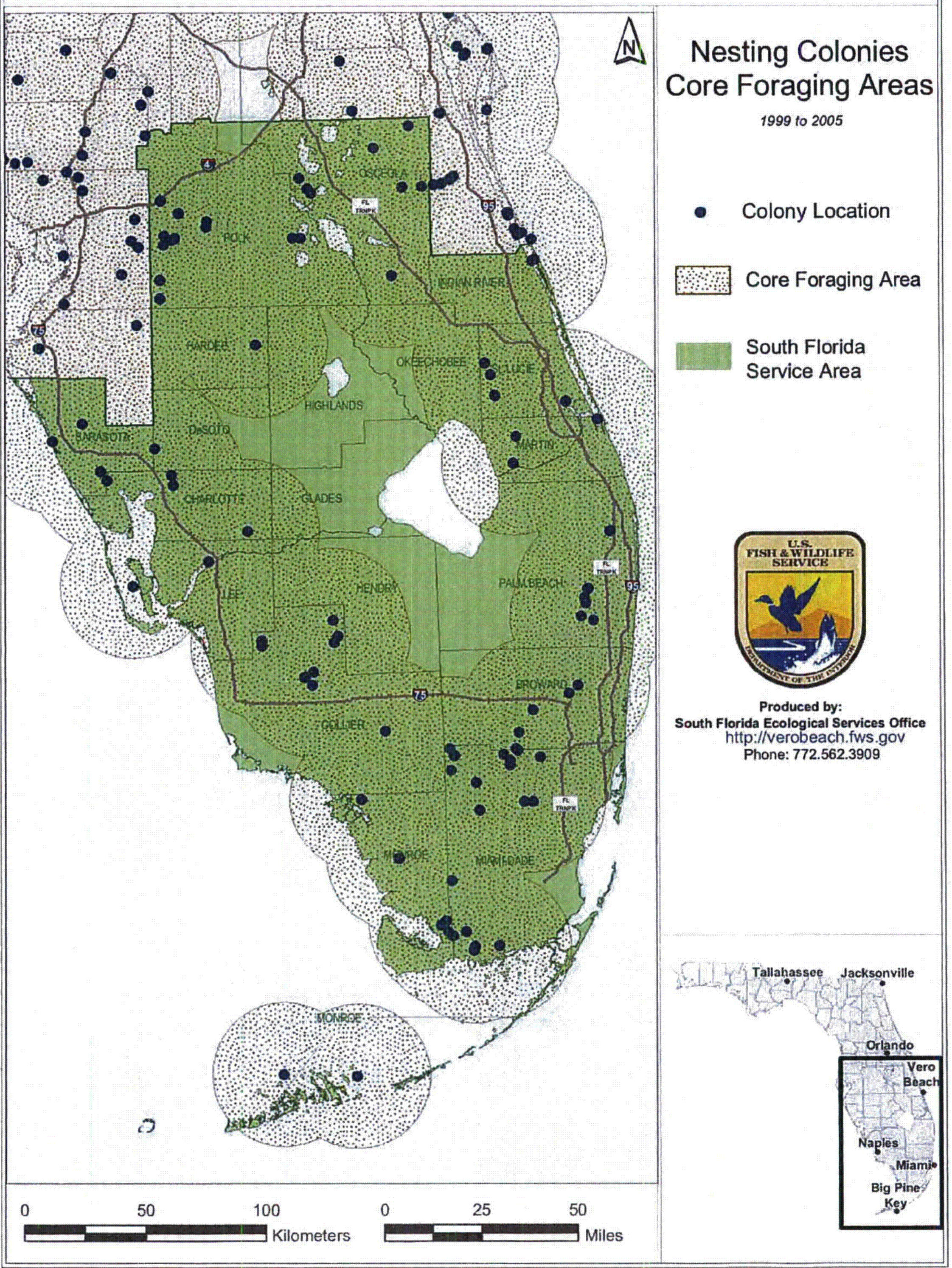
Section 27-3-22 states, in part, "It shall be unlawful for any person to hunt, trap, take, possess, sell, purchase, ship, or transport any hawk, eagle, owl, or any other bird or any part, nest, or egg thereof...".

The wood stork is listed as endangered pursuant to the Endangered Wildlife Act of 1973 (Section 27-3-130 of the Code). Section 391-4-13-.06 of the Rules and Regulations of the Georgia Department of Natural Resources prohibits harassment, capture, sale, killing, or other actions which directly cause the death of animal species protected under the Endangered Wildlife Act. The destruction of habitat of protected species on public lands is also prohibited.

4. State of South Carolina

Section 50-15-40 of the South Carolina Nongame and Endangered Species Conservation Act states, "Except as otherwise provided in this chapter, it shall be unlawful for any person to take, possess, transport, export, process, sell, or offer of sale or ship, and for any common or contract carrier knowingly to transport or receive for shipment any species or subspecies of wildlife appearing on any of the following lists: (1) the list of wildlife indigenous to the State, determined to be endangered within the State...(2) the United States' List of Endangered Native Fish and Wildlife... (3) the United States' List of Endangered Foreign Fish and Wildlife ..."

Wood Stork


Nesting Colonies
Core Foraging Areas
1999 to 2005
Colony Location
Core Foraging Area
South Florida
Service Area
Produced by:
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http://verobeach.fws.gov
Phone: 772.562.3909
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DESOTO
MARTIN
CHARLOTTE
GLADES
LEE
HENDRY
PALM BEACH
BROWARD
COLLIER
MONROE
MIAMI-DADE
Tallahassee
Jacksonville
Orlando
Vero Beach
Naples
Miami
Big Pine Key
0
50
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Kilometers
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Miles

Enclosure 3

Wood Stork Foraging Analysis: Excerpts of concepts and procedure as presented by the Service in this appendix may be viewed in detail in any one of our recent Biological Opinions for project related impacts to the wood stork. These documents can be found at the internet website address http://www.fws.gov/filedownloads/ftp%5verobeach.

Foraging Habitat

Researchers have shown that wood storks forage most efficiently and effectively in habitats where prey densities are high and the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978, Browder 1984, Coulter 1987). Prey availability to wood storks is dependent on a composite variable consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too deep (greater than 30 cm) for storks or the tree canopy at the site is too dense for storks to land. Calm water, about 5-40 cm (2-16 in) in depth, and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993).

Coulter and Bryan's (1993) study suggested that wood storks preferred ponds and marshes, and visited areas with little or no canopy more frequently. Even in foraging sites in swamps, the canopy tended to be sparse. They suggested that open canopies may have contributed to detection of the sites and more importantly may have allowed the storks to negotiate landing more easily than at closed-canopy sites. In their study, the median amount of canopy cover where wood stork foraging was observed was 32 percent. Other researchers (P.C. Frederick, University of Florida, personal communication 2006; J.A. Rodgers, FWC, personal communication 2006) also confirm that wood storks will forage in woodlands, though the woodlands have to be fairly open and vegetation not very dense. Furthermore, the canopies must be open enough for wood storks to take flight quickly to avoid predators.

Melaleuca-infested Wetlands: As discussed previously, wetland suitability for wood stork foraging is partially dependent on vegetation density. Melaleuca is a dense-stand growth plant species, effectively producing a closed canopy and dense understory growth pattern that generally limits a site's accessibility to foraging by wading birds. However, O'Hare and Dalrymple (1997) suggest moderate infestations of melaleuca may have little effect on some species' productivity (*i.e.*, amphibians and reptiles) as long as critical abiotic factors such as hydrology remain. They also note as the levels of infestation increase, usage by wetland dependent species decreases. Their studies also showed that the number of fish species present in a wetland system remain stable at certain levels of melaleuca. However, the availability of the prey base for wood storks and other foraging wading birds is reduced by the restriction of access caused from dense and thick exotic vegetation. Wood storks and other wading birds can forage in these systems in open area pockets (*e.g.*, wind blow-downs), provided multiple conditions are optimal (*e.g.*, water depth, prey density). In O'Hare and Dalrmyple's study (1997), they identify five cover types (Table 1) and provide information on the number of wetland dependent bird species and the number of individuals observed within each of these vegetation classes (Table 2).

Table 1: Vegetation classes

DMM	75-100 percent mature dense melaleuca coverage
DMS or (SDM)	75-100 percent sapling dense melaleuca coverage
P75	50-75 percent melaleuca coverage
P50	0-50 percent melaleuca coverage
MAR (Marsh)	0-10 percent melaleuca coverage

The number of wetland-dependent species and individuals observed per cover type is shown below in columns 1, 2, and 3 (Table 2). To develop an estimate of the importance a particular wetland type may have (based on density and aerial coverage by exotic species) to wetland dependent species, we developed a foraging suitability value using observational data from O'Hare and Dalrymple (1997). The Foraging Suitability Value as shown in column 5 (Table 2) is calculated by multiplying the number of species by the number of individuals and dividing this value by the maximum number of species and individuals combined (12*132=1584). The results are shown below for each of the cover types in O'Hare and Dalrymple (1997) study (Table 1). As an example, for the P50 cover type, the foraging suitability is calculated by multiplying 11 species times 92 individuals for a total of 1,012. Divide this value by 1,584, which is the maximum number of species times the maximum number of individuals (12*132 = 1,584). The resultant is 0.6389 or 64 percent 11*92=1012/1584*100=63.89).

Table 2: Habitat Foraging Suitability

Cover Type	# of Species (S)	# of Individuals (I)	S*I	Foraging Suitability
DMM	1	2	2	0.001
DMS	4	10	40	0.025
P75	10	59	590	0.372
P50	11	92	1,012	0.639
MAR	12	132	1,584	1.000

This approach was developed to provide us with a method of assessing wetland acreages and their relationship to prey densities and prey availability. We consider wetland dependent bird use to be a general index of food availability. Based on this assessment we developed an exotic foraging suitability index (Table 3):

Table 3. Foraging Suitability Percentages

Exotic Percentage	Foraging Suitability (percent)
Between 0 and 25 percent exotics	100
Between 25 and 50 percent exotics	64
Between 50 and 75 percent exotics	37
Between 75 and 90 percent exotics	3
Between 90 and 100 percent exotics	0

In our assessment however, we consider DMM to represent all exotic species densities between 90 and 100 percent and DMS to represent all exotic species densities between 75 and 90 percent. In our evaluation of a habitat's suitability, the field distinction between an exotic coverage of

90 percent and 100 percent in many situations is not definable, therefore unless otherwise noted in the field reports and in our analysis; we consider a suitability value of 3 percent to represent both densities.

Hydroperiod: The hydroperiod of a wetland can affect the prey densities in a wetland. For instance, research on Everglades fish populations using a variety of quantitative sampling techniques (pull traps, throw traps, block nets) have shown that the density of small forage fish increases with hydroperiod. Marshes inundated for less than120 days of the year average ± 4 fish/m^2; whereas, those flooded for more than 340 days of the year average ± 25 fish/m^2 (Loftus and Eklund 1994, Trexler et al. 2002).

The Service (1999) described a short hydroperiod wetland as wetlands with between 0 and 180-day inundation, and long hydroperiod wetlands as those with greater than 180-day inundation. However, Trexler et al. (2002) defined short hydroperiod wetlands as systems with less than 300 days per year inundation. In our discussion of hydroperiods, we are considering short hydroperiod wetlands to be those that have an inundation of 180 days or fewer.

The most current information on hydroperiods in south Florida was developed by the SFWMD for evaluation of various restoration projects throughout the Everglades Protection Area. In their modeling efforts, they identified the following seven hydroperiods:

Table 4. SFWMD Hydroperiod Classes – Everglades Protection Area

Hydroperiod Class	Days Inundated
Class 1	0-60
Class 2	60-120
Class 3	120-180
Class 4	180-240
Class 5	240-300
Class 6	300-330
Class 7	330-365

Fish Density per Hydroperiod: In the Service's assessment of project related impacts to wood storks, the importance of fish data specific to individual hydroperiods is the principle basis of our assessment. In order to determine the fish density per individual hydroperiod, the Service relied on the number of fish per hydroperiod developed from throw-trap data in Trexler et al.'s (2002) study and did not use the electrofishing data also presented in Trexler et al.'s study that defined fish densities in catch per unit effort, which is not hydroperiod specific. Although the throw-trap sampling generally only samples fish 8 cm or less, the Service believes the data can be used as a surrogate representation of all fish, including those larger than 8 cm, which are typically sampled by either electrofishing or block net sampling.

We base this evaluation on the following assessment. Trexler et al.'s (2002) study included electrofishing data targeting fish greater than 8 cm, the data is recorded in catch per unit effort and in general is not hydroperiod specific. However, Trexler et al. (2002) notes in their assessment of the electrofishing data that in general there is a correlation with the number of fish per unit effort per changes in water depth. In literature reviews of electrofishing data by Chick et al. (1999 and 2004), they note that electrofishing data provides a useful index of the abundance of larger fish in shallow, vegetated habitat, but length, frequency, and species compositional data should be interpreted with caution. Chick et al. (2004) also noted that electrofishing data for large fish (> 8cm) provided a positive correlation of the number of fish per unit effort (abundance) per changes in hydropeiod. The data in general show that as the hydroperiod decreases, the abundance of larger fishes also decreases.

Studies by Turner et al. (1999), Turner and Trexler (1997), and Carlson and Duever (1979) also noted this abundance trend for fish species sampled. We also noted in our assessment of prey consumption by wood storks in the Ogden et al. (1976) study (Figure 4) (discussed below), that the wood stork's general preference is for fish measuring 1.5 cm to 9 cm, although we also acknowledged that wood storks consume fish larger than the limits discussed in the Ogden et al. (1976) study. A similar assessment is reference by Trexler and Goss (2009) noting a diversity of size ranges of prey available for wading birds to consume, with fish ranging from 6 to 8 cm being the preferred prey for larger species of wading birds, particularly wood storks (Kushlan et al. 1975).

Therefore, since data were not available to quantify densities (biomass) of fish larger than 8 cm to a specific hydroperiod, and Ogden et al.'s (1976) study notes that the wood stork's general preference is for fish measuring 1.5 cm to 9 cm, and that empirical data on fish densities per unit effort correlated positively with changes in water depth, we believe that the Trexler et al. (2002) throw-trap data represents a surrogate assessment tool to predict the changes in total fish density and the corresponding biomass per hydroperiod for our wood stork assessment.

In consideration of this assessment, the Service used the data presented in Trexler et al.'s (2002) study on the number of fish per square-meter per hydroperiod for fish 8 cm or less to be applicable for estimating the total biomass per square-meter per hydroperiod for all fish. In determining the biomass of fish per square-meter per hydroperiod, the Service relied on the summary data provided by Turner et al. (1999), which provides an estimated fish biomass of 6.5 g/m^2 for a Class 7 hydroperiod for all fish and used the number of fish per square-meter per hydroperiod from Trexler et al.'s data to extrapolate biomass values per individual hydroperiods.

Trexler et al.'s (2002) studies in the Everglades provided densities, calculated as the square-root of the number of fish per square meter, for only six hydroperiods; although these cover the same range of hydroperiods developed by the SFWMD. Based on the throw-trap data and Trexler et al.'s (2002) hydroperiods, the square-root fish densities are:

Table 5. Fish Densities per Hydroperiod from Trexler et al. (2002)

Hydroperiod Class	Days Inundated	Fish Density
Class 1	0-120	2.0
Class 2	120-180	3.0
Class 3	180-240	4.0
Class 4	240-300	4.5
Class 5	300-330	4.8
Class 6	330-365	5.0

Trexler et al.'s (2002) fish densities are provided as the square root of the number of fish per square meter. For our assessment, we squared these numbers to provide fish per square meter, a simpler calculation when other prey density factors are included in our evaluation of adverse effects to listed species from the proposed action. We also extrapolated the densities over seven hydroperiods, which is the same number of hydroperiods characterized by the SFWMD. For example, Trexler et al.'s (2002) square-root density of a Class 2 wetland with three fish would equate to a SFWMD Model Class 3 wetland with nine fish. Based on the above discussion, the following mean annual fish densities were extrapolated to the seven SFWMD Model hydroperiods:

Table 6. Extrapolated Fish Densities for SFWMD Hydroperiods

Hydroperiod Class	Days Inundated	Extrapolated Fish Density
Class 1	0-60	2 fish/m^2
Class 2	60-120	4 fish/m^2
Class 3	120-180	9 fish/m^2
Class 4	180-240	16 fish/m^2
Class 5	240-300	20 fish/m^2
Class 6	300-330	23 fish/m^2
Class 7	330-365	25 fish/m^2

__**Fish Biomass per Hydroperiod:**__ A more important parameter than fish per square-meter in defining fish densities is the biomass these fish provide. In the ENP and WCA-3, based on studies by Turner et al. (1999), Turner and Trexler (1997), and Carlson and Duever (1979), the standing stock (biomass) of large and small fishes combined in unenriched Class 5 and 6 hydroperiod wetlands averaged between 5.5 to 6.5 grams-wet-mass/m^2. In these studies, the data was provided in g/m^2 dry-weight and was converted to g/m^2 wet-weight following the procedures referenced in Kushlan et al. (1986) and also referenced in Turner et al. (1999). The fish density data provided in Turner et al. (1999) included both data from samples representing fish 8 cm or smaller and fish larger than 8 cm and included summaries of Turner and Trexler (1997) data, Carlson and Duever (1979) data, and Loftus and Eklund (1994) data. These data sets also reflected a 0.6 g/m^2 dry-weight correction estimate for fish greater than 8 cm based on Turner et al.'s (1999) block-net rotenone samples.

Relating this information to the hydroperiod classes developed by the SFWMD, we estimated the mean annual biomass densities per hydroperiod. For our assessment, we considered Class 7 hydroperiod wetlands based on Turner et al. (1999) and Trexler et al. (2002) studies to have a mean annual biomass of 6.5 grams-wet-mass/m^2 and to be composed of 25 fish/m^2. The remaining biomass weights per hydroperiod were determined as a direct proportion of the number of fish per total weight of fish for a Class 7 hydroperiod (6.5 grams divided by 25 fish equals 0.26 grams per fish).

For example, given that a Class 3 hydroperiod has a mean annual fish density of 9 fish/m^2, with an average weight of 0.26 grams per fish, the biomass of a Class 3 hydroperiod would be 2.3 grams/m^2 (9*0.26 = 2.3). Based on the above discussion, the biomass per hydroperiod class is:

Table 7. Extrapolated Mean Annual Fish Biomass for SFWMD Hydroperiods

Hydroperiod Class	Days Inundated	Extrapolated Fish Biomass
Class 1	0-60	0.5 gram/m^2
Class 2	60-120	1.0 gram/m^2
Class 3	120-180	2.3 grams/m^2
Class 4	180-240	4.2 grams/m^2
Class 5	240-300	5.2 grams/m^2
Class 6	300-330	6.0 grams/m^2
Class 7	330-365	6.5 grams/m^2

Wood stork suitable prey size: Wood storks are highly selective in their feeding habits and in studies on fish consumed by wood storks, five species of fish comprised over 85 percent of the number and 84 percent of the biomass of over 3,000 prey items collected from adult and nestling wood storks (Ogden et al. 1976). Table 8 lists the fish species consumed by wood storks in Ogden et al. (1976).

Table 8. Primary Fish Species consumed by Wood Storks from Ogden et al. (1976)

Common name	Scientific name	Percent Individuals	Percent Biomass
Sunfishes	*Centrarchidae*	14	44
Yellow bullhead	*Italurus natalis*	2	12
Marsh killifish	*Fundulus confluentus*	18	11
Flagfish	*Jordenella floridae*	32	7
Sailfin molly	*Poecilia latipinna*	20	11

These species were also observed to be consumed in much greater proportions than they occur at feeding sites, and abundant smaller species [*e.g.*, mosquitofish (*Gambusia affinis*), least killifish (*Heterandria formosa*), bluefin killifish (*Lucania goodei*)] are under-represented, which the researchers believed was probably because their small size did not elicit a bill-snapping reflex in these tactile feeders (Coulter et al. 1999). Their studies also showed that, in addition to selecting larger species of fish, wood storks consumed individuals that are significantly larger (>3.5 cm) than the mean size available (2.5 cm), and many were greater than 1-year old (Ogden et al. 1976, Coulter et al. 1999). However, Ogden et al. (1976) also found that wood storks most likely consumed fish that were between 1.5 and 9.0 cm in length (Figure 4 in Ogden et al. 1976).

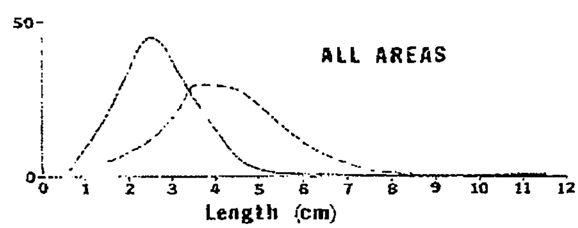

FIGURE 4. Length frequency distribution of fish available to and consumed by Wood Storks in different habitats.

In Ogden et al.'s (1976) Figure 4, the dotted line is the distribution of fish consumed and the solid line is the available fish. Straight interpretation of the area under the dotted line curve represents the size classes of fish most likely consumed by wood storks and is the basis of our determination of the amount of biomass that is within the size range of fish most likely consumed by wood storks, which in this example is a range size of 1.5 to 9.0 cm in length.

Wood stork suitable prey base (biomass per hydroperiod): To estimate that fraction of the available fish biomass that might be consumed by wood storks, the following analysis was conducted. Trexler et al.'s (2002) 2-year throw trap data of absolute and relative fish abundance per hydroperiod distributed across 20 study sites in the ENP and the WCAs was considered to be representative of the Everglades fish assemblage available to wood storks (n = 37,718 specimens of 33 species). Although Trexler et al.'s (2002) data was based on throw-trap data and representative of fish 8 cm or smaller, the Service believes the data set can be used to predict the biomass/m^2 for total fish (those both smaller and larger than 8 cm). This approach is also supported, based on our assessment of prey consumption by wood storks in Ogden et al.'s (1976) study (Figure 4), that the wood storks general preference is for fish measuring 1.5 cm to 9 cm and is generally inclusive of Trexler et al.'s (2002) throw-trap data of fish 8 cm or smaller.

To estimate the fraction of the fish biomass that might be consumed by wood storks, the Service, using Trexler et al.'s (2002) throw-trap data set, determined the mean biomass of each fish species that fell within the wood stork prey size limits of 1.5 to 9.0 cm. The mean biomass of each fish species was estimated from the length and wet mass relationships for Everglades' icthyofauna developed by Kushlan et al. (1986). The proportion of each species that was outside of this prey length and biomass range was estimated using the species mean and variance provided in Table 1 in Kushlan et al. (1986). These biomass estimates assumed the length and mass distributions of each species was normally distributed and the fish biomass could be estimated by eliminating that portion of each species outside of this size range. These biomass estimates of available fish prey were then standardized to a sum of 6.5 g/m^2 for Class 7 hydroperiod wetlands (Service 2009).

For example, Kushlan et al. (1986) lists the warmouth (*Lepomis gulosus*) with a mean average biomass of 36.76 g. In fish samples collected by Trexler et al. (2002), this species accounted for 0.048 percent (18/37,715=0.000477) of the Everglades freshwater ichthyofauna. Based on an average biomass of 36.76 g (Kushlan et al. 1986), the 0.048 percent representation from Trexler et al. (2002) is equivalent to an average biomass of 1.75 g (36.76*0.048) or 6.57 percent (1.75/26.715) of the estimated average biomass (26.715 g) of Trexler et al.'s (2002) samples (Service 2009).

Standardizing these data to a sample size of 6.5 g/m^2, the warmouth biomass for long hydroperiod wetlands would be about 0.427 g (Service 2009). However, the size frequency distribution (assumed normal) for warmouth (Kushlan et al. 1986) indicate 48 percent are too large for wood storks and 0.6 percent are too small (outside the 1.5 cm to 9 cm size range most likely consumed), so the warmouth biomass within the wood stork's most likely consumed size range is only 0.208 g (0.427*(0.48+0.006)=0.2075) in a 6.5 g/m^2 sample. Using this approach summed over all species in long hydroperiod wetlands, only 3.685 g/m^2 of the 6.5 g/m^2 sample consists of fish within the size range likely consumed by wood storks or about 57 percent (3.685/6.5*100=56.7) of the total biomass available.

An alternative approach to estimate the available biomass is based on Ogden et al. (1976). In their study (Table 8), the sunfishes and four other species that accounted for 84 percent of the biomass eaten by wood storks totaled 2.522 g of the 6.5 g/m^2 sample (Service 2009). Adding the remaining 16 percent from other species in the sample, the total biomass would suggest that 2.97 g of a 6.5 g/m^2 sample are most likely to be consumed by wood storks or about 45.7 percent (2.97/6.5=0.4569)

The mean of these two estimates is 3.33g/m^2 for long hydroperiod wetlands (3.685 + 2.97 = 6.655/ 2 = 3.33). This proportion of available fish prey of a suitable size (3.33 g/m^2 / 6.5 g/m^2 = 0.51 or 51 percent) was then multiplied by the total fish biomass in each hydroperiod class to provide an estimate of the total biomass of a hydroperiod that is the appropriate size and species composition most likely consumed by wood storks.

As an example, a Class 3 SFWMD model hydroperiod wetland with a biomass of 2.3 grams/m^2, adjusted by 51 percent for appropriate size and species composition, provides an available biomass of 1.196 grams/m^2. Following this approach, the biomass per hydroperiod potentially available to predation by wood storks based on size and species composition is:

Table 9. Wood Stork Suitable Prey Base (fish biomass per hydroperiod)

Hydroperiod Class	Days Inundated	Fish Biomass
Class 1	0-60	0.26 gram/m^2
Class 2	60-120	0.52 gram/m^2
Class 3	120-180	1.196 grams/m^2
Class 4	180-240	2.184 grams/m^2
Class 5	240-300	2.704 grams/m^2
Class 6	300-330	3.12 grams/m^2
Class 7	330-365	3.38 grams/m^2

<u>**Wood Stork-Wading Bird Prey Consumption Competition**</u>: In 2006, (Service 2006), the Service developed an assessment approach that provided a foraging efficiency estimate that 55 percent of the available biomass was actually consumed by wood storks. Since the implementation of this assessment approach, the Service has received comments from various sources concerning the Service's understanding of Fleming et al.'s (1994) assessment of prey base consumed by wood storks versus prey base assumed available to wood stork and the factors included in the 90 percent prey reduction value.

In our original assessment, we noted that, "*Fleming et al. (1994) provided an estimate of 10 percent of the total biomass in their studies of wood stork foraging as the amount that is actually consumed by the storks. However, the Fleming et al. (1994) estimate also includes a second factor, the suitability of the foraging site for wood storks, a factor that we have calculated separately. In their assessment, these two factors accounted for a 90 percent reduction in the biomass actually consumed by the storks. We consider these two factors as equally important and are treated as equal components in the 90 percent reduction; therefore, we consider each factor to represent 45 percent of the reduction. In consideration of this approach, Fleming et al.'s (1994) estimate that 10 percent of the biomass would actually be consumed by the storks would be added to the 45 percent value for an estimate that 55 percent (10 percent plus the remaining 45 percent) of the available biomass would actually be consumed by the storks and is the factor we believe represents the amount of the prey base that is actually consumed by the stork.*"

In a follow-up review of Fleming et al.'s (1994) report, we noted that the 10 percent reference is to prey available to wood storks, not prey consumed by wood storks. We also noted the 90 percent reduction also includes an assessment of prey size, an assessment of prey available by water level (hydroperiod), an assessment of suitability of habitat for foraging (openness), and an assessment for competition with other species, not just the two factors considered originally by the Service (suitability and competition). Therefore, in re-evaluating of our approach, we identified four factors in the 90 percent biomass reduction and not two as we previously considered. We believe these four factors are represented as equal proportions of the 90 percent reduction, which corresponds to an equal split of 22.5 percent for each factor. Since we have accounted previously for three of these factors in our approach (prey size, habitat suitability, and hydroperiod) and they are treated separately in our assessment, we consider a more appropriate foraging efficiency to represent the original 10 percent and the remaining 22.5 percent from the 90 percent reduction discussed above. Following this revised assessment, our competition factor would be 32.5 percent, not the initial estimate of 55 percent.

Other comments reference the methodology's lack of sensitivity to limiting factors, i.e., is there sufficient habitat available across all hydroperiods during critical life stages of wood stork nesting and does this approach over emphasize the foraging biomass of long hydroperiod wetlands with a corresponding under valuation of short hydroperid wetlands. The Service is aware of these questions and is examining alternative ways to assess these concerns. However, until futher research is generated to refine our approach, we continue to support the assessment tool as outlined.

Following this approach, Table 10 has been adjusted to reflect the competition factor and represents the amount of biomass consumed by wood storks and is the basis of our effects assessments (Class 1 hydroperiod with a biomass 0.26 g, multiplied by 0.325, results in a value of 0.08 g [0.25*.325=0.08]) (Table 10).

Table 10 Actual Biomass Consumed by Wood Storks

Hydroperiod Class	Days Inundated	Fish Biomass
Class 1	0-60	0.08 gram/m^2
Class 2	60-120	0.17 gram/m^2
Class 3	120-180	0.39 grams/m^2
Class 4	180-240	0.71 grams/m^2
Class 5	240-300	0.88 grams/m^2
Class 6	300-330	1.01 grams/m^2
Class 7	330-365	1.10 grams/m^2

<u>Sample Project of Biomass Calculations and Corresponding Concurrence Determination</u>

Example 1:

An applicant is proposing to construct a residential development with unavoidable impacts to 5 acres of wetlands and is proposing to restore and preserve 3 acres of wetlands onsite. Data on the onsite wetlands classified these systems as exotic impacted wetlands with greater than 50 percent but less than 75 percent exotics (Table 3) with an average hydroperiod of 120-180 days of inundation.

The equation to calculate the biomass lost is: The number of acres, converted to square-meters, times the amount of actual biomass consumed by the wood stork (Table 10), times the exotic foraging suitability index (Table 3), equals the amount of grams lost, which is converted to kg.

Biomass lost (5*4,047*0.39 (Table 10)*0.37 (Table 3)=2,919.9 grams or 2.92 kg)

In the example provided, the 5 acres of wetlands, converted to square-meters (1 acre= 4,047 m^2) would provide 2.9 kg of biomass (5*4,047*0.39 (Table 10)*0.37 (Table 3)= 2,919.9 grams or 2.9 kg), which would be lost from development.

The equation to calculate the biomass from the preserve is the same, except two calculations are needed, one for the existing biomass available and one for the biomass available after restoration.

Biomass Pre: (3*4,047*0.39(Table 10)*0.37 (Table 3)=1,751.95grams or 1.75 kg)

Biomass Post: (3*4,047*0.39 (Table 10)*1(Table 3)=4,734.99 grams or 4.74 kg)

Net increase: 4.74 kg-1.75 kg = 2.98 kg Compensation Site

Project Site Balance 2.98 kg- 2.92 kg = 0.07kg

The compensation proposed is 3 acres, which is within the same hydroperiod and has the same level of exotics. Following the calculations for the 5 acres, the 3 acres in its current habitat state, provides 1.75 kg (3*4,047*0.39 (Table 10)*0.37 (Table 3)=1,751.95grams or 1.75 kg) and following restoration provides 4.74 kg (3*4,047*0.39 (Table 10)*1(Table 3)=4,734.99 grams or 4.74 kg), a net increase in biomass of 2.98 kg (4.74-1.75=2.98).

Example 1: 5 acre wetland loss, 3 acre wetland enhanced – same hydroperiod - NLAA

Hydroperiod	Existing Footprint		On-site Preserve Area				Net Change*	
			Pre Enhancement		Post Enhancement			
	Acres	Kgrams	Acres	Kgrams	Acres	Kgrams	Acres	Kgrams
Class 1 - 0 to 60 Days								
Class 2 - 60 to 120 Days								
Class 3 - 120 to 180 Days	5	2.92	3	1.75	3	4.74	(5)	0.07
Class 4 - 180 to 240 Days								
Class 5 - 240 to 300 Days								
Class 6 - 300 to 330 Days								
Class 7 - 330 to 365 days								
TOTAL	**5**	**2.92**	**3**	**1.75**	**3**	**4.74**	**(5)**	**0.07**

*Since the net increase in biomass from the restoration provides 2.98 kg and the loss is 2.92 kg, there is a positive outcome (4.74-1.75-2.92=0.07) in the same hydroperiod and Service concurrence with a NLAA is appropriate.

Example 2:

In the above example, if the onsite preserve wetlands were a class 4 hydroperiod, which has a value of 0.71. grams/m^2 instead of a class 3 hydroperiod with a 0.39 grams/m^2 [Table 10]), there would be a loss of 2.92 kg of short hydroperiod wetlands (as above) and a net gain of 8.62 kg of long-hydroperiod wetlands.

Biomass lost: (5*4,047*0.39 (Table 10)*0.37 (Table 3)=2,919.9 grams or 2.92 kg)

The current habitat state of the preserve provides 3.19 kg (3*4,047*0.71 (Table 10)*0.37 (Table 3)=3,189.44 grams or 3.19 kg) and following restoration the preserve provides 8.62 kg (3*4,047*0.71 (Table 10)*1(Table 3)= 8,620.11 grams or 8.62 kg, thus providing a net increase in class 4 hydroperiod biomass of 5.43 kg (8.62-3.19=5.43).

Biomass Pre: (3*4,047*0.71(Table 10)*0.37 (Table 3) = 3,189.44 grams or 3.19 kg)

Biomass Post: (3*4,047*0.71 (Table 10)*1(Table 3)=8,620.11 grams or 8.62 kg)

Net increase: 8.62 kg-3.19 kg = 5.43 kg

Project Site Balance 5.43 kg- 2.92 kg = 2.51 kg

Example 2: 5 acre wetland loss, 3 acre wetland enhanced – different hydroperiod – May Affect

Hydroperiod	**Existing Footprint**		**On-site Preserve Area**				**Net Change***	
			Pre Enhancement		**Post Enhancement**			
	Acres	**Kgrams**	**Acres**	**Kgrams**	**Acres**	**Kgrams**	**Acres**	**Kgrams**
Class 1 - 0 to 60 Days								
Class 2 - 60 to 120 Days								
Class 3 - 120 to 180 Days	5	2.92					(5)	-2.92
Class 4 - 180 to 240 Days			3	3.19	3	8.62	0	5.43
Class 5 - 240 to 300 Days								
Class 6 - 300 to 330 Days								
Class 7 - 330 to 365 days								
TOTAL	**5**	**2.92**	**3**	**3.19**	**3**	**8.62**	**(5)**	**2.51**

In this second example, even though there is an overall increase in biomass, the biomass loss is a different hydroperiod than the biomass gain from restoration, therefore, the Service could not concur with a NLAA and further coordination with the Service is appropriate.

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