Appendix 7A-2: Picayune Strand Restoration Project Baseline

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SUMMARY

Picayune Strand Restoration Project is a Comprehensive Everglades Restoration Plan (CERP) and Acceler8 project that will rehydrate a failed 1960s subdivision, known as Southern Golden Gate Estates, by removing the infrastructure of roads and canals and restoring its pre-drainage hydrology. The Picayune Strand area is located in southwestern Collier County. It is surrounded by preserves and wildlife areas that will be linked and enhanced by the restored conditions within the project area, creating a combined natural area that will function as a single connected regional ecosystem. The regional ecosystem includes estuaries, freshwater wetlands, and uplands. A combination of restored hydrologic and fire regimes along with exotic vegetation control can be expected to return most of Picayune Strand to its pre-drainage character.

Construction has begun on the project site. Structures from developed properties have been removed, seven miles of Prairie Canal has been filled, and all roads east of Merritt Canal have been removed. This work was completed in spring 2004. Permits that authorized completed construction contain extensive monitoring requirements. This level of monitoring is not required to track restoration success nor is it sustainable. Modifications to the permit monitoring requirements are currently being discussed; however, this appendix fulfills the baseline reporting requirements of two of the original permits. Future reports will reflect permit modifications.

The main purpose of this appendix is to report on baseline conditions within and around the project area. Not all of the baseline data has been analyzed, but the data that has been analyzed is presented in this report. In addition to providing a partial baseline report, this chapter discusses pre-drainage and post-drainage conditions of hydrology, soil, fire, plant communities, estuarine resources, and fish and wildlife, including the endangered Florida panther and West Indian manatee. Baseline information will be updated in future editions of the *South Florida Environmental Report – Volume I* (SFER).

This edition of the baseline report contains detailed baseline information on small mammals, fish, aquatic macroinvertebrates, terrestrial invertebrates, amphibians, Pumpkin Bay benthic mapping, and incidental wildlife observations. It also contains partial baseline information on plant communities, including soil type and fire interval, and birds. A short summary of hydrology and water quality is also included, but most of this data is still being analyzed.

Some post-construction information on hydrology and exotic and nuisance species is also included. Hydrologic improvements have been observed within Fakahatchee Strand Preserve State Park adjacent to the filled Prairie Canal. An initial exotic and nuisance species monitoring survey was conducted along former roadway sites and the filled canal in May 2005, and the first control treatment was done in May 2006.

BACKGROUND

Picayune Strand Restoration Project, formerly known as Southern Golden Gate Estates Ecosystem Restoration Project, is a CERP and Acceler8 project. The project involves rehydrating a 55,247-acre (about 94 square miles) failed 1960s residential subdivision by removing the infrastructure of roads and canals and restoring its pre-drainage hydrology (USACE and SFWMD, 2004). An extensive canal system was excavated to drain surface waters and provide fill for development. Roads were constructed on a quarter-mile grid. The canals and roads have over-drained the area, resulting in the reduction of aquifer recharge, greatly increased freshwater point source discharges to receiving estuaries to the south, invasion by upland vegetation, loss of ecological connectivity and associated habitat, and increased frequency of forest fires.

Picayune Strand is located in southwestern Collier County, one of the fastest growing counties in the nation (USACE and SFWMD, 2004). It is located between Interstate Highway 75 (“Alligator Alley”) and U.S. Highway 41 (**Figure 1**). It is located southwest of the Florida Panther National Wildlife Refuge (NWR), north of the Ten Thousand Islands NWR, east of the South Belle Meade State Conservation and Recreation Lands (CARL) Project, west of the Fakahatchee Strand Preserve State Park, and northeast of Collier-Seminole State Park and Rookery Bay National Estuarine Research Preserve (**Figure 1**). The South Belle Meade CARL Project, known simply as “Belle Meade”, and the Southern Golden Glades Estates CARL Project have been combined by the State of Florida to form Picayune Strand State Forest.

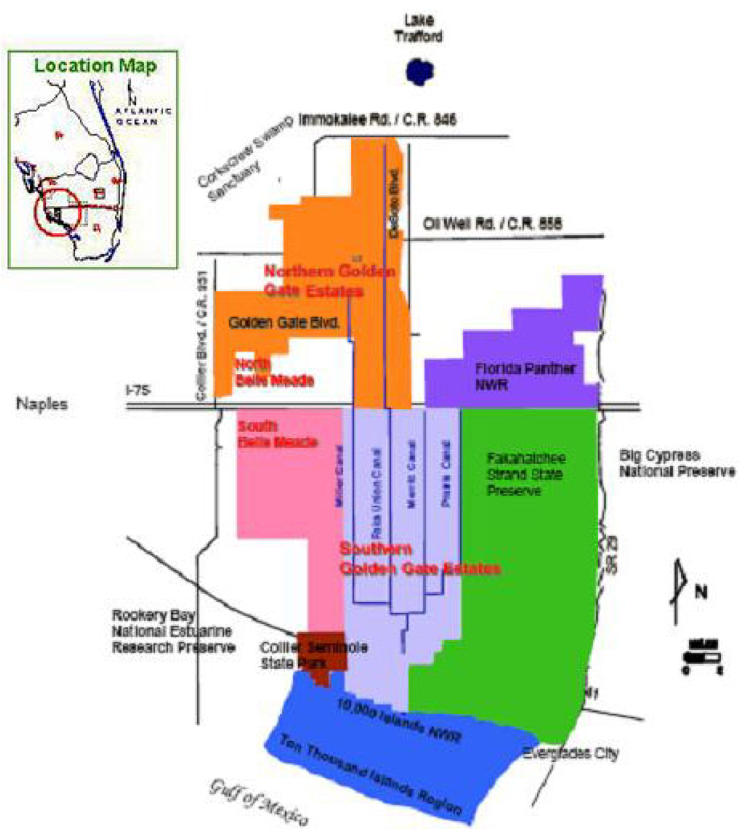

Figure 1. Picayune Strand Restoration Project (formerly Southern Golden Gate Estates CARL Project).

The Picayune Strand Restoration Project area constitutes the heart this forest. These federal and state preserves and parks surrounding the Picayune Strand Restoration Project area will be linked and enhanced by restored conditions within this area. The combined natural area will be able to function as one connected regional ecosystem. Currently, the failed subdivision creates drainage and fire impacts to the adjacent lands and acts as a barrier to movement and growth of populations of plants and animals. Also, it is one of the few locations in South Florida where large cypress forests can be restored.

The Southern Golden Gate Estates subdivision included 19,992 platted parcels laid out in a quarter-mile grid, with 279 miles of roads, 251 culverts, 10 bridges, 48 miles of drainage canals, and eight weirs (**Figure 2**) (USACE and SFWMD, 2004). Hydrologic restoration of the area will be accomplished by removing 227 miles of roads, plugging 42 miles of canals, and installing three pump stations and spreader channels to convey water across the area as overland sheetflow (**Figure 3**). Canal plugs will be placed south of the pump station in the Miller, Faka Union and Merritt canals, and placed in the entire length of the Prairie Canal, preventing the canals from transporting water southward to the estuaries. Source material for canal plugs and swale blocks is spoil from original canal and swale excavations, and demolition and degrading of the roads. Spreader channels will be located immediately downstream of the pump stations and will distribute flows along overland areas to emulate historic sheetflow. Pump stations and levees will provide flood protection for surrounding developed areas including Northern Golden Gates Estates. Culverts will be placed under U.S. 41 to allow water sheet-flowing across the landscape to continue flowing southward to the estuaries of the Ten Thousand Island region, improving timing and volume of freshwater flows to the estuaries of Palm, Blackwater, Buttonwood, Pumpkin, Faka Union and Fakahatchee Bays (**Figure 4**).

The combination of restored hydrology, more natural fire regime, and appropriate exotic vegetation control can be expected to reestablish the pre-drainage character of Picayune Strand plant communities (USACE and SFWMD, 2004). Expected ecosystem benefits include restoration of historic wetland communities, restoration of sheetflow towards coastal estuaries, reduction of harmful surge flows through the Faka Union Canal into Faka Union Bay, improved freshwater overland flow and seepage into other bays of the Ten Thousand Islands region, improved aquifer recharge, decreased frequency and intensity of forest fires, improved habitat for fish and wildlife including threatened and endangered species, reduced invasion of exotic species, and increased spatial extent of wetlands.

The time frame for restoration of plant communities will vary, but tree-dominated cover types do not change rapidly (USACE and SFWMD, 2004). The length of time needed to accomplish full community restoration will depend on the type of community to be reestablished and the degree to which the communities have been disturbed, particularly by severe fires. Loss of older forest trees means several decades to replace that canopy, during which time the sites would be dominated by earlier successional communities, most likely willow in cypress swamps and a mixture of wax myrtle and herbaceous species in pine flatwoods. During this successional period it would be important to monitor for and eradicate exotic/invasive plant species while their populations are small.

Plugging and filling of the Faka Union Canal system would restore sheetflow across the landscape, reestablish natural flow-ways, and bring back groundwater levels to near pre-drainage conditions on much of the surrounding public lands (**Figure 1**) (USACE and SFWMD, 2004). Plugging the Prairie Canal would improve groundwater levels within the affected portion of Fakahatchee Strand Preserve State Park. Filling the Merritt Canal would mitigate overdrainage problems in the Florida Panther NWR. Flow-ways in Belle Meade and Collier Seminole State Park would be reestablished by plugging the Miller and Faka Union Canals.

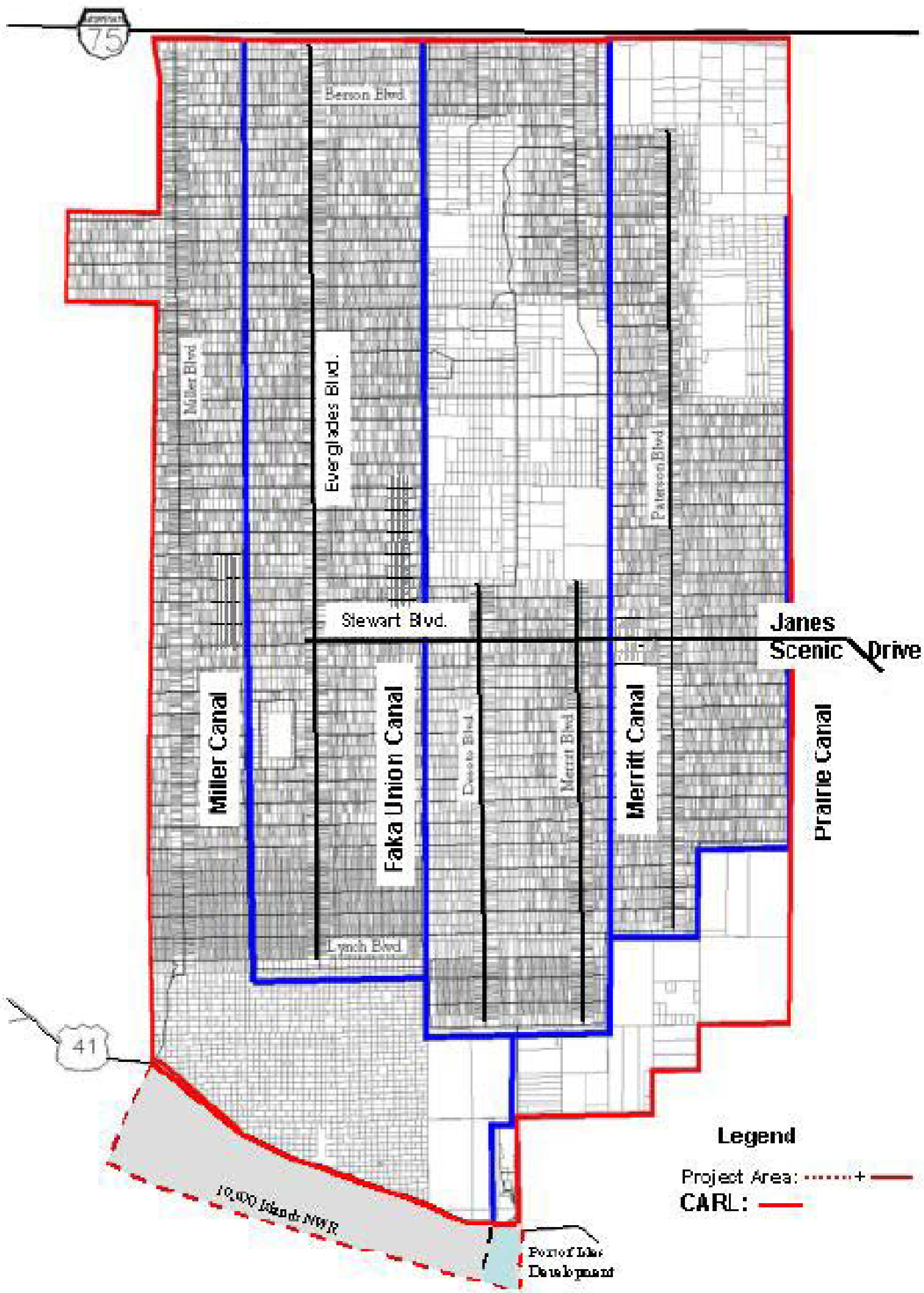

Figure 2. Map Picayune Strand Restoration Project area showing subdivision infrastructure.

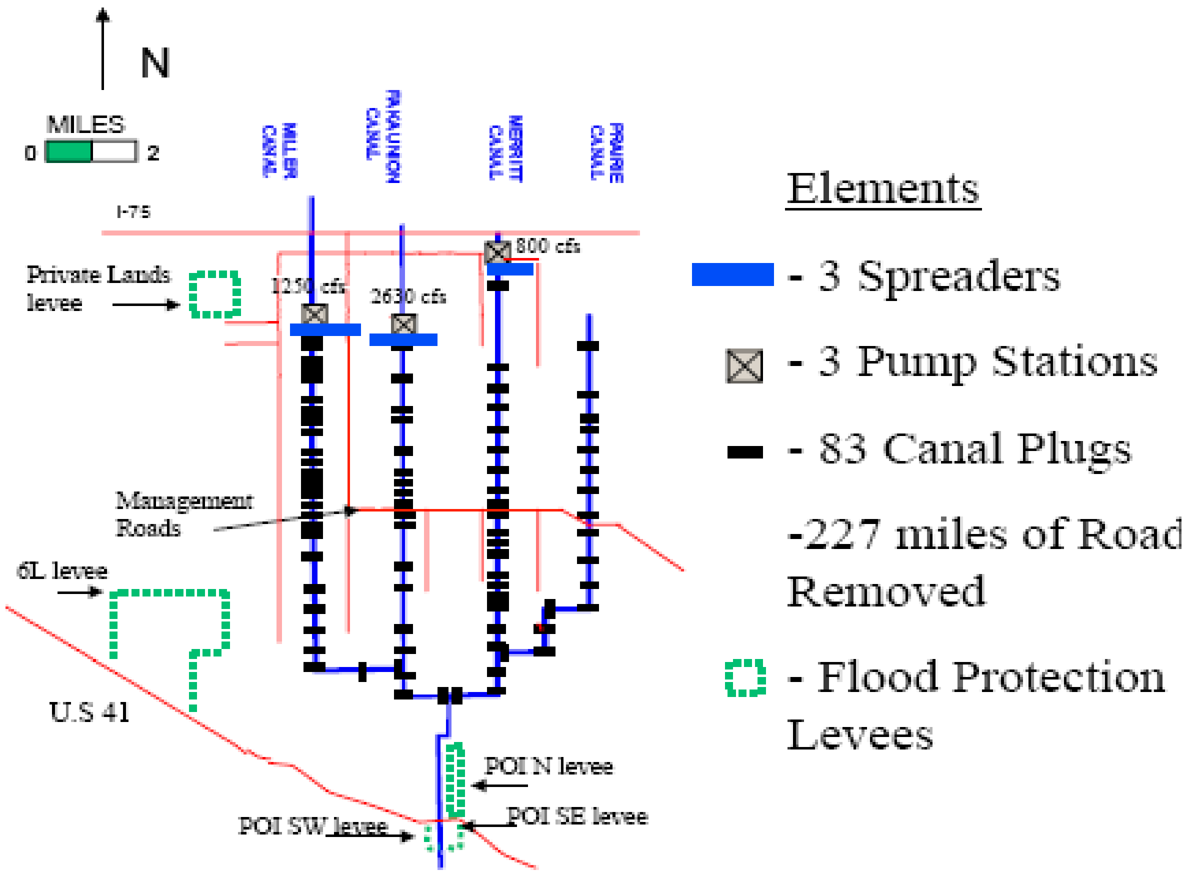

Figure 3. Construction features of the Picayune Strand Restoration Project.

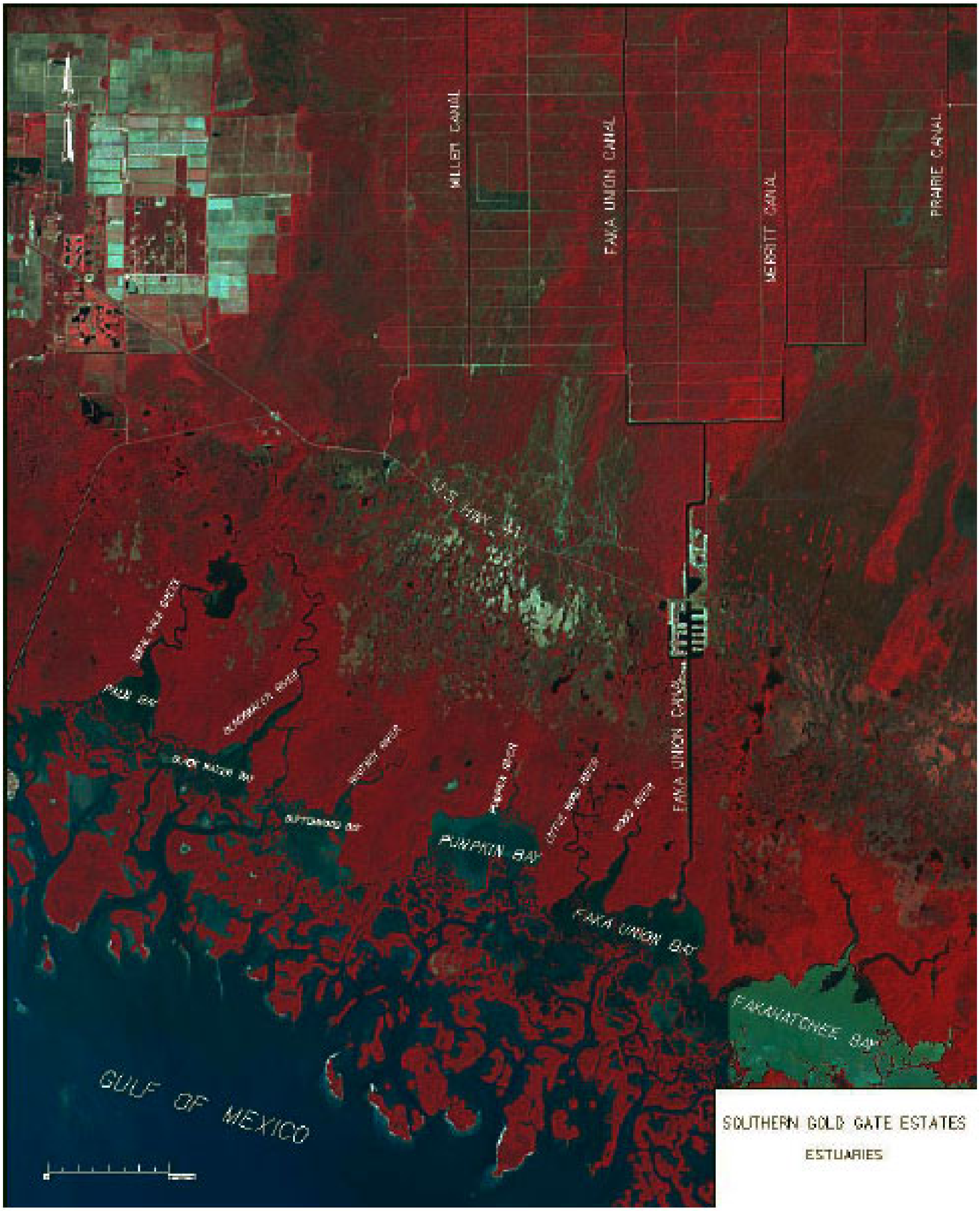

Figure 4. Estuaries, rivers and bays affected by Picayune Strand.

PRE-DRAINAGE AND POST-DRAINAGE CONDITIONS

HYDROLOGY

Prior to anthropogenic impacts, flat topography, marly soils, and seasonal rainfall cycles were principal influences on the hydrology of the Picayune Strand area. During the wet season, from June through October, rainfall was drained as a gentle, broad, slow-moving overland sheetflow a few inches to a few feet deep and up to several miles wide. Seasonal flooding occurred several months of the year (USACE and SFWMD, 2004). Wetland hydroperiods were maintained well into the dry season (SFWMD and NRCS, 2003). This natural sheetflow system absorbed floodwater, promoted groundwater recharge, sustained wetland vegetation, rejuvenated freshwater aquifers, assimilated nutrients, and removed suspended materials. Overland sheetflow contributed freshwater inflow across a broad front to bays and estuaries of the Ten Thousand Islands region. Pre-drainage, natural surface runoff in the area has been reported to be up to 10 inches annually (USACE and SFWMD, 2004).

Land drainage activities began in southwest Florida with the diversion and channelization of the Caloosahatchee River (USACE and SFWMD, 2004). Significant anthropogenic alterations of the hydrologic regime and vegetative communities have occurred within the project area beginning with cypress logging operations in the 1940s and 1950s. The greatest changes occurred with development of the Southern Golden Glades Estates subdivision in the 1960s. Historic, shallow flow paths were intercepted by roads and borrow ditches, and surface water and groundwater were drained by canals (USACE and SFWMD, 2004).

Canal excavation began in 1963 and ended in 1971. These canals are part of the Faka Union Canal system. Once completed, the canal system lowered previously existing groundwater levels from 2 to 4 feet (Addison et al., 2006). Average canal discharge records for 1969 to 2003 measured upstream from the outflow weir in Faka Union Canal (near the intersection of the canal and U.S. 41) were 115 cubic feet per second (cfs) during the dry season (November through May) and 460 cfs during the wet season (June through October) (SFWMD and NRCS, 2003). Runoff that once slowly drained as overland sheetflow is now channelized and released into Faka Union Bay as a point discharge, causing freshwater shock loads to the bay's estuary (SFWMD and NRCS, 2003). Less runoff is available for other estuaries within the Ten Thousand Island regions (USACE and SFWMD, 2004) and for groundwater recharge (SFWMD and NRCS, 2003). Water table drawdowns associated with Southern Golden Gates Estates canals have extended over two miles into Fakahatchee Strand Preserve State Park.

SOIL

Most soils within the project area are characterized as poorly or very poorly drained and historically were subject to intermittent or prolonged flooding. Under unaltered conditions, soil type and vegetation are strongly correlated; therefore, observations of soil types provide information about pre-development natural flow-ways and land cover (SFWMD and NRCS, 2003). The 1954 Collier County Soil Survey (Leighty et al., 1954) indicated several soils that might be found within the project area. Most of the area has black or dark-gray, mucky, and fine sand or peaty muck; others areas have brown peat.

Drainage of the project area landscape and the consequent increase in wildfires has caused oxidation of much of the organic soil. Lost organic soils in some deeper wetlands will require centuries to replace. In the meantime, either deeper wetland communities, such as pop ash, pond apple sloughs, or open water would dominate these sites (USACE and SFWMD, 2004). Restoration of water depth and duration, and reestablishment of a higher groundwater table would help arrest the destruction of organic soils by oxidation and fire. Organic matter will start to deposit in areas with proper parent material, living organisms, climate and topography; however, the rate of organic soil formation over time is not clear.

FIRE

Thirty years of alterations to the hydrological cycle caused by canals have resulted in more frequent and intense wildfires within the Picayune Strand Restoration Project area (USACE and SFWMD, 2004). Fires commonly move from prairies or flatwoods farther into adjacent cypress sloughs or other hydric forest communities than was historically common (SFWMD and NRCS, 2003). This alters species compositions in communities formerly more hydric, as most resident species are not well adapted to withstand fires (Wade et al., 1980). Fires may burn closer to or below surface soil, as surface water and moisture levels are lower than levels before drainage. Intense fires have burned out soil organic matter that is associated with many hydric plant communities. Due to rapid drainage by canals, the window for prescribed burning is greatly reduced. Fewer prescribed burns lead to fuel build up, more intense wildfires and a reduced ability to control exotics (USACE and SFWMD, 2004).

PLANT COMMUNITIES

In July 2001, the Natural Resources Conservation Service (NRCS) provided a detailed map, based on 1940 aerial photographs, of pre-drainage distribution of major plant community types in the Picayune Strand Restoration Project area (**Figure 5, Panel A**) (SFWMD and NRCS, 2003). Comparison of 1940 and 1953 aerial photography with 1954 soil survey information verifies historic plant communities within this map. Although this retrospective map obviously cannot be ground-truthed and may contain some errors, it can be used to compare future change following restoration if the restoration target is a return to a more natural or pre-drainage condition. Using 1995 color infrared aerial photography, current soil survey information (Leighty et al., 1998), and extensive ground-truthing, the NRCS also developed a map of 1995 plant communities (**Figure 5, Panel B**) analogous to that developed for 1940 (SFWMD and NRCS, 2003).

Major native plant communities in the project area prior to drainage were cypress-dominated forest, wet prairie and pine flatwood (**Table 1**) (Leighty et al., 1954). Almost 40,000 acres were cypress forest (**Table 2**). Freshwater marsh and hammock communities were also present. Even those sites normally designated as uplands, particularly islands of pine flatwoods often had water at or above the ground surface for at least short periods during the wet season (USACE and SFWMD, 2004). Fires were a common occurrence and were an important factor in health and survival of many terrestrial communities (USACE and SFWMD, 2004). In addition, modern impacts continue to occur over distances as great as a mile – or more – from the canals into adjacent public lands.

Historic plant community composition has changed from that of wetland and transitional vegetation to more upland, invasive and exotic-dominated systems (**Tables 1** and **2**; **Figure 5**) (SFWMD and NRCS, 2003; USACE and SFWMD, 2004). As historic cypress strands became drier due to the canal-induced drawdown, vegetative succession shifted toward a mixed cypress-hardwood-cabbage palm system (USACE and SFWMD, 2004). Cypress forest has been reduced by almost half from 40,000 acres in 1940 to 20,000 acres in 1995 (**Table 2**) and location of cypress with palms communities have shifted (**Figure 5**). Much of the original cypress and cypress with palms community has been replaced by cabbage palm hammocks or pine flatwoods (SFWMD and NRCS, 2003). Hammock communities now include mesic and hardwood hammocks in addition to cabbage palm and hydric hammocks present in 1940 (SFWMD and NRCS, 2003). Often, invasive exotic species like Brazilian pepper (*Schinus terebinthifolius*) and melaleuca (*Melaleuca quinquenervia*) have become dominant or co-dominant in many of these formerly hydric communities (USACE and SFWMD, 2004).

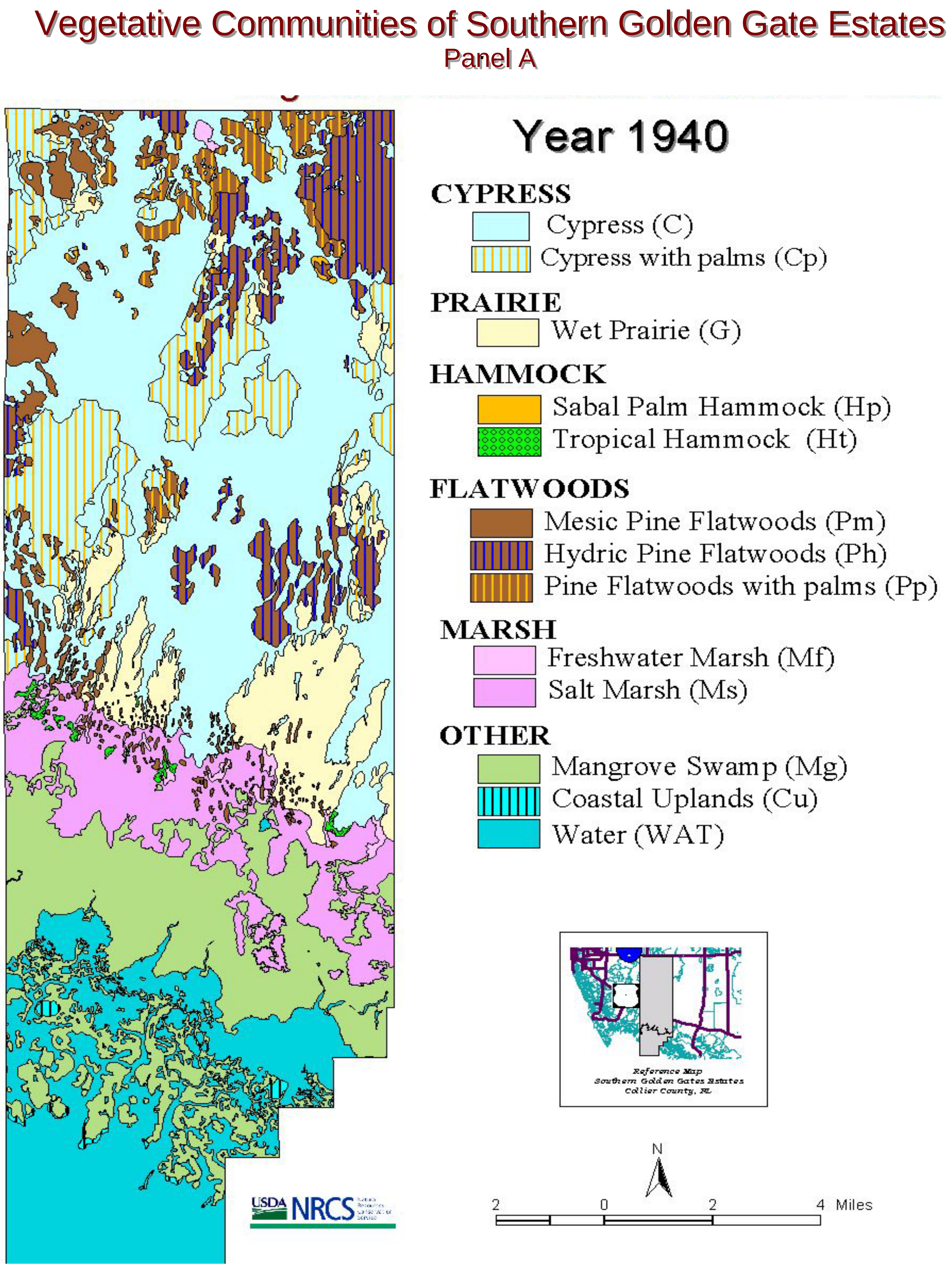

Figure 5, Panel A. Pre-drainage (Panel A, 1940) and post-drainage (Panel B, 1995) vegetation maps of the Picayune Strand Restoration Project area.

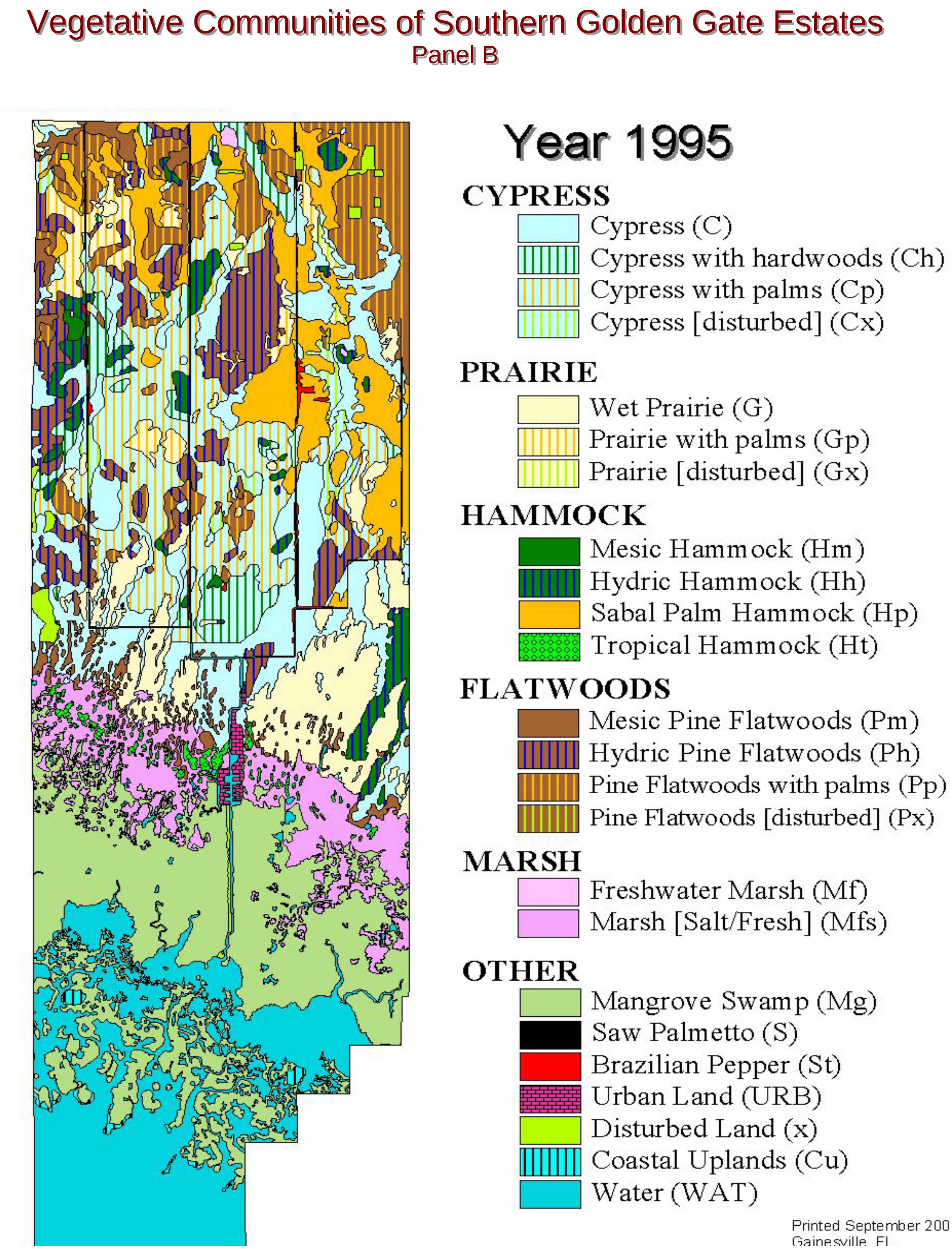

Figure 5, Panel B. Post-drainage vegetation map (1995) of the Picayune Strand Restoration Project area.

Brazilian pepper often occurs as a result of soil disturbance associated with canals and adjacent spoil piles and forms a nearly complete shrub layer. To ensure restoration, it must be monitored and removed from filled in roadways and canals. Following drainage, salt marsh acreage decreased and mangrove swamp and water increased. The general northward advance of mangroves into saltwater marshes (**Figure 5**) is likely partially due to reduced freshwater flows. However, other factors such as reduced fire frequency and sea level rise could also be involved. Plant communities within Picayune Strand are still in transition following disturbance of natural conditions. These communities are not stable and will not maintain current characteristics over the long term. In absence of restoration, communities will succeed towards more upland and exotic plant communities.

Table 1. Descriptions of major plant communities in 1940 versus 1995.

Community Type	Dominant Species	Other Species	Wet Season Water Depth (inches)	Hydro-periods (months)	Non-Hydrologic Influences	Pre-Drainage (1940) Relative Abundance	1995 Relative Abundance
Cypress Forests	dense stands of bald cypress (*Taxodium distichum*)	hardwoods (< 30% cover)	12 - 24	6 - 10	< fire	++++	++++
Freshwater Marsh	low-diversity herbaceous with tall, dense strands of grass and forbs	bald cypress (< 30% cover)	12 - 24	6 - 10	fire, organic soils	++	++
Wet Prairie	high-diversity herbaceous with short open stands of grasses sedges and forbs	slash pine or bald cypress (< 30% cover)	6 - 12	2 - 6	fire, mineral soils (sand, marl, rock)	+++	+++
Hydric Pine Flatwoods	open canopy of slash pines with dense and diverse herbaceous ground cover of grasses, sedges and forbs		2 - 6	1 - 2	fire, sand or rock substrate	+++	+++
Flatwoods with Cabbage Palm	slash pines with cabbage palm (*Sabal palmetto*)		< 2 - 6	< 1 - 2	fire	+++	+++
Cabbage Palm Hammocks	cabbage palms		< 2 - 6	<1 - 2	> fires, sand or rock substrate	+	+++
Hydric Hammock			6 - 12	2-6	fire		+++
Mesic Pine Flatwoods	open canopy of slash pines (*Pinus eliottii*) pines with dense saw palmetto (*Serenoa repens*)		< 2	< 1	fire, sand or rock substrate	+++	+++
Mesic Hammock			< 2	<1	no fire	-	++
Brazilian Pepper			< 2	<1	exotic	-	++
Hardwood Hammocks	hardwood species	cabbage palms, live oaks (*Quercus virginiana*)	+/- 6	0 - 2	no fire, sand or rock substrate	++	++

The native cabbage palm (*Sabal palmetto*) has become dominant throughout much of the area during the past few decades, increasing from approximately 55 acres in 1940 to almost 7,300 acres in 1995 (**Table 2**) (SFWMD and NRCS, 2003). These palms form dense populations of similar-sized, apparently young trees, beneath widely spaced individuals that appear to be very old. The younger palms appear to be 20–30 years old, suggesting that the population increase occurred as the hydrology of the area changed. Cabbage palm forest has now become almost a pure biotype within many areas. The Florida Division of Forestry now considers this palm an invasive species that needs to be controlled in order to maintain ecosystem diversity (USACE and SFWMD, 2004).

Table 2. Acreages and percentages of each plant community in 1940 and 1995.

	1940		1995		Difference (1995–1940)	
PLANT COMMUNITY	**Acres**	**Percent Total Acreage**	**Acres**	**Percent Total Acreage**	**Acres**	**Percent Total Acreage**
Cypress	30,583.1	30.5%	10,567.1	10.5%	-20,016.0	-19.9%
Cypress with hardwoods	0.0	0.0%	2,845.7	2.8%	2,845.7	2.8%
Cypress with palms	8,758.1	8.7%	9,025.6	9.0%	267.5	0.3%
Coastal Uplands	302.9	0.3%	301.9	0.3%	0.0	0.0%
Cypress (disturbed)	0.0	0.0%	1,246.2	1.2%	1,246.2	1.2%
Wet Prairie	7,619.3	7.6%	7,031.0	7.0%	-588.3	-0.6%
Prairie with palms	0.0	0.0%	2,043.6	2.0%	2,043.6	2.0%
Prairie (disturbed)	0.0	0.0%	161.8	0.2%	161.8	0.2%
Hydric Hammock	0.0	0.0%	2,574.2	2.6%	2,574.2	2.6%
Mesic Hammock	0.0	0.0%	149.8	0.1%	139.8	0.1%
Cabbage Palm Hammock	55.8	0.1%	7,286.4	7.3%	7,230.7	7.2%
Tropical Hammock	264.9	0.3%	688.6	0.7%	423.7	0.4%
Freshwater Marsh	512.1	0.5%	94.7	0.1%	-417.5	-0.4%
Marsh (Salt/Fresh)	8,574.2	8.5%	6,480.4	6.5%	-2,093.8	-2.1%
Mangrove	16,564.5	16.5%	18,417.3	18.3%	1,852.8	1.8%
Hydric Pine Flatwoods	7,141.2	7.1%	5,852.9	5.8%	-1,288.3	-1.3%
Mesic Pine Flatwoods	2,908.0	2.9%	1,983.0	2.0%	-924.9	-0.9%
Pine Flatwoods with palms	2,408.0	2.4%	6,478.1	6.5%	4,070.2	4.1%
Pine Flatwoods (disturbed)	0.0	0.0%	48.2	0.0%	48.2	0.0%
Saw Palmetto	0.0	0.0%	6.2	0.0%	6.2	0.0%
Brazilian Pepper	0.0	0.0%	273.1	0.3%	273.1	0.3%
Urban Land	0.0	0.0%	298.8	0.3%	298.8	0.3%
Water	14,721.9	14.7%	15,843.8	15.8%	1,121.9	1.1%
Disturbed Land	0.0	0.0%	725.0	0.7%	725.0	0.7%

Restoration of cypress and pine flatwood communities that have been replaced by other plant communities will take many decades once pre-development hydrology is restored. Where most of the older cypress and pine flatwood stands are still present but have been invaded by palms or hardwoods, it should take less time, but still a few decades. Plant communities on more disturbed sites may look worse for some time as they may become dominated by successional communities. Application of an appropriate fire regime and/or mechanical clearing will expedite recovery of the latter sites. With restoration of pre-development hydrology and fire, along with mechanical clearing of hardwoods and cabbage palms, coverage of hammocks should be substantially reduced (SFWMD and NRCS, 2003).

Certain areas are not expected to be restored to their historic condition. The area upstream of the pumps and spreader system will likely remain drier following restoration of pre-development hydrology. It may be difficult to re-establish isolated freshwater marshes near the coast because no seed sources may be available. Also, sea level rise could be an additional impediment to marsh re-establishment (SFWMD and NRCS, 2003).

FISH AND WILDLIFE

Prior to drainage, wetland systems in Picayune Strand contained water during summer and fall and may have dried out completely in winter and early spring (USACE and SFWMD, 2004). Wet/dry cycles increase diversity of wildlife that can utilize these wet/dry communities. Species present in the region include wading birds, white-tailed deer, wild boar, and Florida panther. The project area is also located within (and upstream of) the largest mangrove swamp in North America, which supports many species including manatees and wading birds.

Drainage of the Picayune Strand Restoration Project area has degraded resources for invertebrates within and adjacent to the project area (USACE and SFWMD, 2004). These wetlands can no longer function effectively as refugia for alligators, turtles, amphibians, and fish during droughts. Shortened hydroperiods have resulted in impacts such as inhibited growth of periphytic algae, which sustain small forage fish, amphibians, and macroinvertebrates. These small fauna are an important food source for larger animals, especially wading birds. The extent of this loss of function in the project area was demonstrated during the 2001 drought when no natural wetlands in the project area retained any water whatsoever. In adjacent Fakahatchee Strand Preserve State Park, an area that has not been as seriously impacted by drainage, some of the deeper wetlands retained water and were refuges for wildlife (Nelson et al., 2001). Several species native to Picayune Strand have large spatial requirements, such as the white ibis (*Eudocimus albus*), wood stork (*Mycteria americana*), and Florida panther (*Felis concolor coryi*) (Ogden et al., 2005). Restoration of Picayune Strand is the key to providing the extensive home ranges needed by these species.

WADING BIRDS AND WOOD STORKS

During favorable years in the 1930s, up to 250,000 wading birds, including white ibis, wood stork, great egrets (*Casmerodius albus*), snowy egret (*Egretta thula*), and tricolored heron (*Egretta caerlea*), nested in the central and southern Everglades (Ogden, 1994) (**Figure 6**). Approximately 90 percent of the wading birds nested along the interface between the freshwater Everglades and mangrove estuaries (Ogden, 1994). These historical Everglades wading bird numbers can be assumed, though on a lesser scale, to be consistent with populations present in pre-drainage Picayune Strand.

Figure 6. Clockwise from top left, wood stork, great blue heron, white ibis, and egret.

Under pre-drainage conditions of the 1930s and 1940s, wood storks were observed to form large nesting colonies in Big Cypress basin of which Picayune Strand is a part (USACE and SFWMD, 2004). Historically, the area would have contained large expanses of standing water wetlands at the end of each rainy season, which would have provided forage for pre-nesting and nesting wood storks as wetlands shrank during the winter early dry season.

Over-drainage of South Florida's Everglades has resulted in a 90–95 percent drop in wading bird population (USACE and SFWMD, 2004) and a relocation of nesting from the Everglades-mangrove interface to the interior freshwater Everglades, principally in the Water Conservation Areas (Ogden, 1994). Much of the decline in wading bird populations throughout South Florida is directly attributable to loss of wetland function resulting from drainage (USACE and SFWMD, 2004). Within the project area, acreage of wetlands that once supported large populations of fish and aquatic invertebrates well into the dry season are now impaired in their ability to function as forage areas. While they can still serve as foraging areas, the period of time that they can function in this capacity has been truncated. Areas that once retained water in time of drought no longer do.

Corkscrew Swamp Sanctuary, located approximately 23 kilometers (km) northeast of Picayune Strand, is the largest wood stork rookery in the United States. Fledgling production at the sanctuary declined from a high of 17,000 fledglings in 1962 to less than 1,000 fledglings in 1998. Wetlands within 30 km of rookery sites have been described as core forage areas for wood storks; however, they may forage as far as 75 km from rookery sites. In response to deteriorating habitat conditions in South Florida, wood storks in this region have delayed initiation of nesting by approximately two months, to February or March in most years, since the 1970s. This shift in the timing of nesting is believed to be responsible for increased frequencies of nest failures and colony abandonment. Colonies that start after January in South Florida risk having young in the nests when May–June rains flood marshes and disperse fish. Construction of the Southern Golden Gates Estate subdivision and other anthropogenic changes in distribution, timing and quantity of water flows have dramatically reduced spatial extent of wood stork habitat surrounding Corkscrew Sanctuary. Restoration of sheetflow will create connections between wetlands; allow forage fish dispersal; establish dry-season or drought-resistant refugia; increase the extent and quality of wetlands; decrease competition between forage fish species; reduce predation on forage fish species, and reduce unwanted exotic fish species that compete with forage fish.

FLORIDA PANTHER

Picayune Strand Restoration Project area provided and still provides habitat for the endangered Florida panther (**Figure 7**) (USACE and SFWMD, 2004). Florida panthers require a wide range to successfully forage and reproduce (Ogden et al., 2005). Panthers prefer native, upland forests, especially hardwood hammocks and pine flatwoods, over wetlands and disturbed habitats (Maehr et al., 1991). Hardwood hammocks provide important habitat for white-tailed deer (*Odocoileus virginianus*), an important panther prey species (Harlow, 1959; Belden et al., 1988; Maehr, 1990, 1992; Maehr et al., 1991). Understory thickets of tall, almost impenetrable, saw palmetto (*Serenoa repens*) have been identified as the most important resting and denning cover for panthers (Maehr, 1990).

Figure 7. Florida panthers in the Picayune Strand Restoration area.

Radio telemetry information for the Florida panther indicates significantly less use of the project area than adjacent public lands to the east and west, possibly due to reduced prey availability and disturbance related to human presence, which is exacerbated by a grid road system (USACE and SFWMD, 2004). Panther dispersal tends to be interrupted by natural (e.g., large water bodies) and anthropogenic (e.g., roads and canals) barriers (Ogden et al., 2005). White-tailed deer and wild hogs are preferred prey for panthers, while smaller animals such as rabbits, raccoon and armadillos are of secondary importance. The vast extent of connected habitat that was available to panthers during pre-drainage times has disappeared.

Rehydration of project wetlands, restoration of more natural plant cover, and removal of most human disturbance within the large project area will undoubtedly favor the panther's ability to feed, breed and shelter. Restoration will also improve habitat conditions for the panthers' prey base, and a more restricted human presence would produce a large block of moderately wild habitat for the panther. Picayune Strand is a critically important segment in the consolidation of a natural landscape that would connect surrounding public lands (**Figure 1**) into a region of sufficient size to assist in the recovery of the Florida panther.

WEST INDIAN MANATEE

Figure 8. West Indian manatees.

Habitat features essential to survival of the endangered West Indian manatee (*Trichechus manatus*) (**Figure 8**) include access to freshwater sources, warm water refugia and preferred forage areas (seagrass beds) adjacent to relatively deeper waters (USACE and SFWMD, 2004). The Port of the Islands Marina Basin, located within the Faka Union Canal system directly south of the last weir structure and including areas underneath and slightly north of U.S. 41, is the second largest warm-water refugia for manatees in southwest Florida (**Figure 9**) (USACE and SFWMD, 2004). This marina basin can support up to 300 West Indian manatees during periods of cold stress. The marina's depth is probably the key feature responsible for creating a "passive" warm-water refuge for this species. Restoration of the other estuaries in the watershed may contribute to additional manatee use of these natural freshwater sources as opposed to the existing freshwater point source discharges from the canal system into Faka Union Bay.

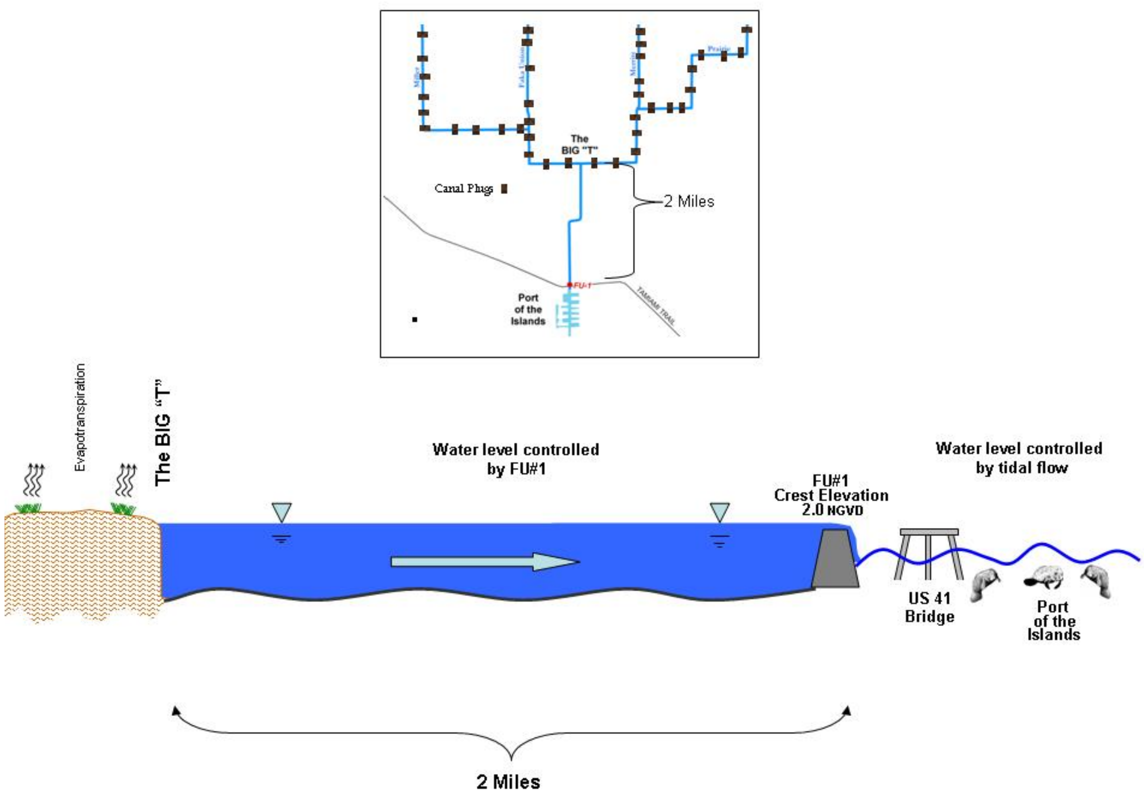

Figure 9. Port of the Islands Marina, in the Faka Union Canal system, is the second largest warm-water refugia for West Indian manatees in southwest Florida.

ESTUARINE RESOURCES

Under pre-drainage conditions, freshwater reached the Ten Thousand Lakes estuaries (**Figure 4**) and associated acreages of salt marsh and mangrove swamp through a combination of overland sheetflow and groundwater seepage (USACE and SFWMD, 2004). The quantity and timing of freshwater inflows determined many characteristics of estuarine habitat by establishing salinity, other aspects of water chemistry, and dynamics of currents and water exchange. This slow year-round influx of fresh water maintained salinity in the natural range that estuarine species require.

Shorelines were generally lined with mangroves (USACE and SFWMD, 2004). Mangroves supported productivity of creeks, bays, and islands by producing large masses of leaf litter and dissolved organic matter that was exported by outgoing tides to bays and channels. Red mangrove roots provided substrate for settling of crustaceans and mollusks, and particularly for oysters, algae, tunicates and annelids, as well as shelter for juvenile fish. Sand and mud bottoms sheltered mollusks, crustaceans and other invertebrates, as well as fish. Plankton and nekton, organisms that live suspended in the water, provided food for filter-feeding fish, oysters and other invertebrates.

In the middle reaches of the estuarine zone (salinities between 15-30 parts per thousand [ppt]), oyster reefs provide additional shelter, substrate and developmental and feeding habitat for a wide range of organisms (USACE and SFWMD, 2004). As filter feeders, oysters remove small particulate matter from the water column, leading to better light penetration, indirectly facilitating colonization of appropriate substrates by seagrasses. Submerged aquatic vegetation may have covered significant parts of bay bottoms under natural conditions. Both oyster reefs and submerged aquatic vegetation are important habitat for juvenile fish and their prey.

BASELINE CONDITIONS

Following is a partial reporting of baseline conditions. Analysis is still being performed on much of the data collected. In many cases, more recent data has been collected than that which is presented below. An updated baseline report will be provided in future SFERs.

HYDROLOGY

Hydrologic monitoring sites within the project area are presented in **Figure 11**. Well monitoring sites were established along four east-west transects beginning in the Belle Meade portion of Picayune Strand State Forest and extending into Fakahatchee Strand Preserve State Park. These transects will allow evaluation of north-south trends. Transects are indicated by T1, T2, T3 and T4 in the well names. Well sites were located in areas that will be accessible under post-restoration conditions, represent major habitats, and, where feasible, are located in proximity to existing wildlife and plant community monitoring sites. Also, three wells (Transect 5) south of Tamiami Trail within brackish marshes are monitored to track restoration effects. Stage and salinity are recorded at these sites (**Figure 10**). The two western wells are in areas where the Southern Golden Gates Estates canal system is eliminating much of the upstream freshwater inflows and the one to the east is located in an area much less affected by the canal system. Well data will be analyzed to determine water level stage and duration. These results will

Figure 10. Data collection at estuarine well site SGT5W1.

be used to assess the effects of pump operations on the inland and estuarine plant and animal communities. This will allow identification of needed pump modifications of pump operations to further improve restoration benefits.

Picayune Strand Restoration Project
Hydrologic and Meteorologic Monitoring Sites

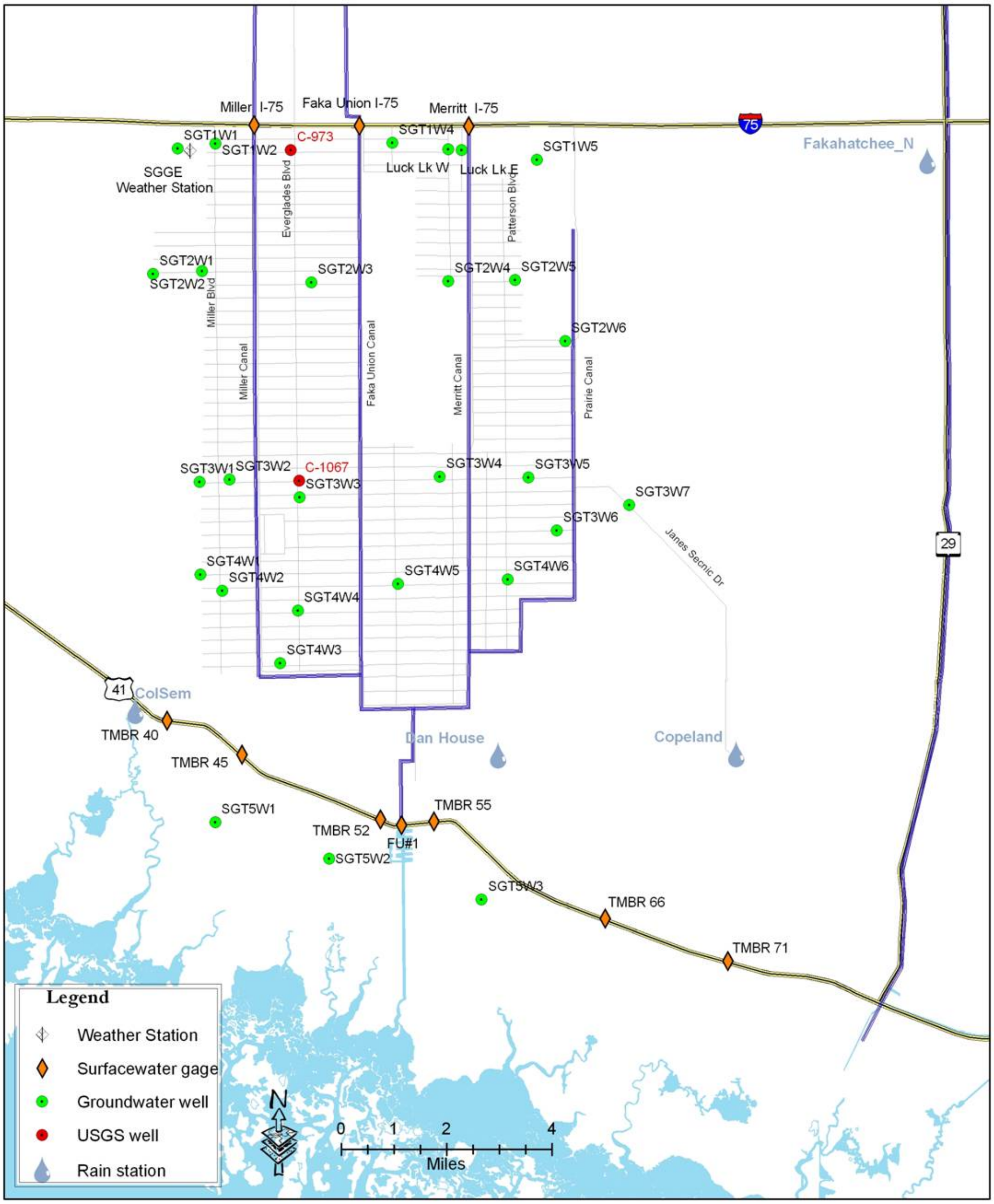

Figure 11. Picayune Strand Restoration Project hydrologic monitoring sites.

Water levels within Fakahatchee Strand Preserve State Park have been measured at 24 wells placed along two transects from 1987 to the present (**Figure 12**). Water levels along the North Transect in the vicinity of Prairie Canal lowered adjacent water levels by up to 2 feet in the summer wet season and up to 5 feet in the spring dry season (**Figure 13**). Canal drainage effects extend 1 to 3 miles into the preserve (**Figure 14**). A similar pattern of monthly drawdowns were found along the South Transect, although it was not as dramatic (**Figures 15** and **16**). The South Transect is closer to sea level, which reduces the ability of a drainage canal to lower water levels. Also, we were not able to install wells closer than within about 2 miles from the Faka Union Canal because at the time of installation, these lands were not publicly owned. In the absence of the Southern Golden Glades Estates canals, these profiles would be essentially flat or at most have a shallow gradient towards Picayune Strand because of the south-southwest direction of water flow in the area. Drawdowns extending from about 5 to 6.5 miles are associated with the Barron River Canal, which is located along State Road 29 along the eastern boundary of Fakahatchee Strand Preserve State Park (**Figure 1**).

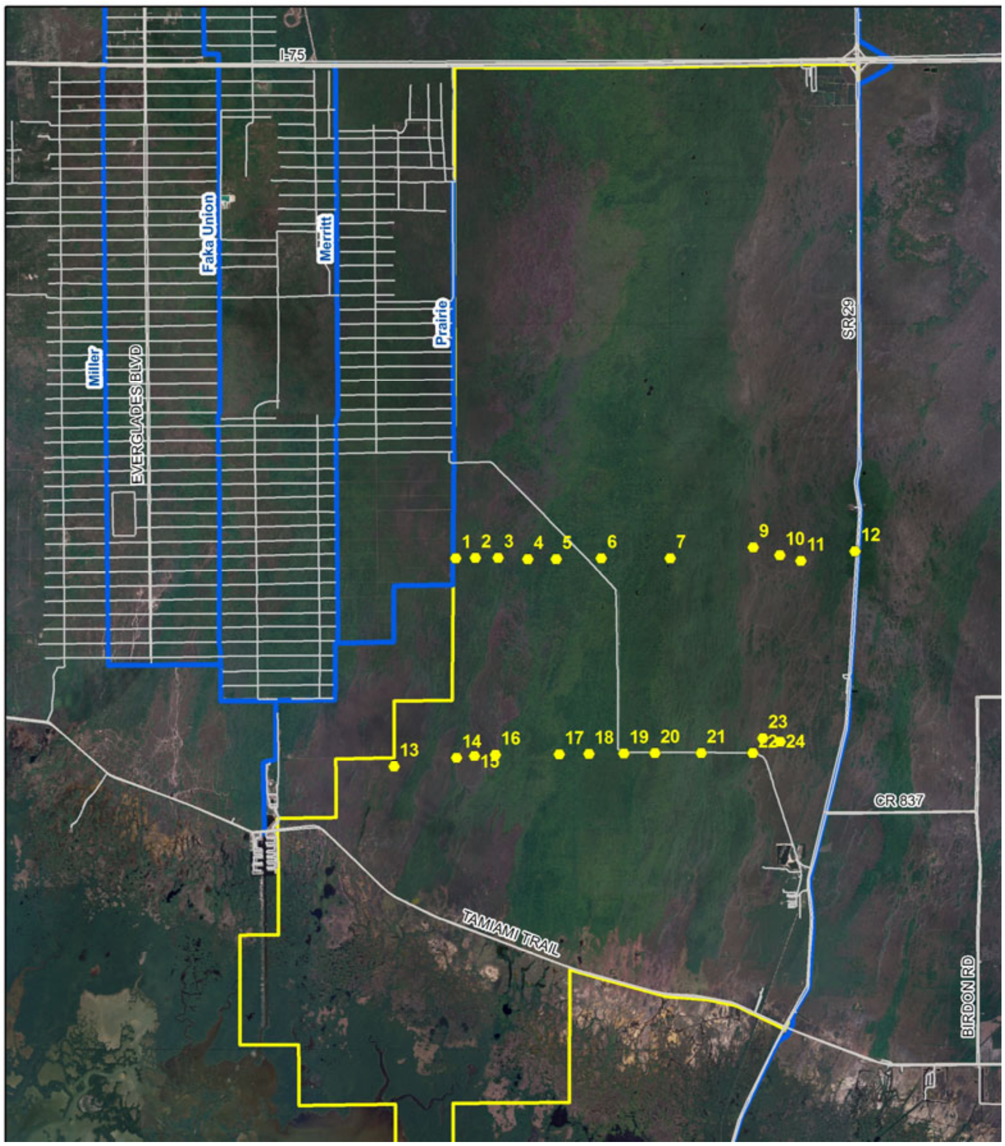

Figure 12. Wells within Fakahatchee Strand Preserve State Park.

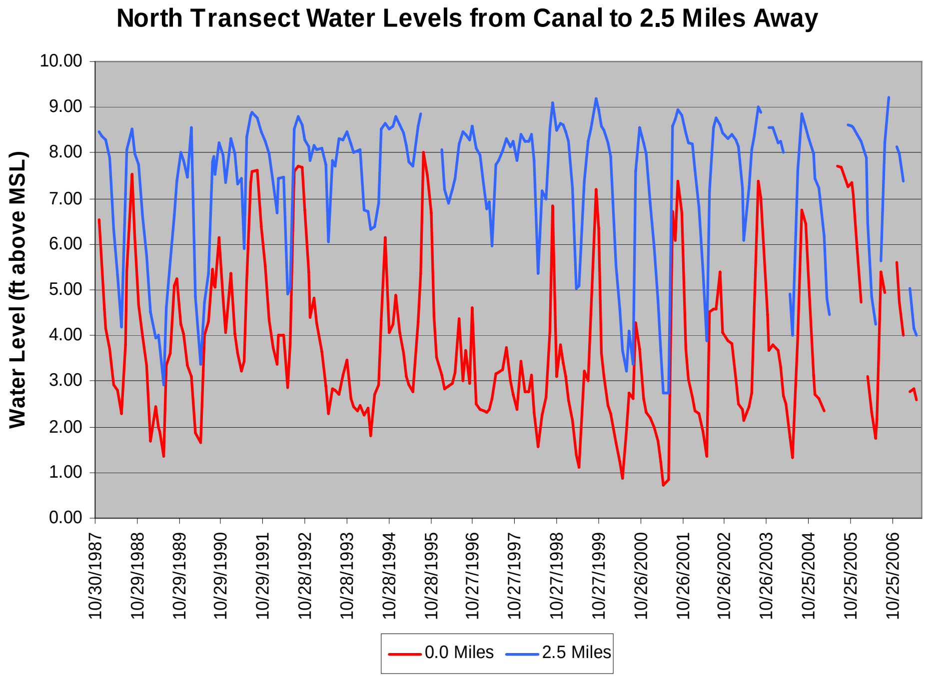

Figure 13. North Transect water levels adjacent to Prairie Canal and at 2.5 miles away.

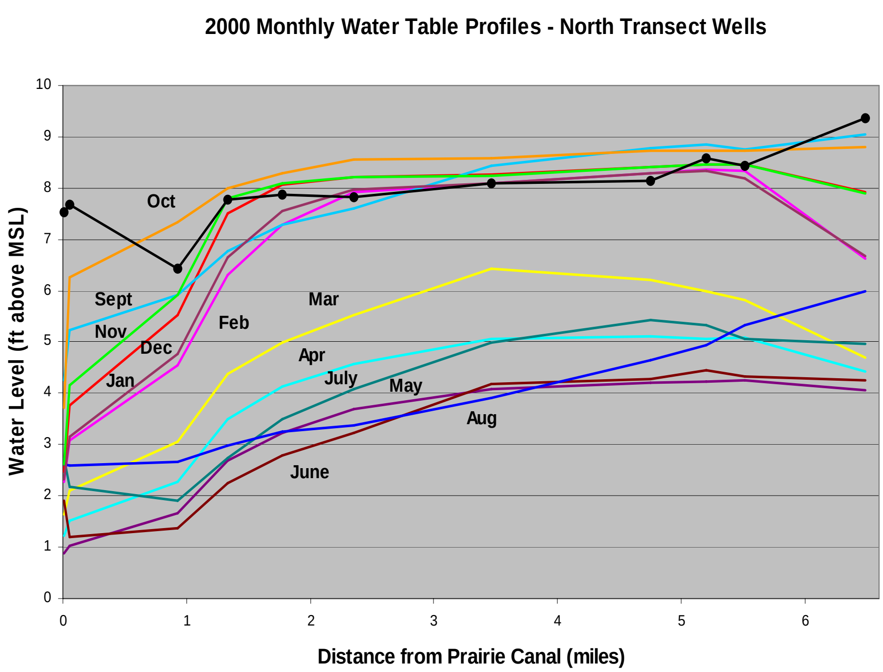

Figure 14. Monthly water table profiles in 2000 along the North Transect within Fakahatchee Strand Preserve State Park from Prairie Canal.

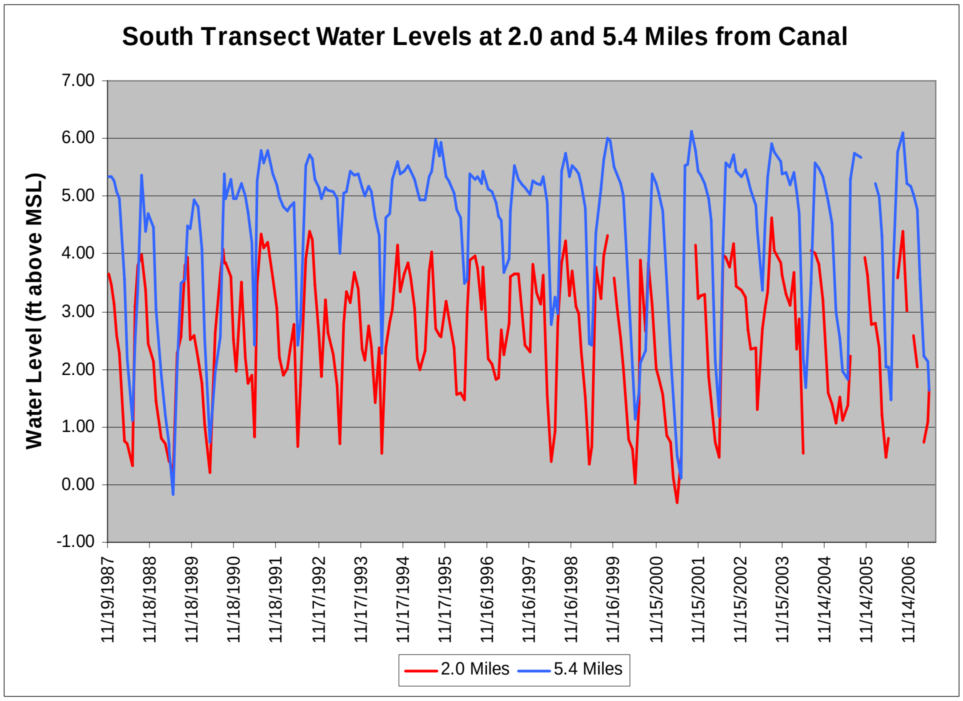

Figure 15. South Transect water levels at 2.0 and 5.4 miles from Faka Union Canal.

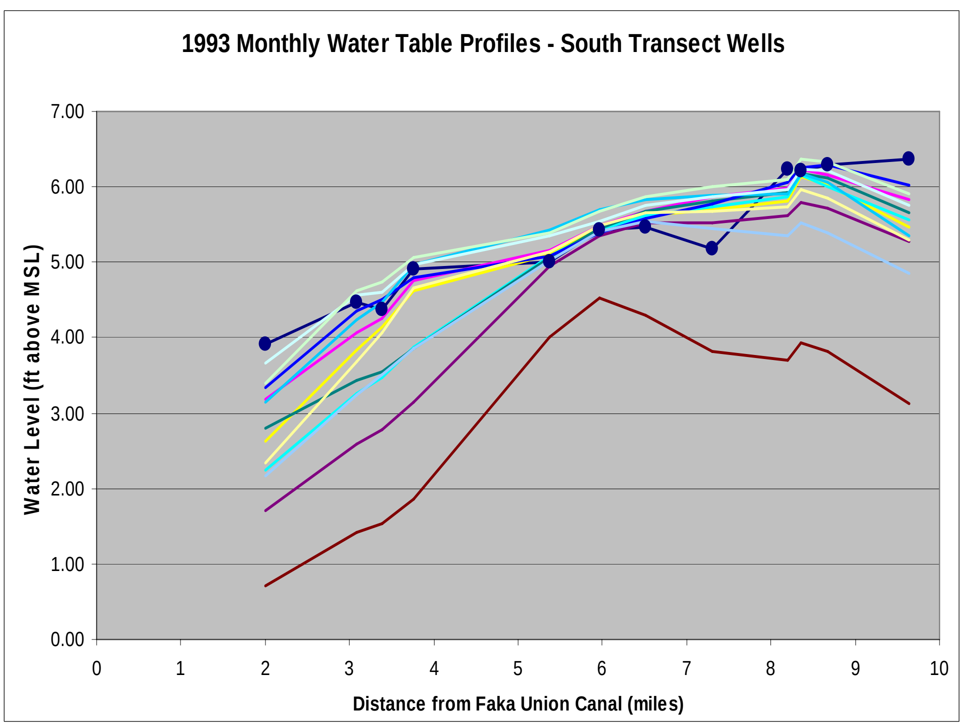

Figure 16. Monthly water table profiles in 1993 along the South Transect within Fakahatchee Strand Preserve State Park from Faka Union Canal.

PLANT COMMUNITIES

The baseline plant community study emphasized relationships between plant species composition, dominance and hydrology (Barry and Woodmansee, 2006). Soil type, fire interval, community type, dominant tree species density, including canopy and subcanopy densities, and shrub cover are reported in this section. In addition, the Barry and Woodmansee (2006) report includes cabbage palm and wetland affinity index information that will be reported in the final version of this appendix. Sampling was conducted in 2004 and 2005. Sampling had already been completed before the eye of Hurricane Wilma passed directly over the study area with 120 mph sustained winds on October 24, 2005.

The canal system within the former Southern Golden Glades Estate subdivision affected water tables of surrounding preserved areas. Therefore, restoration of more natural hydrology to Picayune Strand will have restoration affects beyond the project borders. Therefore, vegetation was monitored not only within the Picayune Strand Restoration Project area, but also within the Belle Meade portion of Picayune Strand State Forest to the west, Fakahatchee Strand Preserve State Park to the east, and Ten Thousand Islands NWR to the south (**Figure 17**). Control sites were established in Fakahatchee Strand Preserve State Park and Florida Panther NWR beyond the hydrologic effects of the canal system.

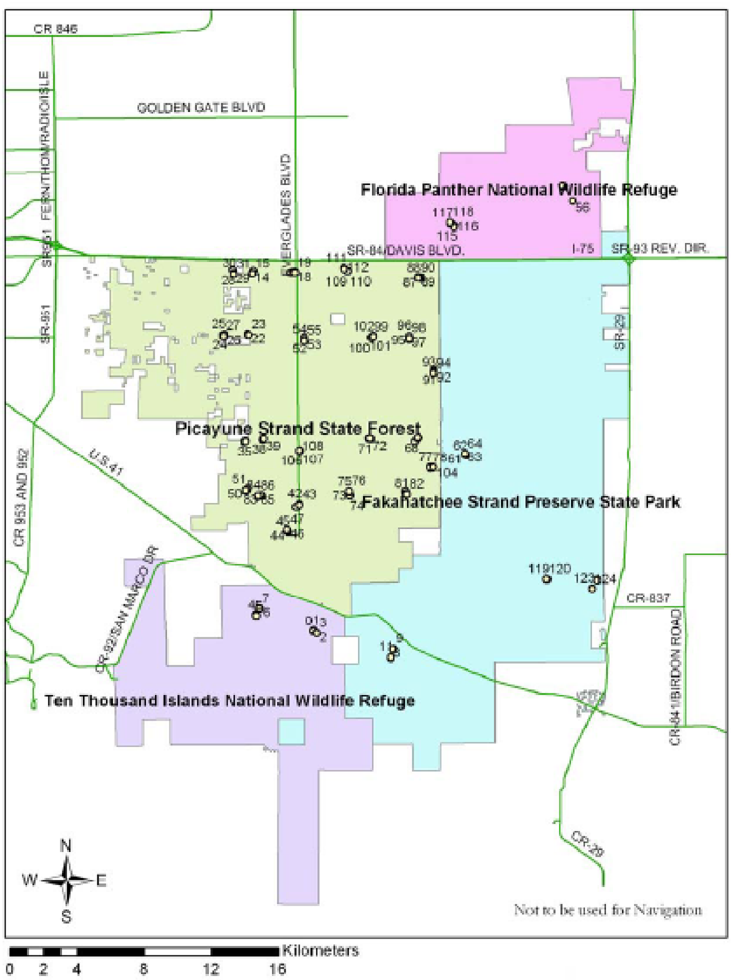

Figure 17. Picayune Strand Restoration Project baseline vegetation transects.

Vegetation transects were established at 27 newly established well sites within Picayune Strand (**Figure 17**): 23 within Picayune Strand Restoration Project area, two within Ten Thousand Islands NWR, and two in areas of Fakahatchee Strand Preserve State Park in the vicinity of Prairie Canal. An additional nine control sites were established within relatively undisturbed areas of Fakahatchee Strand Preserve State Park and Florida Panther NWR. Two transects were established at each well. Each vegetation line was located at least 25 meters from where there was likely to be any direct influence of road removal or any other disturbance during restoration. They were located in relatively uniform stands of vegetation, both in terms of the existing community and the likely restored community.

Soil Type

Soil types were determined for vegetation transects utilizing data from the Collier County Soil Survey (Liudahl et al., 1998). Most transects crossed more than one soil type. This information is presented in **Table 3** along with the location the soil was found.

Table 3. Location and number of transects having each soil type.

SOIL TYPE	Number of Transects with Soil Type
Picayune Strand State Forest	
Boca, Riveria, limestone substratum, Copeland fine sands, depressional	10
Chobee, Winder and Gator soils, depressional	1
Hallandale and Boca fine sands	22
Hallandale fine sand	9
Holopaw and Okeelanta soils, depressional	1
Holopaw fine sand, limestone substratum	2
Ochopee fine sandy loam	3
Ochopee fine sandy loam, low	7
Oldsmar fine sand, limestone substratum	1
Pennsuco silt loam	3
Riveria fine sand, limestone substratum	3
Riveria, limestone substratum-Copeland fine sands	1
undetermined	1
Fakahatchee Strand Preserve State Park	
Boca, Riveria, limestone substratum, Copeland fine sands, depressional	3
Hallandale and Boca fine sands	2
Kesson muck, frequently flooded	2
Ochopee fine sandy loam	8
Ochopee fine sandy loam, low	2
Fakahatchee Strand Preserve State Park Control Sites	
Boca, Riveria, limestone substratum, Copeland fine sands, depressional	2
Ochopee fine sandy loam	1
Ochopee fine sandy loam, low	2
Florida Panther NWR Control Sites	
Boca, Riveria, limestone substratum, Copeland fine sands, depressional	2
Hallandale and Boca fine sands	1
Hallandale fine sand	1
Ochopee fine sandy loam	1
Ochopee fine sandy loam, low	1
Ten Thousand Islands NWR	
Kesson muck, frequently flooded	4

Fire Interval

Fire intervals were recorded during vegetation sampling (**Table 4**) (Barry and Woodmansee, 2006). Within the study area, two transects, both non-control transects, had fires within the past year (Fire Interval 1). One transect was in mesic pine flatwoods and the other in prairie habitat. Seventeen non-control and five control transects in various habitats had fires within one to seven years (Fire Interval 2). Most transects (31 non-control and seven control) had not experienced fire in more than seven years (Fire Interval 3).

Table 4. Fire intervals for plant community transects.

HABITAT	FIRE INTERVAL	NON-CONTROL NUMBER OF TRANSECTS	CONTROL NUMBER OF TRANSECTS
Cypress Slough	3	5	3
Cypress w/ graminoid understory	3	1	
Cypress w/ graminoid understory	2	2	1
Cypress/Hardwood Slough	3	1	
Disturbed Cypress Slough	3	2	
Disturbed Cypress Slough	2	1	
Disturbed Prairie	3	1	
Freshwater Marsh	3	2	
Hydric Hammock	3	4	
Hydric Pine Flatwoods	3	4	1
Hydric Pine Flatwoods	2	4	3
Mesic Flatwoods	3	4	
Mesic Flatwoods	2	1	
Mesic Flatwoods	1	1	
Prairie	3	1	1
Prairie	2	6	2
Prairie	1	1	
Cabbage Palm Hammock	3	2	
Cabbage Palm Hammock	2	3	
Saltwater Marsh	3	4	2

Community Types and Structure

Community types found within Picayune Strand State Forest are cypress slough, cypress with graminoid understory, cypress/hardwood slough, disturbed cypress slough, prairie, disturbed prairie, hydric hammock, hydric pine flatwoods and mesic pine flatwoods (**Table 5**). Transects within Fakahatchee Strand Preserve State Park adjacent to Prairie Canal showed the area to be relatively undisturbed, with communities of cypress slough, cypress with graminoid understory, prairie and hydric pinelands. Cypress slough and hydric pine flatwood communities were found in Fakahatchee Strand Preserve State Park control sites. Cypress slough, prairie and hydric pine flatwood communities were found in Florida Panther NWR control sites. Examples of some plant communities are presented in **Figure 18**.

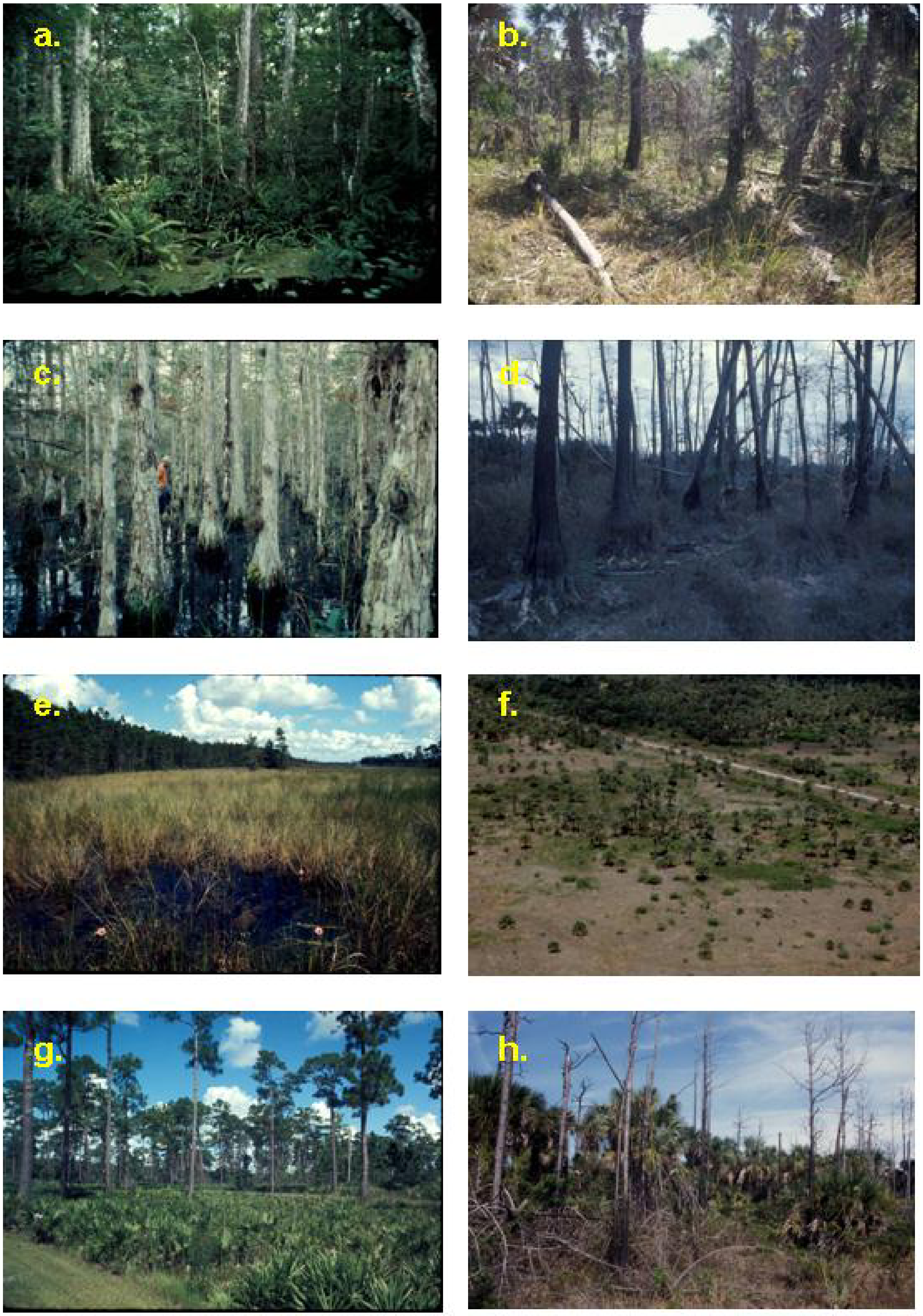

Figure 18. Examples of plant communities in Picayune Strand Restoration Project area: (a) cypress slough, (b) disturbed cypress slough, (c) cypress with graminoid understory, (d) disturbed cypress, (e) prairie, (f) disturbed prairie, (g) pine flatwoods, and (h) disturbed pine flatwoods.

Table 5 presents tree density for dominant species found within each plant community for each area. Densities were broken down into canopy, subcanopy, lower strata, and total in all strata. Densities greater than 1,000 trees per acre (trees/ac) were observed in control site hydric pine flatwood communities and most non-control site plant communities (**Table 5**). The only non-control plant communities that did not have an overall tree density greater than 1,000 trees/ac were prairie and disturbed prairie. Highest density of canopy species was observed in cabbage palm hammock (499 trees/ac) within Picayune Strand State Forest. Cypress slough in Picayune Strand State Forest had the highest subcanopy tree density. Highest density in the lower strata was observed in cabbage palm hammock and disturbed cypress slough in Picayune Strand State Forest, which both had greater than 3,000 trees/ac.

Table 5. Density of dominant tress by community type and strata.

Plant Community	Density (trees/acre)			
	Picayune Strand State Forest	Fakahatchee Strand Preserve State Forest	Fakahatchee Strand Preserve State Forest Control	Florida Panther NWR Control
Cypress Slough				
Canopy	288	281	332	97
Subcanopy	563	345	186	162
Lower Strata	489	1,602	162	81
Total	1,340	2,228	680	340
Cypress w/Graminoid Understory				
Canopy	300	138		
Subcanopy	194	65		
Lower Strata	1,141	1,788		
Total	1,635	1,991		
Cypress/ Hardwood Slough				
Canopy	372			
Subcanopy	178			
Lower Strata	858			
Total	1,408			
Disturbed Cypress Slough				
Canopy	154			
Subcanopy	16			
Lower Strata	3,220			
Total	3,390			
Prairie				
Canopy		5		16
Subcanopy	19			49
Lower Strata	32	248		340
Total	51	253		405
Disturbed Prairie				
Canopy	16			
Subcanopy				
Lower Strata	453			
Total	469			

Table 5. continued. Density of dominant tress by community type and strata.

Plant Community	Density (trees/acre)			
	Picayune Strand State Forest	Fakahatchee Strand Preserve State Forest	Fakahatchee Strand Preserve State Forest Control	Florida Panther NWR Control
Hydric Hammock				
Canopy	210			
Subcanopy	61			
Lower Strata	1,663			
Total	1,934			
Cabbage Palm Hammock				
Canopy	499			
Subcanopy	43			
Lower Strata	3,536			
Total	4,078			
Hydric Pine Flatwood				
Canopy	271	123	146	
Subcanopy	231	32		
Lower Strata	1,671	1,217	1,278	
Total	2,173	1,372	1,424	
Mesic Pine Flatwood				
Canopy	303			
Subcanopy	117			
Lower Strata	2,241			
Total	2,661			

Dominant Tree Species Canopy and Subcanopy Densities

Dominant tree species found in Picayune Strand State Forest are cabbage palm, laurel oak (*Quercus laurifolia*), pond cypress (*Taxodium ascendens*), and slash pine (*Pinus elliottii*) (**Tables 6** and **7**). Dominant tree species were divided into three strata: canopy, subcanopy, and lower strata. Canopy trees were defined as those woody plants with a diameter at breast height (dbh) greater than 10 cm. The subcanopy consisted of trees with a dbh between 2.5 and 10 cm. All trees that were smaller than 2.5 cm dbh were considered lower strata.

The cabbage palm, at 960 trees/ac, has the highest density for canopy species in Picayune Strand State Forest, followed by pond cypress (848 trees/ac), slash pine (384 trees/ac), and laurel oak (222 trees/ac). Pond cypress had a subcanopy density (838 trees/ac) almost as high as its canopy density, but cabbage palm subcanopy tree density (248 trees/ac) was much lower than its canopy density. Laurel oak and pond cypress exhibited a similar pattern between canopy and subcanopy trees, but both had smaller densities of subcanopy trees compared to canopy trees. Fakahatchee Strand Preserve State Park sites affected by the Prairie Canal had overall lower canopy and subcanopy densities than Picayune Strand State Forest, with cabbage palms having the highest density in the canopy (361 trees/acre) and pond cypress the highest density in the subcanopy (326 trees/ac). Control sites within Fakahatchee Strand Preserve State Park did not have laurel oak. Pond cypress had the highest density (307 trees/ac canopy, 186 trees/ac subcanopy) within these sites. The only dominant tree species found in the canopy of control sites within Florida Panther NWR was pond cypress, which had a density of 113 trees/ac. In addition to pond cypress (178 trees/ac), cabbage palm (32 trees/ac) was also present in the subcanopy of Florida Panther NWR control sites.

Table 6. Density of dominant tree species in canopy strata for each location.

Tree Name and Habitat	Density (trees/acre)			
	Picayune Strand State Forest	Fakahatchee Strand Preserve State Park	Fakahatchee Strand Preserve State Park Control	Florida Panther NWR Control
Cabbage Palm				
Cypress slough	3	151	24	
Cypress w/ graminoid understory	65	138		
Cypress/hardwood slough	49			
Disturbed cypress slough	65			
Prairie		5		
Disturbed prairie	16			
Hydric hammock	113			
Cabbage palm hammock	459			
Hydric pine flatwoods	85	70	65	
Mesic pine flatwoods	105			
Total	960	364	89	
Laurel Oak				
Cypress slough	19	5		
Cypress w/ graminoid understory	16			
Cypress/hardwood slough	81			
Hydric hammock	65			
Cabbage palm hammock	41			
Total	222	5		
Pond Cypress				
Cypress slough	265	124	307	97
Cypress w/ graminoid understory	219			
Cypress/hardwood slough	243			
Disturbed cypress slough	89			
Prairie				16
Hydric hammock	32			
Total	848	124	307	113
Slash Pine				
Hydric pine flatwoods	186	55	80	
Mesic pine flatwoods	198			
Total	384	55	80	

Table 7. Density of dominant tree species in subcanopy for each location.

Plant Community	Density (trees per acre)			
	Picayune Strand State Forest	Fakahatchee Strand Preserve State Park	Fakahatchee Strand Preserve State Park Control	Florida Panther NWR Control
Cabbage Palm				
Cypress slough	3	5		
Cypress w/graminoid understory	16	57		
Cypress/hardwood slough	49			
Disturbed cypress slough	16			
Prairie				32
Hydric hammock	28			
Cabbage palm hammock	43			
Hydric pine flatwoods	32	32		
Mesic pine flatwoods	61			
Total	248	94		32
Laurel Oak				
Cypress slough	3	22		
Cypress/hardwood slough	49			
Hydric hammock	29			
Total	81	22		
Pond Cypress				
Cypress slough	557	318	186	162
Cypress w/graminoid understory	178	8		
Cypress/hardwood slough	81			
Prairie	19			16
Hydric hammock	4			
Total	839	326	186	178
Slash Pine				
Hydric pine flatwoods	198			
Mesic pine flatwoods	61			
Total	259			

Shrub Cover

Species composition and cover were quantified using 0.5-square meter rectangular quadrats placed at 10-meter intervals along each transect line. With some exceptions, trees with a dbh less than 2.5 cm dbh were considered shrubs. All common shrubs such as wax-myrtle (*Myrica cerifera*), willow (*Salix caroliniana*), Brazilian pepper, and saltbush (*Baccharis* spp.) were considered shrubs. Also, saw palmetto was always considered a shrub. Seven classes of cover were used: (1) < 1 percent, (2) 0–5 percent, (3) 5–25 percent, (4) 25–50 percent, (5) 50–75 percent, (6) 75–95 percent, and (7) 95–100 percent.

Sixty-one species of shrubs were found. The full list is too large to present here. Therefore, data for total shrub cover, separating other species from cabbage palm and saw palmetto, are presented in **Table 8**. Highest shrub coverage in Picayune Strand State Forest was in mesic pine flatwoods, where high density of saw palmetto naturally occurs. Disturbed cypress slough habitat (194.10 percent cover) had much higher shrub coverage than cypress slough habitats. Cypress slough habitats in Picayune Strand State Forest and in the area of Fakahatchee Strand Preserve State Park affected by Prairie Canal had more than twice the shrub coverage as the control sites.

The areas with the highest Brazilian pepper coverage were found throughout Picayune Strand State Forest and in the areas of Fakahatchee Strand Preserve State Park along the Prairie Canal. Significant coverage (> 30 percent) was found in drained cypress communities, including transects designated as cabbage palm hammock in Picayune Strand State Forest, which were historically cypress with graminoid understory. Only one control site had significant coverage of Brazilian pepper.

Table 8. Shrub cover by habitat and location.

	Percent Cover			
Habitat/Plant	**Picayune Strand State Forest**	**Fakahatchee Strand Preserve State Park**	**Fakahatchee Strand Preserve State Park Control**	**Florida Panther NWR Control**
Cypress Slough				
Cabbage Palm	5.04	14.53	4.30	0.20
Saw Palmetto	2.68			
All other Cover	59.12	81.93	27.30	20.20
Total	66.84	96.46	31.60	20.40
Cypress w/Graminoid Understory				
Cabbage Palm	10.20	35.80		
Saw Palmetto				
All other Cover	46.10	106.40		2.90
Total	56.30	142.20		2.90
Cypress/Hardwood Hammock				
Cabbage Palm	32.60			
Saw Palmetto				
All other Cover	33.40			
Total	66.00			

Table 8 continued. Shrub cover by habitat and location.

	Percent Cover			
Habitat/Plant	Picayune Strand State Forest	Habitat/Plant	Picayune Strand State Forest	Habitat/Plant
Disturbed Cypress Slough				
Cabbage Palm	29.95			
Saw Palmetto				
All other Cover	164.15			
Total	194.10			
Prairie				
Cabbage Palm	0.13	6.67		5.80
Saw Palmetto		2.20		0.40
All other Cover	21.97	9.47		13.50
Total	22.10	18.34		19.70
Disturbed Prairie				
Cabbage Palm	2.40			
Saw Palmetto				
All other Cover	8.40			
Total	10.80			
Hydric Hammock				
Cabbage Palm	14.28			
Saw Palmetto				
All other Cover	69.18			
Total	83.46	0.00	0.00	0.00
Cabbage Palm Hammock				
Cabbage Palm	34.33			
Saw Palmetto	1.53			
All other Cover	115.83			
Total	151.69	0.00	0.00	0.00
Hydric Pine Flatwoods				
Cabbage Palm	26.15	16.04	24.40	68.40
Saw Palmetto	1.95	1.32	23.60	94.20
All other Cover	73.20	19.72	89.40	239.20
Total	101.30	37.08	137.40	401.80
Mesic Pine Flatwoods				
Cabbage Palm	29.50			
Saw Palmetto	104.55			
All other Cover	179.40			
Total	313.45	0.00	0.00	0.00
Freshwater Marsh				
Cabbage Palm				
Saw Palmetto				
All other Cover	68.30			
Total	68.30	0.00	0.00	0.00

Cabbage Palms

Special attention was paid to cabbage palms, which have become a dominant species in many former wetland habitats. They were separated into the six strata: (1) “new growth” canopy, (1.5) “old growth” canopy, (2) subcanopy, (3) shrub layer, (4) ground cover, and (5) seedlings. Within control sites, cabbage palms were found only in cypress slough and prairie habitats (**Table 9**). All palms within the Florida Panther NWR cypress slough canopy were “old growth”. No other “old growth” palms were found in control sites. Cabbage palm density was much higher in Picayune Strand State Forest and areas of Fakahatchee Strand Preserve State Park influenced by the Prairie Canal. They were found in all Picayune Strand habitats. “Old growth” palms were only found in disturbed cypress slough and cabbage palm hammock habitats, and “new growth” palms exceeded “old growth” in both of these habitats. This indicates cabbage palms were not common in Picayune Strand prior to drainage. In contrast, cabbage palms were only found in cypress slough, cypress with graminoid, and prairie habitats within Fakahatchee Strand sites influenced by the Prairie Canal. Also, within cypress slough habitats, more “old growth” palms were present than “new growth” palms. This reflects the lesser drainage impacts on Fakahatchee Strand.

Table 9. Cabbage palm density by habitat, strata, and location.

Strata	Cabbage Palm Density (trees/ac)			
	Picayune Strand State Forest	Fakahatchee Strand Preserve State Park	Fakahatchee Strand Preserve State Park Control	Florida Panther NWR Control
Cypress Slough				
1 - Old Growth		86		16
1	3	65	8	
2	3	5		
3	68	529	40	
4	392	394	121	65
5	29	680		16
Total	495	1,759	169	97
Cypress w/Graminoid Understory				
1 - Old Growth				
1	65	138		
2	16	57		
3	194	752		
4	704	858		
5	243	178		
Total	1,222	1,983		
Cypress/Hardwood Hammock				
1 - Old Growth				
1	49			
2	49			
3	291			
4	550			
5	16			
Total	955			

Table 9 continued. Cabbage palm density by habitat, strata, and location.

	Cabbage Palm Density (trees/ac)			
Strata	**Picayune Strand State Forest**	**Fakahatchee Strand Preserve State Park**	**Fakahatchee Strand Preserve State Park Control**	**Florida Panther NWR Control**
Disturbed Cypress Slough				
1 - Old Growth	24			
1	41			
2	16			
3	663			
4	2,096			
5	461			
Total	3,301			
Prairie				
1 - Old Growth				
1		5		
2				32
3	5	32		
4	27	200		324
5		16		16
Total	32	253		372
Disturbed Prairie				
1 - Old Growth				
1	16			
2				
3	32			
4	421			
5				
Total	469			
Hydric Hammock				
1 - Old Growth				
1	113			
2	28			
3	170			
4	1,165			
5	328			
Total	1,804			
Cabbage Palm Hammock				
1 - Old Growth	81			
1	378			
2	43			
3	400			
4	1,257			
5	1,880			
Total	4,039			

Cabbage palm was the shrub species that was the most significant indicator of hydrological change. Coverage of cabbage palms greater than or equal to 5 percent is presented in **Table 10**. Data collected less than one year since a fire was eliminated from the comparison because a change in coverage could be the result of fire, not hydrology. The habitats having coverage greater than or equal to 5 percent within Picayune Strand State Forest Cabbage are cypress slough, cypress with graminoid understory, cypress/hardwood slough, disturbed cypress slough, hydric pine flatwoods, mesic pine flatwoods, hydric hammock, and cabbage palm hammock, which had the highest percent cover in Picayune Strand. Areas of Fakahatchee influenced by Prairie Canal having cabbage-palm coverage exceeding 5 percent were cypress slough, cypress with graminoid understory, which had the largest percent cover of all sites, and hydric pine flatwoods. The only habitat within the control areas having cabbage palm coverage greater than 5 percent was hydric pine flatwoods.

Table 10. Cabbage palm percent cover by habitat and location, and fire interval.

	Percent Cover of Cabbage Palms			
Habitat	Picayune Strand State Forest	Fakahatchee Strand Preserve State Park	Fakahatchee Strand Preserve State Park Control	Florida Panther NWR Control
Cypress Slough	5.0	11.5		
Cypress w/Graminoid Understory	5.2	35.8		
Cypress/Hardwood Slough	32.6			
Disturbed Cypress Slough	26.8			
Hydric Pine Flatwoods	26.2	16.0	24.4	38.8
Mesic Pine Flatwoods	16.7			
Hydric Hammock	14.3			
Cabbage Palm Hammock	34.3			

Wetland Affinity Index

Dominance by hydrophytic species can be quantified by summarizing data using wetland indicator values (Reed, 1988). The wetland affinity index is the weighted mean probability of occurrence in wetlands for all species combined in each one square meter quadrat. This allows us to quantify the degree of dominance by inundation-tolerant species (0.99 = obligate wetland species, 0.5 = facultative wetland species, and < 0.5 = upland species). This information must be viewed with the understanding that many southwest Florida plant species are poorly understood and may not be accurately categorized regarding their affinity for wetlands.

The wetland affinity index was calculated at the quadrat level, excluding epiphytes, then averaged first by transect then by site variables (**Table 11**). These data follow the general trend with cypress and marsh communities showing greater dominance by wetland species than hammock and pineland species. However, a clear difference between the less-drained Florida Panther NWR and the severely drained Picayune Strand State Forest is not obvious. The wetland affinity index once observed with a lower index at Picayune Strand State Forest. Little difference was observed in prairie data, although the absolute lowest values were observed at Picayune Strand State Forest.

Table 11. Wetland affinity index for each habitat by fire interval and location.

Fire Interval	Picayune Strand State Forest	Fakahatchee Strand Preserve State Park	Fakahatchee Strand Preserve State Park Control	Florida Panther NWR Control	Ten Thousand Islands NWR
Cypress Slough					
2		0.906407			
3		0.658810			
3			0.791426		
3	0.787776				
Cypress w/Graminoid Understory					
2				0.884038	
2		0.621183			
2	0.727108				
3	0.278604				
Cypress/Hardwood Slough					
3	0.636008				
Disturbed Cypress Slough					
2	0.577112				
3	0.707396				
Prairie					
1				0.702048	
1	0.709296				
2				0.708589	
2		0.688246			
2			0.864612		
2	0.623231				
3		0.836061			
3			0.726691		
3	0.903416				
Disturbed Prairie					
3	0.590104				

FISH AND WILDLIFE

Pre-restoration surveys were conducted in 2001–2004 by the Conservancy of Southwest Florida (Addison et al., 2006) to obtain baseline data on the species of wildlife that would most likely be affected by hydrologic restoration of Picayune Strand. Surveys were conducted for small mammals, fish, aquatic and terrestrial macroinvertebrates, and birds using sampling sites in five plant communities (**Figure 19**). This study used slightly different designations of plant community than those for the plant-communities baseline discussed in the previous section. Audible anuran surveys were conducted at the sites shown on **Figure 21** under the *Amphibian* section in this appendix. Incidental wildlife observations were also recorded. Additional studies are currently being conducted including an aquatic and terrestrial macroinvertebrates study, assessment of distribution and abundance of wood storks and wading birds, and panther habitat and prey studies.

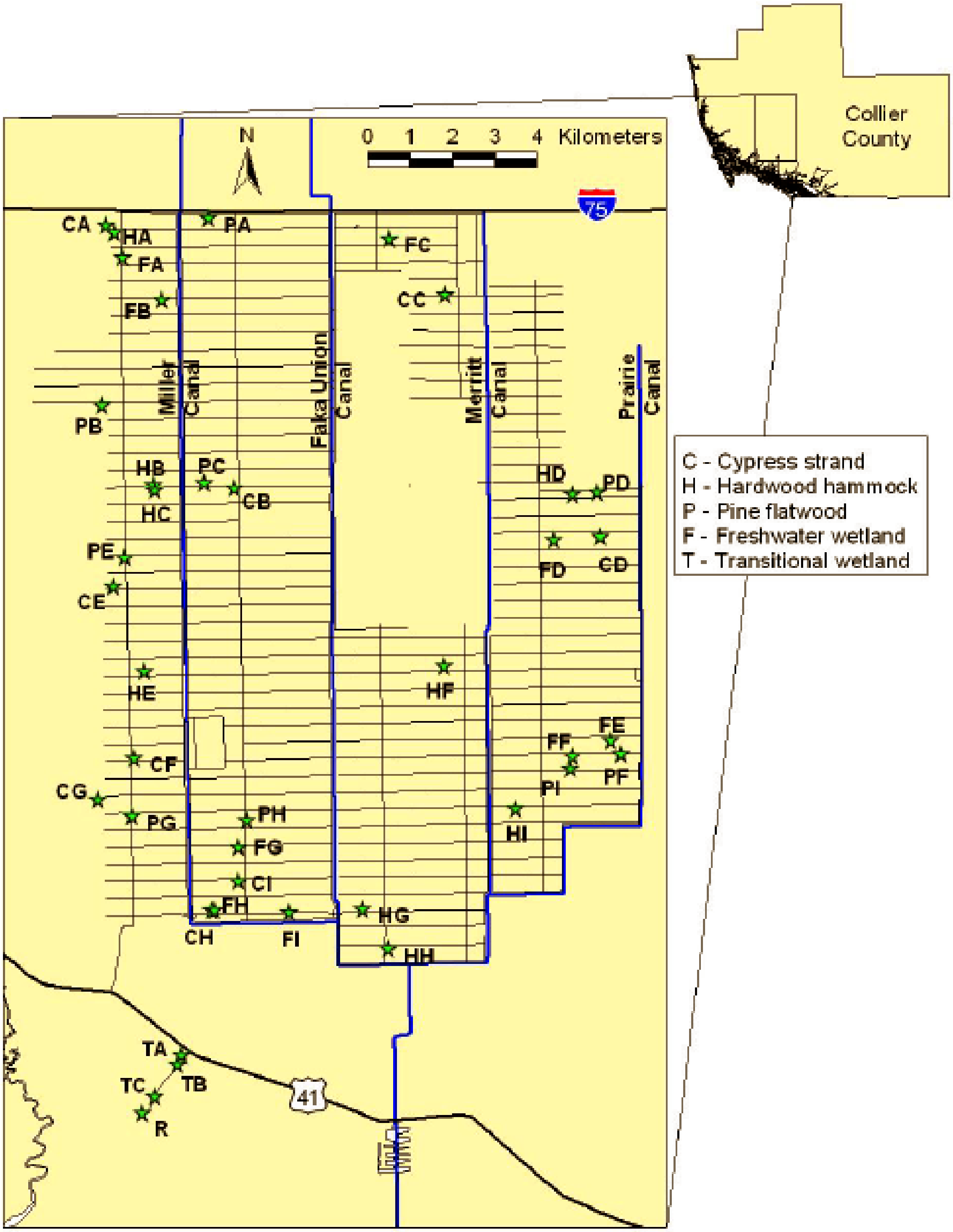

Figure 19. Location of wildlife sampling sites.

Small Mammals

Five species of small mammal were trapped during surveys: cotton mouse (*Peromyscus gossypinus*), hispid cotton rat (*Sigmodon hispidus*), marsh rice rat (*Oryzomys palustris*), southern short-tailed shrew (*Blarina carolinensis*), and eastern spotted skunk (*Spilogue putorius*) (Addison et al., 2006). Total of all species were 1,649 captures, 356 of which were recaptures (**Table 12**). Cotton mouse was the most abundant species with a total of 1,199 captures, 281 of which were recaptures, followed by hispid cotton rat with a total of 423 captures, 73 of which were recaptures.

Table 12. Total number of captures and percent composition of small mammal species for each plant community.

			Percent Composition per Plant Community					
Species	Total Captures	Re-Captures	Cypress Strand	Pine Flatwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
Cotton Mouse	1,199.0	281.0	79.1	46.7	90.0	18.3	13.3	83.3
Hispid Cotton Rat	423.0	73.0	20.9	52.6	7.9	76.6	76.7	16.7
Marsh Rice Rat	15.0	2.0		0.7		5.1	10.0	
Southern Short-tailed Shrew	7.0				1.2			
Spotted Skunk	5.0				0.9			

Cotton mice were the most frequently captured species in cypress strands, hardwood hammocks, and the access road, while hispid cotton rats were the most frequently captured in the freshwater and transitional wetlands (**Table 13**). Composition of these species was comparable in pine flatwoods. For individual species among plant communities, cotton mice were most frequently captured at the access road site and in the hardwood hammock community. However, the road is an anthropomorphic feature that created artificial uplands within transitional marshes. When captures from this site were excluded, substantially higher frequency of cotton mice were found in hardwood hammock and cypress strand communities. Hispid cotton and marsh rice rats were primarily captured in freshwater and transitional marshes. Southern short-tailed shrews and spotted skunks were only captured in hardwood hammocks. Small mammal captures were annually variable with no consistent trends in seasonal compositions (**Table 14**).

Table 13. Percent occurrence of small mammal species for each plant community.

	Percent Occurrence per Plant Community					
Species	Cypress Strand	Pine Flatwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
All Categories						
Cotton Mouse	20.1	4.2	34.8	3.1	1.6	36.2
Hispid Cotton Rat	12.5	11.2	7.2	30.4	21.7	17.0
Marsh Rice Rat		3.1	0.0	40.6	56.3	
Southern Short-Tailed Shrew			100.0			
Spotted Skunk			100.0			
Excluding Access Road Captures						
Cotton Mouse	31.5	6.6	54.6	4.8	2.5	-
Hispid Cotton Rat	15.1	13.5	8.7	36.6	26.2	-
Marsh Rice Rat		3.1	0.0	40.6	56.3	-
Southern Short-Tailed Shrew			100.0			-
Spotted Skunk			100.0			-

Table 14. Seasonal percent composition of small mammal species.

	2001					2002			2003	
Species	**Dry**	**Early Wet**	**Wet**	**Early Dry**		**Dry**	**Wet**		**Dry**	**Wet**
Cotton Mouse	8.5	23.9	23.0	44.6		51.7	48.3		57.9	42.1
Hispid Cotton Rat	21.2	50.9	16.7	11.3		76.1	23.9		50.9	49.1
Marsh Rice Rat	70.0	30.0				100.0				100.0
Southern Short-Tailed Shrew						16.7	83.3			100.0
Spotted Skunk				100.0		51.7	78.3			

Fish

A total of 23 species of fish were captured, of which 19 were native species and four were non-indigenous species (Addison et al., 2006). Eastern mosquitofish (*Gambusia holbrooki*) was the dominant fish species, comprising 80–86 percent of fish found in upland and freshwater communities and 52 percent of fish found in transitional wetlands (**Table 15**). Flagfish (*Jordanella floridae*) was the second-most abundant fish species in upland and freshwater habitats, while sailfin molly (*Poecilia latipinna*) was the second most abundant in transitional wetlands. Flagfish and sheepshead minnow (*Cyprinodon variegates*), also had relatively high abundances (6–7 percent) in transitional wetlands.

Table 15. Percent composition of fish species for each plant community.

Common Name (* denotes non-indigenous species)		**Percent Composition per Plant Community**				
	Species Name	**Cypress Strand**	**Pine Flatwood**	**Hardwood Hammock**	**Freshwater Wetland**	**Transitional Wetland**
Black Acara*	*Cichlasoma bimaculatum*	0.65		0.28	0.85	0.26
Bluefin Killifish	*Lucania goodei*	0.75			2.72	0.62
Bluegill	*Lepomis macrochirus*	0.65	0.34		0.16	0.05
Blue-Spotted Sunfish	*Enneacanthus gloriosus*	0.32			0.43	
Brook Silverside	*Labidesthes sicculus*				0.13	
Dollar Sunfish	*Lepomis marginatus*	2.05			0.23	
Eastern Mosquitofish	*Gambusia holbrooki*	85.67	82.99	80.00	86.05	52.13
Flagfish	*Jordanella floridae*	7.22	14.63	18.59	3.90	6.96
Golden Topminnow	*Fundulus chrysotus*	0.54	1.70	0.28	0.46	0.00
Inland Silverside	*Menidia beryllina*					0.10
Largemouth Bass	*Micropterus salmoides*				0.03	
Least Killifish	*Heterandria formosa*	0.43	0.34	0.28	1.97	
Marsh Killifish	*Fundulus confluentus*	0.11		0.28	0.69	1.25
Mayan Cichlid*	*Cichlasoma urophthalmus*	0.54			0.03	
Pike Killifish	*Belonesox belizanus* *				0.07	0.57
Rainwater Killifish	*Lucania parva*					0.31
Redear Sunfish	*Lepomis microlophus*	0.11			0.10	
Sailfin Molly	*Poecilia latipinna*	0.11			1.60	30.74
Sheepshead Minnow	*Cyprinodon variegatus*					6.28
Spotted Sunfish	*Lepomis punctatus*	0.22			0.07	
Spotted Tilapia*	*Tilapia mariae*				0.03	
Swamp Darter	*Etheostoma fusiforme*				0.03	
Warmouth	*Chaenobryttus gulosus*	0.65		0.28	0.46	0.05

For individual fish species among plant communities (**Table 16**), brook silversides (*Labidesthes sicculus*), largemouth bass (*Micropterus salmoides*), spotted tilapia (*Tilapia mariae*), and swamp darter (*Etheostoma fusiforme*) were only captured in freshwater wetlands, whereas inland silversides (*Menidia beryllina*), sheepshead minnows, and rainwater killifish (*Lucania parva*) were only captured in transitional wetlands (Addison et al., 2006). The non-indigenous pike killifish (*Belonesox belizanus*) and, to a lesser degree, the Mayan cichlid (*Cichlasoma urophthalmus*) predominated in the transitional wetlands, but were also captured in freshwater wetlands and, for the latter, cypress strands. Blue-spotted sunfish (*Enneacanthus gloriosus*) were more frequent and had a higher abundance in freshwater wetlands, and dollar sunfish (*Lepomis marginatus*) were more frequent and abundant in cypress strands.

Table 16. Percent occurrence of fish species in each plant community.

	Percent Occurrence per Plant Community				
Common Name (* denotes non-indigenous species)	**Cypress Strand**	**Pine Flatwood**	**Hardwood Hammock**	**Freshwater Wetland**	**Transitional Wetland**
Black Acara*	21.25		9.45	52.63	16.67
Bluefin Killifish	10.65			72.16	17.18
Bluegill	33.71	44.95		16.05	5.29
Blue-Spotted Sunfish	27.27			72.73	
Brook Silverside				100.0	
Dollar Sunfish	82.61			17.39	
Eastern Mosquitofish	13.36	12.73	32.80	25.23	15.88
Flagfish	8.58	44.04	22.53	8.71	16.15
Golden Topminnow	8.98	71.86	4.79	14.37	
Inland Silverside					100.0
Largemouth Bass				100.00	
Least Killifish	8.17	16.34	5.45	70.04	
Marsh Killifish	2.61		6.97	31.37	59.05
Mayan Cichlid*	28.08			3.21	68.71
Pike Killifish*				9.94	90.96
Rainwater Killifish				0.00	100.00
Redear Sunfish	36.84			63.16	0.00
Sheepshead Minnow					100.00
Spotted Sunfish	77.78			22.22	
Spotted Tilapia*				100.00	
Swamp Darter				100.00	
Warmouth	35.22		15.65	43.60	5.52
Sailfin Molly	0.17			4.78	95.05

Mean total lengths were calculated for fish species in each plant community and five species exhibited significant differences in lengths among biotopes (**Table 17**) (Addison et al., 2006). However, the observed significance for some species may have been confounded by the effects of small sample sizes, unequal sampling effort among communities, and/or sampling bias by capture method. Mosquitofish and flagfish were the most numerically dominant fish species and both are readily captured in Breder traps, leaving unequal effort as a possible factor influencing the observed differences. Nonetheless, the sample of lengths for mosquitofish in the cypress strand was significantly smaller than those of all the other biotopes, and the length of samples in the hardwood hammock and pine flatwood were significantly greater than those in the freshwater and transitional wetlands. For flagfish, the sample of lengths in the hardwood hammock was significantly smaller than those in the other communities.

Table 17. Mean length of fish species in each plant community.

Species (* denotes non-indigenous species)	Percent Occurrence per Plant Community (dark blue/bold indicates length of a single fish)					
	Cypress Strand	Pine Flatwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	*p*-value
Black Acara*	39.8 ± 15.4		**35.0**	39.5 ± 14.3	49.2 ± 11.0	0.30
Bluefin Killifish	23.9 ± 3.6		-	28.6 ± 8.3	26.1 ± 2.4	0.09
Bluegill	22.2 ± 8.6	**50.0**	-	34.8 ± 8.1	**37.0**	0.09
Blue-Spotted Sunfish	16.7 ± 2.9	-	-	12.6 ± 1.7	-	0.009
Brook Silverside	-	-	-	22.5 ± 2.9	-	-
Dollar Sunfish	28.5 ± 2.5	-	-	58.1 ± 17.0	-	0.0002
Eastern Mosquitofish	21.7 ± 8.4	25.3 ± 8.1	26.6 ± 7.4	22.6 ± 8.9	22.5 ± 5.8	<0.0001
Flagfish	24.9 ± 8.2	25.7 ± 6.9	21.4 ± 5.2	25.5 ± 7.9	24.6 ± 6.2	0.0002
Golden Topminnow	36.8 ± 6.8	34.4 ± 5.6	**23.0**	42.6 ± 9.5	-	0.24
Inland Silverside	-	-	-	-	28.5 ± 0.7	-
Largemouth Bass	-	-	-	145.0 ± 7.1	-	-
Least Killifish	18.3 ± 9.6	**15.0**	**12.0**	16.8 ± 5.0	-	0.50
Marsh Killifish	**26.0**	-	**56.0**	27.7 ± 8.9	34.0 ± 12.9	0.07
Mayan Cichlid*	40.0 ± 4.2	-	-	**110.0**	68.7 ± 35.9	0.02
Pike Killifish*	-	-	-	44.0 ± 24.0	57.5 ± 17.0	0.35
Rainwater Killifish	-	-	-	-	32.2 ± 4.8	-
Redear Sunfish	**21.0**	-	-	63.7 ± 50.0	-	-
Sheepshead Minnow	-	-	-	-	23.5 ± 6.6	-
Spotted Sunfish	37.0 ± 11.3	-	-	**55.0**	-	-
Spotted Tilapia*	-	-	-	**60.0**	-	-
Swamp Darter	-	-	-	**28.0**	-	-
Warmouth	27.5 ± 3.6	-	**62.0**	33.3 ± 28.0	**65.0**	0.33
Sailfin Molly	**18.0**	-	-	29.7 ± 12.3	30.1 ± 9.1	0.09

Aquatic Macroinvertebrates

A total of five classes, 15 orders, 45 families and 88 genera of aquatic macroinvertebrates were collected from all plant communities combined (**Table 18**). At least 14 genera may be considered as indicators of relatively natural hydroperiods for freshwater systems in southwest Florida: crayfish (*Procambarus* spp.), grass shrimp (*Palaemonetes* sp.), planorbid snails (*Planorbella* sp.), limpets (*Ancylidae* sp.), and certain several genera of dragonflies (*Anisoptera* spp.). The highest number of long hydroperiod indicators were found in the freshwater wetland communities followed by cypress, transitional wetland, hardwood hammock, and pine flatwood.

Mayflies (*Ephemeroptera*) of the genera *Callibaetis* and *Caenis* were found in all communities but were relatively abundant in cypress strands (16 percent) and freshwater wetlands (15 percent) (**Table 18**). Pond snails (*Physella/Haitia*) also had relatively high percent composition in cypress strands (9 percent) and freshwater wetlands (9 percent), but were also found in the other communities. Damselflies of the genus *Ischnura* were also relatively abundant in each community and contributed more than 12 percent of the total number of species collected from transitional wetlands. *Palaemonetes* (12 percent) and chironomidae (9 percent) also had a high percent composition in transitional wetlands. Hardwood hammocks were dominated by ostracod crustaceans (20 percent), dytiscid beetles (12 percent), and *Cyphon* sp. The pine flatwood biotope collections were dominated by mayflies (25 percent), crayfish (12 percent), Rheumatobates (9 percent), and Ischnura (9 percent).

Table 18. Percent composition of aquatic macroinvertebrate operational taxonomic units in each plant community.

Class	Order	Family	Genus (+ denotes hydroperiod indicator)	Cypress Strand	Pine Flatwood	Hardwood Hammock	Fresh-water Wetland	Transi-tional Wetland
Hydrachnida	*Hydrachnida*	*Hydrachnida*	*Hydrachnida*	0.60			0.38	2.28
Clitellata	*Hirudinea*	*Hirudinea*	*Hirudinea*	0.40	6.06		0.31	0.35
Crustacea	*Branchipoda*	*Daphniidae*	*Daphniidae*	7.58		0.74	0.31	0.00
Crustacea	*Ostracoda*	*Cyprididae*	*Cyprididae*	6.99		19.7	1.13	0.18
Crustacea	*Amphipoda*	*Gammaridae*	*Gammaridae*					1.93
Crustacea	*Amphipoda*	*Hyallelidae*	*Hyalella*				1.39	5.43
Crustacea	*Decapoda*	*Cambaridae*	*Procambarus +*	2.79	12.12		1.01	0.35
Crustacea	*Decapoda*	*Palaemonidae*	*Palaemonetes +*	0.40		0.37	0.06	11.73
Mollusca	*Gastropoda*	*Ancylidae*	*Ancylidae +*			0.37	2.39	
Mollusca	*Gastropoda*	*Lymnaeidae*	*Fossaria*				0.25	0.35
Mollusca	*Gastropoda*	*Physidae*	*Physella/Haitia*	8.98	6.06	1.49	9.19	1.40
Mollusca	*Gastropoda*	*Planorbidae*	*Planorbella +*	0.20			1.07	0.53
Mollusca	*Gastropoda*	*Viviparidae*	*Viviparidae*				0.00	1.93
Mollusca	*Gastropoda*	*Hydrobiidae*	*Hydrobiidae*				0.00	5.08
Insecta	*Anisoptera*	*Aeshnidae*	*Anax +*	0.20			1.32	0.00
Insecta	*Anisoptera*	*Aeshnidae*	*Coryphaeschna +*				0.38	
Insecta	*Anisoptera*	*Aeshnidae*	*Gynacantha +*	0.40		0.74	1.64	
Insecta	*Anisoptera*	*Aeshnidae*	*Nasiaeschna +*	0.20		2.60	0.25	
Insecta	*Anisoptera*	*Libellulidae*	*Erythemis +*				0.57	1.58
Insecta	*Anisoptera*	*Libellulidae*	*Erythrodiplax +*	1.80			0.38	
Insecta	*Anisoptera*	*Libellulidae*	*Miathyria +*				0.13	
Insecta	*Anisoptera*	*Libellulidae*	*Pachydiplax +*	0.80		2.23	2.64	0.18
Insecta	*Anisoptera*	*Libellulidae*	*Pantala +*				0.76	
Insecta	*Anisoptera*	*Libellulidae*	*Perithemis +*				0.00	0.88
Insecta	*Anisoptera*	*Libellulidae*	*Libellulidae*	0.80	3.03	0.00	0.06	0.53
Insecta	*Coleoptera*	*Dryopidae*	*Pelonomus*			0.37	0.57	0.18
Insecta	*Coleoptera*	*Dytiscidae*	*Dytiscidae*			11.9	1.07	
Insecta	*Coleoptera*	*Dytiscidae*	*Copelatus*				1.07	
Insecta	*Coleoptera*	*Dytiscidae*	*Cybister*	1.00		0.37	0.94	
Insecta	*Coleoptera*	*Dytiscidae*	*Hydaticus*	1.20		1.49	0.63	
Insecta	*Coleoptera*	*Dytiscidae*	*Laccophilus*	2.00			1.70	
Insecta	*Coleoptera*	*Dytiscidae*	*Megadytes*	0.00			0.13	
Insecta	*Coleoptera*	*Dytiscidae*	*Thermonectus*	2.20		1.12	1.07	
Insecta	*Coleoptera*	*Gyrinidae*	*Dineutus*	3.39	6.06	2.23	0.82	0.35
Insecta	*Coleoptera*	*Gyrinidae*	*Gyrinus*	0.80			0.38	0.35
Insecta	*Coleoptera*	*Haliplidae*	*Haliplus*				1.39	
Insecta	*Coleoptera*	*Hydrophilidae*	*Berosus*	0.20			0.63	1.23
Insecta	*Coleoptera*	*Hydrophilidae*	*Enochrus*	1.00	3.03	0.00	0.25	1.05
Insecta	*Coleoptera*	*Hydrophilidae*	*Tropisternus*	1.20	3.03	0.37	4.28	5.60
Insecta	*Coleoptera*	*Noteridae*	*Noteridae*			0.74	0.38	0.35
Insecta	*Coleoptera*	*Noteridae*	*Hydrocanthus*	5.59	6.06		3.84	2.45
Insecta	*Coleoptera*	*Noteridae*	*Suphis*				0.69	0.00
Insecta	*Coleoptera*	*Noteridae*	*Suphisellus*				1.07	0.70
Insecta	*Coleoptera*	*Scirtidae*	*Cyphon*	3.99	3.03	8.55	0.25	0.00
Insecta	*Coleoptera*	*Scirtidae*	*Scirtes*	0.20	0.00	1.86	0.25	0.00

Table 18 continued. Percent composition of aquatic macroinvertebrate operational taxonomic units in each plant community.

Class	Order	Family	Genus (+ denotes hydroperiod indicator)	Cypress Strand	Pine Flatwood	Hardwood Hammock	Fresh-water Wetland	Tran-sitional Wetland
Insecta	*Collembola*	*Isotomidae*	*Isotomidae*	0.40			0.13	
Insecta	*Diptera*	*Brachycera*	*Brachycera*					6.30
Insecta	*Diptera*	*Ceratopogonidae*	*Ceratopogonidae*	0.20			0.06	1.05
Insecta	*Diptera*	*Ceratopogonidae*	*Bezzia*	0.40		0.37		
Insecta	*Diptera*	*Chaoboridae*	*Chaoborus*	0.20			0.19	
Insecta	*Diptera*	*Chironomidae*	*Chironomidae*	4.59	3.03	10.04	4.85	8.58
Insecta	*Diptera*	*Culicidae*	*Culicidae*	0.40		1.49	0.82	0.35
Insecta	*Diptera*	*Culicidae*	*Aedes*	0.20		1.86	0.06	0.00
Insecta	*Diptera*	*Culicidae*	*Anopheles*	1.00		0.74	1.01	0.35
Insecta	*Diptera*	*Culicidae*	*Culex*	4.79	3.03	1.12	0.44	0.70
Insecta	*Diptera*	*Culicidae*	*Mansonia*				1.76	
Insecta	*Diptera*	*Stratiomyidae*	*Stratiomyidae*				0.38	1.05
Insecta	*Diptera*	*Stratiomyidae*	*Odontomyia*				0.76	1.05
Insecta	*Ephemeroptera*	*Baetidae*	*Callibaetis*	10.78	12.12	1.49	14.61	4.38
Insecta	*Ephemeroptera*	*Caenidae*	*Caenis*	4.99	12.12	0.37	2.71	0.00
Insecta	*Hemiptera*	*Belostomatidae*	*Belostomatidae*			4.09	0.25	0.18
Insecta	*Hemiptera*	*Belostomatidae*	*Belostoma*		2.20	3.40	2.80	2.60
Insecta	*Hemiptera*	*Belostomatidae*	*Lethocerus*		0.60	0.25		
Insecta	*Hemiptera*	*Corixidae*	*Trichocorixa*		0.20	0.38	1.93	
Insecta	*Hemiptera*	*Corixidae*	*Tenagobia*			0.13		
Insecta	*Hemiptera*	*Corixidae*	*Corixidae*		1.20	0.69	2.45	
Insecta	*Hemiptera*	*Gerridae*	*Gerridae*		0.60	0.00	0.18	
Insecta	*Hemiptera*	*Gerridae*	*Limnoporus*		0.60	0.25	0.88	0.37
Insecta	*Hemiptera*	*Gerridae*	*Neogerris*		0.40	0.06	0.35	
Insecta	*Hemiptera*	*Gerridae*	*Trepobates*		0.40	0.13	0.18	
Insecta	*Hemiptera*	*Gerridae*	*Rheumatobates*	9.09	0.40			1.49
Insecta	*Hemiptera*	*Hydrometridae*	*Hydrometra*		0.40	0.44	2.10	0.37
Insecta	*Hemiptera*	*Mesoveliidae*	*Mesovelia*			0.31	0.53	
Insecta	*Hemiptera*	*Naucoridae*	*Pelocoris*	3.03	0.40	1.64	3.33	
Insecta	*Hemiptera*	*Nepidae*	*Ranatra*			0.50		
Insecta	*Hemiptera*	*Notonectidae*	*Notonectidae*		0.80	0.19		0.37
Insecta	*Hemiptera*	*Notonectidae*	*Buenoa*		0.40	2.14		0.74
Insecta	*Hemiptera*	*Notonectidae*	*Notonecta*			3.02		3.72
Insecta	*Hemiptera*	*Pleidae*	*Neoplea*			0.94		0.00
Insecta	*Hemiptera*	*Pleidae*	*Paraplea*			0.25		0.00
Insecta	*Hemiptera*	*Velidae*	*Microvelia*			0.06		1.49
Insecta	*Hemiptera*	*Velidae*	*Steinovelia*		0.40			
Insecta	*Trichoptera*	*Hydroptilidae*	*Oxyethira*		0.80			
Insecta	*Zygoptera*	*Coenagrionidae*	*Enallagma*		0.20	0.31	0.18	0.37
Insecta	*Zygoptera*	*Coenagrionidae*	*Ischnura*	9.09	7.19	8.25	12.43	9.67
Insecta	*Zygoptera*	*Coenagrionidae*	*Telebasis*			0.19		
Insecta	*Zygoptera*	*Coenagrionidae*	*Coenagrionidae*			0.82	1.75	
Insecta	*Zygoptera*	*Lestidae*	*Lestes*			0.57		

The highest number of long-hydroperiod indicators was found in freshwater wetlands. Freshwater wetlands contained 12 genera that were unique to, or found only in this community (i.e., endemism), including four water beetles, three *Anisoptera*, two *Zygoptera*, two *Hemiptera*, and one mosquito (**Table 16**). Transitional wetlands held five endemic genera. Cypress strands held two endemic genera while hardwood hammocks and pine flatwoods had none. When compared by percent composition to other communities, crayfish are shown to occur 74 percent in pine flatwoods. However, this value was calculated based on only one sampling event from two locations during an extreme high water event during late September and October 2003. These were most likely non-resident fauna that had been transported by flood waters from nearby canals, deeper wetlands, or roadside swales.

Table 19. Percent occurrence of each aquatic macroinvertebrate operational taxonomic unit in each community.

Class	Order	Family	Genus (+ hydroperiod indicator)	Cypress Strand	Pine Flatwood	Hardwood Hammock	Fresh-water Wetland	Transitional Wetland
Hydrachnida	*Hydrachnida*	*Hydrachnida*	*Hydrachnida*	18.41			11.61	69.98
Clitellata	*Hirudinea*	*Hirudinea*	*Hirudinea*	5.60	85.06		4.42	4.92
Crustacea	*Branchipoda*	*Daphniidae*	*Daphniidae*	87.76		8.60	3.64	
Crustacea	*Ostracoda*	*Cyprididae*	*Cyprididae*	24.95		70.37	4.05	0.63
Crustacea	*Amphipoda*	*Gammaridae*	*Gammaridae*					100.00
Crustacea	*Amphipoda*	*Hyallelidae*	*Hyalella*				20.33	79.67
Crustacea	*Decapoda*	*Cambaridae*	*Procambarus +*	17.17	74.48		6.19	2.15
Crustacea	*Decapoda*	*Palaemonidae*	*Palaemonetes +*	3.18		2.96	0.50	93.36
Mollusca	*Gastropoda*	*Ancylidae*	*Ancylidae +*			13.45	86.55	
Mollusca	*Gastropoda*	*Lymnaeidae*	*Fossaria*				41.83	58.17
Mollusca	*Gastropoda*	*Physidae*	*Physella/Haitia*	33.11	22.34	5.48	33.9	5.17
Mollusca	*Gastropoda*	*Planorbidae*	*Planorbella*	11.12			59.62	29.26
Mollusca	*Gastropoda*	*Viviparidae*	*Viviparidae*	0.00				100.00
Mollusca	*Gastropoda*	*Hydrobiidae*	*Hydrobiidae*					100.00
Insecta	*Anisoptera*	*Aeshnidae*	*Anax +*	13.11			86.89	
Insecta	*Anisoptera*	*Aeshnidae*	*Coryphaeschna +*				100.00	
Insecta	*Anisoptera*	*Aeshnidae*	*Gynacantha +*	14.36		26.74	58.90	
Insecta	*Anisoptera*	*Aeshnidae*	*Nasiaeschna +*	6.54		85.22	8.25	
Insecta	*Anisoptera*	*Libellulidae*	*Erythemis +*				26.45	73.55
Insecta	*Anisoptera*	*Libellulidae*	*Erythrodiplax +*	82.62			17.38	
Insecta	*Anisoptera*	*Libellulidae*	*Miathyria +*				100.00	
Insecta	*Anisoptera*	*Libellulidae*	*Pachydiplax +*	13.65		38.14	45.22	2.99
Insecta	*Anisoptera*	*Libellulidae*	*Pantala +*				100.00	
Insecta	*Anisoptera*	*Libellulidae*	*Perithemis +*					100.00
Insecta	*Anisoptera*	*Libellulidae*	*Libellulidae*	18.08	68.6		1.43	11.89
Insecta	*Coleoptera*	*Dryopidae*	*Pelonomus*			33.38	50.89	15.73
Insecta	*Coleoptera*	*Dytiscidae*	*Dytiscidae*			91.74	8.26	
Insecta	*Coleoptera*	*Dytiscidae*	*Copelatus*				100.00	
Insecta	*Coleoptera*	*Dytiscidae*	*Cybister*	43.12		16.06	40.81	
Insecta	*Coleoptera*	*Dytiscidae*	*Hydaticus*	36.13		44.87	19.00	
Insecta	*Coleoptera*	*Dytiscidae*	*Laccophilus*	54.00			46.00	
Insecta	*Coleoptera*	*Dytiscidae*	*Megadytes*				100.00	
Insecta	*Coleoptera*	*Dytiscidae*	*Thermonectus*	50.11		25.45	24.43	
Insecta	*Coleoptera*	*Gyrinidae*	*Dineutus*	26.40	47.15	17.35	6.37	2.73

Table 19 continued. Percent occurrence of each aquatic macroinvertebrate operational taxonomic unit in each community.

Class	Order	Family	Genus (* hydroperiod indicator)	Cypress Strand	Pine Flatwood	Hardwood Hammock	Fresh-water Wetland	Transitional Wetland
Insecta	*Coleoptera*	*Gyrinidae*	*Gyrinus*	52.30			24.75	22.95
Insecta	*Coleoptera*	*Hydrophilidae*	*Berosus*	9.71			30.64	59.65
Insecta	*Coleoptera*	*Hydrophilidae*	*Enochrus*	18.72	56.84		4.73	19.71
Insecta	*Coleoptera*	*Hydrophilidae*	*Tropisternus*	8.27	20.92	2.57	29.56	38.69
Insecta	*Coleoptera*	*Noteridae*	*Noteridae*			50.52	25.68	23.8
Insecta	*Coleoptera*	*Noteridae*	*Hydrocanthus*	31.15	33.78		21.41	13.66
Insecta	*Coleoptera*	*Noteridae*	*Suphis*				100.00	
Insecta	*Coleoptera*	*Noteridae*	*Suphisellus*				60.45	39.55
Insecta	*Coleoptera*	*Scirtidae*	*Cyphon*	25.23	19.15	54.03	1.59	
Insecta	*Coleoptera*	*Scirtidae*	*Scirtes*	8.64		80.46	10.90	
Insecta	*Collembola*	*Isotomidae*	*Isotomidae*	76.02			23.98	
Insecta	*Diptera*	*Brachycera*	*Brachycera*					100.00
Insecta	*Diptera*	*Ceratopogonidae*	*Ceratopogonidae*	15.2			4.79	80.01
Insecta	*Diptera*	*Ceratopogonidae*	*Bezzia*	51.78		48.22		
Insecta	*Diptera*	*Chaoboridae*	*Chaoborus*	51.37			48.63	
Insecta	*Diptera*	*Chironomidae*	*Chironomidae*	14.77	9.75	32.29	15.6	27.6
Insecta	*Diptera*	*Culicidae*	*Culicidae*	13.07		48.67	26.8	11.46
Insecta	*Diptera*	*Culicidae*	*Aedes*	9.41		87.62	2.97	
Insecta	*Diptera*	*Culicidae*	*Anopheles*	32.20		23.99	32.51	11.30
Insecta	*Diptera*	*Culicidae*	*Culex*	47.54	30.07	11.07	4.37	6.95
Insecta	*Diptera*	*Culicidae*	*Mansonia*				100.00	
Insecta	*Diptera*	*Stratiomyidae*	*Stratiomyidae*				26.45	73.55
Insecta	*Diptera*	*Stratiomyidae*	*Odontomyia*				41.83	58.17
Insecta	*Ephemeroptera*	*Baetidae*	*Callibaetis*	24.85	27.95	3.43	33.68	10.09
Insecta	*Ephemeroptera*	*Caenidae*	*Caenis*	24.71	60.03	1.84	13.41	0.00
Insecta	*Hemiptera*	*Belostomatidae*	*Belostomatidae*			90.54	5.58	3.88
Insecta	*Hemiptera*	*Belostomatidae*	*Belostoma*	19.96		23.66	30.91	25.47
Insecta	*Hemiptera*	*Belostomatidae*	*Lethocerus*	70.39			29.61	
Insecta	*Hemiptera*	*Corixidae*	*Trichocorixa*	7.97			15.09	76.94
Insecta	*Hemiptera*	*Corixidae*	*Tenagobia*				100.00	
Insecta	*Hemiptera*	*Corixidae*	*Corixidae*	27.58			15.95	56.47
Insecta	*Hemiptera*	*Gerridae*	*Gerridae*	77.37				22.63
Insecta	*Hemiptera*	*Gerridae*	*Limnoporus*	28.54		17.72	12.01	41.74
Insecta	*Hemiptera*	*Gerridae*	*Neogerris*	49.14			7.75	43.11
Insecta	*Hemiptera*	*Gerridae*	*Trepobates*	57.01			17.98	25.01
Insecta	*Hemiptera*	*Gerridae*	*Rheumatobates*	3.64	82.82	13.55		
Insecta	*Hemiptera*	*Hydrometridae*	*Hydrometra*	12.05		11.22	13.30	63.43
Insecta	*Hemiptera*	*Mesoveliidae*	*Mesovelia*				37.47	62.53
Insecta	*Hemiptera*	*Naucoridae*	*Pelocoris*	4.76	36.10		19.50	39.64
Insecta	*Hemiptera*	*Nepidae*	*Ranatra*				100.00	
Insecta	*Hemiptera*	*Notonectidae*	*Notonectidae*	58.75		27.35	13.9	
Insecta	*Hemiptera*	*Notonectidae*	*Buenoa*	12.16		22.64	65.20	
Insecta	*Hemiptera*	*Notonectidae*	*Notonecta*			55.15	44.85	
Insecta	*Hemiptera*	*Pleidae*	*Neoplea*				100.00	
Insecta	*Hemiptera*	*Pleidae*	*Paraplea*				100.00	
Insecta	*Hemiptera*	*Velidae*	*Microvelia*			95.94	4.06	

Table 19 continued. Percent occurrence of each aquatic macroinvertebrate operational taxonomic unit in each community.

Class	Order	Family	Genus (* hydroperiod indicator)	Cypress Strand	Pine Flatwood	Hardwood Hammock	Fresh-water Wetland	Transitional Wetland
Insecta	*Trichoptera*	*Hydroptilidae*	*Oxyethira*	100.00				
Insecta	*Zygoptera*	*Coenagrionidae*	*Enallagma*	18.81		35.03	29.67	16.5
Insecta	*Zygoptera*	*Coenagrionidae*	*Ischnura*	15.41	19.50	20.73	17.69	26.67
Insecta	*Zygoptera*	*Coenagrionidae*	*Telebasis*				100.00	
Insecta	*Zygoptera*	*Coenagrionidae*	*Coenagrionidae*				31.85	68.15
Insecta	*Zygoptera*	*Lestidae*	*Lestes*				100.00	

Terrestrial Invertebrates

Ants were the only terrestrial macroinvertebrates surveyed. A total of 39 species were collected, of which 28 were native and 11 were non-indigenous (Addison et al., 2006) (**Table 20**). The non-indigenous red imported fire ant (*Solenopsis invicata*) was the dominant species in freshwater wetlands and cypress strands, in which it was 89 percent and 61 percent respectively, of species composition (**Table 20**). Another non-indigenous ant species, *Pheidole moerens*, was the second most abundant in both freshwater and transitional wetlands, particularly the latter. *Pheidole floridana* was the most abundant ant species at access roads and in hardwood hammocks, and was the second most abundant in cypress strands. *Pheidole dentata* and the non-indigenous *Paratrechina bourbonica* were the second most abundant ant species at the access road and in cypress strands, respectively.

Forty-three percent of ant species were only captured in a particular community and, of this total, 46 percent were only captured in pine flatwoods (**Table 21**). Nine other ant species exhibited an affinity (60–90 percent of respective species totals) for certain communities. The red imported fire ant was distributed across all biotopes, but 60 percent of the species total was found in freshwater wetlands and cypress strands.

Table 20. Percent composition of ant species in each plant community.

Scientific Name *(* denotes non-indigenous species)*	Cypress Strand	Pine Hardwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
Aphaenogaster miamiana	1.62	1.02	16.84	1.12	0.00	0.00
Brachymyrmex obscurior	0.00	0.00	0.00	0.00	0.00	6.52
Camponotus floridanus	0.00	0.34	0.53	0.00	0.00	0.00
*Cardiocondyla emeryi**	0.00	1.69	0.26	0.00	0.00	2.17
*Cardiocondyla nuda**	0.00	0.34	0.00	0.00	0.00	0.00
Crematogaster ashmeadi	0.65	1.36	0.53	0.00	5.26	0.00
Crematogaster atkinsoni	0.00	0.68	0.26	0.56	15.79	0.00
Crematogaster pilosa	0.00	0.68	0.00	0.00	5.26	0.00
Dorymyrmex bureni	0.00	2.71	0.00	2.25	10.53	10.87
Formica archboldi	0.00	1.02	0.00	0.00	0.00	0.00
Forelius pruinosus	1.29	14.92	0.53	0.56	0.00	2.17
Leptothorax pergandei	0.00	0.34	0.00	0.00	0.00	0.00
Monomorium floricola	0.32	0.34	1.32	0.00	0.00	2.17
*Monomorium viride**	0.00	3.05	0.00	0.00	0.00	0.00
Odontomachus brunneus	0.32	4.41	4.74	0.00	0.00	2.17
*Odontomachus ruginodis**	0.00	0.00	0.00	0.00	0.00	2.17
*Paratrechina bourbonica**	0.00	0.00	0.79	0.00	0.00	15.22
Paratrechina concinna	0.65	0.00	0.00	0.00	0.00	0.00

Table 20 continued. Percent composition of ant species in each plant community.

Scientific Name (* denotes non-indigenous species)	Cypress Strand	Pine Hardwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
*Paratrechina guatemalensis**	0.00	0.68	1.05	0.00	0.00	0.00
Pheidole dentigula	0.00	0.00	0.53	0.00	0.00	0.00
Pheidole floridana	13.59	9.15	24.47	0.00	0.00	28.26
*Pheidole moerens**	8.41	6.44	10.79	5.62	21.05	6.52
Pheidole morrisii	0.00	0.68	0.00	0.00	0.00	0.00
*Pseudomyrmex gracilis**	0.00	0.00	0.26	0.00	0.00	2.17
*Solenopsis invicta**	61.17	37.63	15.53	89.33	26.32	15.22
Solenopsis nickersoni	0.00	1.02	0.00	0.00	0.00	0.00
*Tapinoma melanocephalum**	0.32	0.00	0.00	0.00	0.00	0.00
Tapinoma sessile	0.00	0.00	0.00	0.00	10.53	0.00
*Tetramorium bicarinatum**	0.00	0.00	0.00	0.56	0.00	0.00

Table 21. Percent occurrence of ant species in each plant community.

Scientific Name (* denotes non-indigenous species)	Cypress Strand	Pine Hardwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
Aphaenogaster miamiana	7.84	3.87	84.42	3.87		
Brachymyrmex obscurior						100.00
Camponotus floridanus		32.84	67.16			
*Cardiocondyla emeryi**		33.28	6.81			59.91
*Cardiocondyla nuda**		100.00				
Crematogaster ashmeadi	16.32	26.83	13.72		43.13	
Crematogaster atkinsoni		8.40	4.30	6.30	81.00	
Crematogaster pilosa		23.73			76.27	
Dorymyrmex bureni		11.13		8.35	17.89	62.62
Formica archboldi		100.00				
Forelius pruinosus	7.92	71.65	3.33	2.44		14.66
Leptothorax pergandei		100.00				
Monomorium floricola	7.45	6.12	31.31			55.11
*Monomorium viride**						
Odontomachus brunneus	2.92	31.23	44.23			21.62
*Odontomachus ruginodis**						100.00
*Paratrechina bourbonica**			4.64			95.36
Paratrechina concinna	100.00					
*Paratrechina guatemalensis**		32.84	67.16			
Pheidole dentata	23.53	18.27	45.07		3.45	9.67
Pheidole floridana	17.60	9.30	32.78			40.32
*Pheidole moerens**	19.73	11.86	26.16	9.36	16.04	16.85
Pheidole morrisii		100.00				
*Pseudomyrmex gracilis**			10.20			89.80
*Solenopsis invicta**	31.28	15.11	8.21	32.46	4.37	8.57
Solenopsis nickersoni		100.00				
*Tapinoma melanocephalum**	100.00					
Tapinoma sessile					100.00	
*Tetramorium bicarinatum**				100.00		

Birds

Two types of studies, aerial surveys and ground surveys, were done for birds. In 2001, a limited aerial survey of wood storks and wading birds was conducted by the US Army Corps of Engineers. An additional, more extensive study has been undertaken to assess the distribution and abundance of wood storks and wading birds (Doyle and Gonnion, 2006). Avian ground surveys were conducted as part of the wildlife surveys (Addison et al., 2006).

WOOD STORKS AND WADING BIRDS

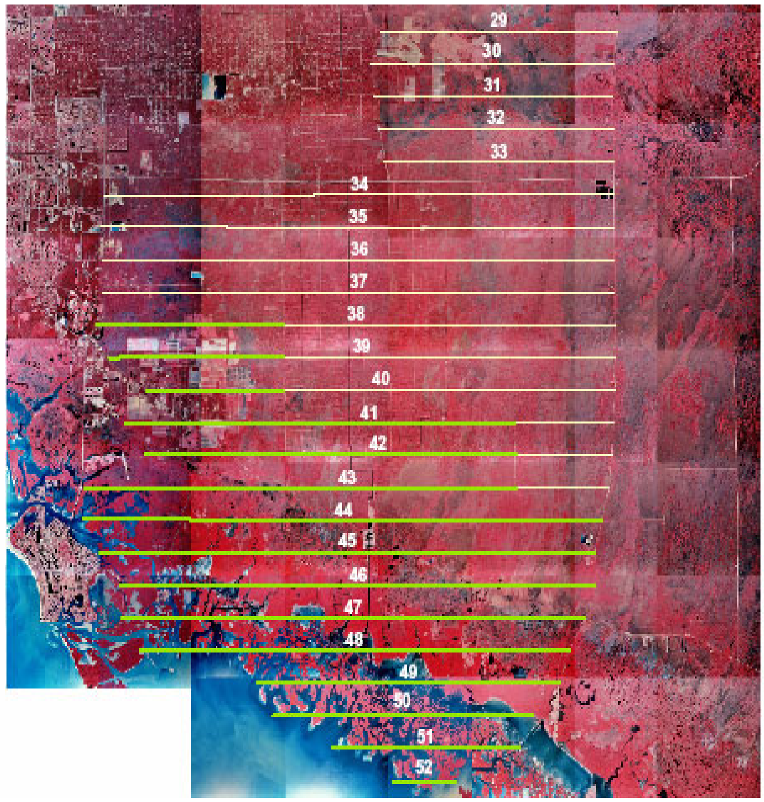

Figure 20. Location of Aerial Wading Bird transects.

Currently, aerial surveys are being conducted within Picayune Strand Restoration Project area and surrounding state and federally owned lands to determine distribution and abundance of wood storks and wading birds. The study area extends from I-75 south to outer Ten Thousand Islands and includes Florida Panther NWR north of I-75 and extends from boundaries of Big Cypress National Preserve and Everglades National Park in the east to roughly County Road 951 in the west (**Figure 20**). Within the study area boundaries are Picayune Strand State Forest, Collier-Seminole State Park, and Fakahatchee Strand Preserve State Park in addition to the areas mentioned above (**Figure 1**). Ecological communities (NRCS, 1989) found within the study area include cypress swamp, scrub cypress, cabbage palm flatwoods, south Florida flatwoods, wet prairie, freshwater marsh, mangrove swamp and mudflats. Coastal areas consist of hundreds of mangrove-dominated islands and associated shallow water estuarine bays. This information will be included in the South Florida Ecosystem Report once it is available.

AVIAN SPECIES SURVEY

Ninety-two avian species were recorded from visual or audible observations during avian surveys conducted in 2001 (Addison et al., 2006) (**Table 22**). The northern cardinal (*Cardinalis cardinalis*) was the most ubiquitous species among the different plant communities, accounting for the highest percent composition within cypress strands (18 percent), hardwood hammocks (22 percent), and pine flatwoods (16 percent). The northern cardinal was also the second most abundant within transitional wetlands (10 percent) and third most abundant within freshwater wetlands (7 percent) and along the access road (5 percent). The blue winged teal (*Anas discors*) was the most frequently observed species of bird within freshwater wetlands (25 percent) and along the access road (17 percent), and the common yellowthroat (*Geothlypis trichas*) was the most frequently observed within transitional wetlands (10 percent). The red-winged blackbird

(*Agelaius phoeniceus*) had the second highest percent composition within freshwater wetlands (19 percent) and the third highest within transitional wetlands (9 percent). The redbellied woodpecker (*Melanerpes carolinus*) was the second most abundant avian species within pine flatwoods (12 percent) and cypress strands (11 percent), and third most abundant within hardwood hammocks (8 percent). The blue-gray gnatcatcher (*Polioptila caerulea*) had the second highest occurrence within hardwood hammocks (13 percent) and the third highest within cypress strands (10 percent). The white-eyed vireo (*Vireo griseus*) was the second most abundant bird along the access road (6 percent), and the cedar waxwing (*Bombycilla cedrorum*) was the third most abundant within pine flatwoods (11 percent).

Table 22. Percent composition of avian species recorded from visual or audible observations in each plant community.

Common Name	Scientific Name	Cypress Strand	Pine Flatwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
American Coot	*Fulica americana*	0.00	0.00	0.00	0.22	0.00	0.00
American Crow	*Corvus brachyrhynchos*	0.16	0.35	0.24	0.13	0.51	0.17
American Kestrel	*Falco sparverius*	0.00	0.00	0.12	0.00	0.17	0.00
American Robin	*Turdus migratorius*	0.00	0.00	0.00	0.00	1.19	2.75
American Woodcock	*Scolopax minor*	0.00	0.00	0.00	0.04	0.00	0.00
Anhinga	*Anhinga anhinga*	0.00	0.00	0.00	0.54	1.19	2.41
Bald Eagle	*Haliaeetus leucocephalus*	0.00	0.00	0.12	0.00	0.00	0.00
Barn Swallow	*Hirundo rustica*	0.00	0.00	0.00	0.04	1.53	1.20
Barred Owl	*Strix varia*	0.16	0.12	0.24	0.00	0.00	0.00
Belted Kingfisher	*Ceryle alcyon*	0.16	0.00	0.00	0.13	2.38	4.47
Black Vulture	*Coragyps atratus*	3.50	4.31	4.12	0.81	1.70	2.06
Black-And-White Warbler	*Mniotilta varia*	0.00	0.00	0.94	0.09	0.00	0.17
Black-Crowned Night-Heron	*Nycticorax nycticorax*	0.00	0.00	0.00	0.00	0.68	2.41
Black-Throated Blue Warbler	*Dendroica caerulescens*	0.00	0.00	0.24	0.00	0.00	0.00
Black-Whiskered Vireo	*Vireo altiloquus*	0.16	0.00	0.00	0.04	0.00	0.00
Blue Headed Vireo	*Vireo solitarius*	0.00	0.00	0.24	0.00	0.00	0.17
Blue-Gray Gnatcatcher	*Polioptila caerulea*	9.54	4.19	12.82	3.15	1.36	0.52
Blue-Winged Teal	*Anas discors*	0.00	0.00	0.00	25.36	0.00	17.18
Boat-Tailed Grackle	*Quiscalus major*	0.16	0.12	4.47	1.84	0.00	0.17
Brown Pelican	*Pelecanus occidentalis*	0.00	0.00	0.00	0.00	0.17	0.52
Brown Thrasher	*Toxostoma rufum*	0.16	0.12	0.24	0.04	0.00	0.00
Brown-Headed Nuthatch	*Sitta pusilla*	0.00	0.23	0.00	0.00	0.00	0.00
Carolina Wren	*Thryothorus ludovicianus*	3.34	5.82	7.18	2.65	2.04	0.69
Cattle Egret	*Bubulcus ibis*	0.00	0.00	0.00	0.49	0.00	0.00
Cedar Waxwing	*Bombycilla cedrorum*	0.64	11.06	0.00	0.00	0.00	0.00
Chipping Sparrow	*Spizella passerina*	0.00	0.00	0.12	0.00	0.00	0.00
Chuck-Will's-Widow	*Caprimulgus carolinensis*	0.16	0.12	0.24	0.00	0.00	0.00
Clapper Rail	*Rallus longirostris*	0.32	0.00	0.00	0.00	0.00	0.00
Common Grackle	*Quiscalus quiscula*	0.00	0.12	0.12	4.63	0.00	0.00
Common Ground-Dove	*Columbina passerine*	0.79	2.10	3.65	0.63	3.23	4.47
Common Moorhen	*Gallinula chloropus*	0.00	0.00	0.00	0.36	0.00	0.17
Common Nighthawk	*Chordeiles minor*	0.64	0.47	0.12	0.13	0.00	0.00
Common Snipe	*Gallinago gallinago*	0.00	0.00	0.00	0.81	0.00	0.00
Common Yellowthroat	*Geothlypis trichas*	0.64	0.81	0.94	1.71	9.86	2.75
Double-Crested Cormorant	*Phalacrocorax auritus*	0.00	0.00	0.00	0.04	1.36	4.98
Downy Woodpecker	*Picoides pubescens*	1.27	2.10	0.12	0.09	0.00	0.00

Table 22 continued. Percent composition of avian species recorded from visual or audible observations in each plant community.

Common Name	Scientific Name	Cypress Strand	Pine Flatwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
Eastern Meadowlark	*Sturnella magna*	0.00	0.93	0.12	2.92	0.00	0.00
Eastern Phoebe	*Sayornis phoebe*	0.16	0.00	0.00	0.54	0.00	0.00
Eastern Towhee	*Pipilo erythrophthalmus*	0.79	0.35	0.35	0.45	0.00	0.00
Fish Crow	*Corvus ossifragus*	0.48	0.00	0.24	0.09	0.85	0.86
Gray Catbird	*Dumetella carolinensis*	3.02	3.26	2.94	1.35	5.61	2.06
Gray Kingbird	*Tyrannus dominicensis*	0.00	0.00	0.00	0.09	0.17	0.00
Great Blue Heron	*Ardea herodias*	0.16	0.00	0.00	0.27	3.06	1.89
Great Crested Flycatcher	*Myiarchus crinitus*	1.75	2.79	1.41	0.90	0.00	0.00
Great Egret	*Ardea alba*	0.00	0.00	0.00	0.45	3.57	2.92
Green Heron	*Butorides virescens*	0.00	0.00	0.00	0.22	0.34	0.69
Hairy Woodpecker	*Picoides villosus*	0.64	0.47	0.00	0.00	0.00	0.00
House Sparrow	*Passer domesticus*	0.00	0.00	0.24	0.00	0.00	0.00
House Wren	*Troglodytes aedon*	0.32	0.00	0.00	0.04	0.00	0.00
Killdeer	*Charadrius vociferous*	0.00	0.00	0.00	0.04	2.89	1.72
Little Blue Heron	*Egretta caerulea*	0.00	0.00	0.00	1.03	1.70	4.64
Loggerhead Shrike	*Lanius ludovicianus*	0.00	0.00	0.00	0.09	0.00	0.00
Mottled Duck	*Anas fulvigula*	0.00	0.00	0.00	0.00	0.00	0.17
Mourning Dove	*Zenaida macroura*	3.97	3.26	1.41	2.02	1.19	3.78
Northern Bobwhite	*Colinus virginiacus*	0.16	0.70	1.29	0.36	0.00	0.00
Northern Cardinal	*Cardinalis cardinalis*	17.81	15.72	21.65	7.01	9.69	5.33
Northern Harrier	*Circus cyaneus*	0.00	0.00	0.00	0.04	0.00	0.00
Northern Mockingbird	*Mimus polyglottos*	0.79	1.16	0.47	0.67	0.51	0.00
Osprey	*Pandion haliaetus*	0.00	0.00	0.24	0.04	0.51	0.69
Palm Warbler	*Dendroica palmarum*	0.00	2.56	0.59	2.47	0.85	0.52
Pied-Billed Grebe	*Podilymbus podiceps*	0.00	0.00	0.00	0.04	0.00	0.34
Pileated Woodpecker	*Dryocopus pileatus*	1.91	1.16	1.53	0.36	0.00	0.00
Pine Warbler	*Dendroica pinus*	3.34	8.15	1.88	0.90	2.04	0.00
Prairie Warbler	*Dendroica discolor*	0.00	0.12	0.00	0.00	0.17	0.00
Purple Martin	*Progne subis*	0.00	0.35	0.35	0.49	0.00	0.00
Red-Bellied Woodpecker	*Melanerpes carolinus*	11.29	11.53	8.12	1.84	4.08	0.69
Red-Cockaded Woodpecker	*Picoides borealis*	0.00	0.35	0.24	0.00	0.00	0.00
Red-Headed Woodpecker	*Melanerpes erythrocephalus*	0.00	0.00	0.12	0.04	0.51	0.00
Red-Shouldered Hawk	*Buteo lineatus*	2.86	1.63	2.71	0.99	2.21	0.69
Red-Tailed Hawk	*Buteo jamaicensis*	0.00	0.00	0.00	0.04	0.00	0.17
Red-Winged Blackbird	*Agelaius phoeniceus*	0.64	0.81	0.00	18.75	9.01	3.78
Ruby-Crowned Kinglet	*Regulus calendula*	0.64	0.00	0.00	0.00	0.00	0.00
Sharp-Shinned Hawk	*Accipiter striatus*	0.00	0.12	0.00	0.04	0.00	0.00
Short-Tailed Hawk	*Buteo brachyurus*	0.00	0.00	0.00	0.04	0.00	0.00
Snowy Egret	*Egretta thula*	0.16	0.00	0.00	0.54	0.34	2.41
Song Sparrow	*Melospiza melodia*	0.00	0.00	0.00	0.09	0.00	0.00
Swallow-Tailed Kite	*Elanoides forficatus*	1.43	0.93	1.41	1.80	0.17	0.34
Swamp Sparrow	*Melospiza georgiana*	0.00	0.00	0.00	0.04	0.00	0.00
Tree Swallow	*Tachycineta bicolor*	1.91	2.68	1.65	2.83	2.04	0.00
Tricolored Heron	*Egretta tricolor*	0.16	0.00	0.00	0.18	1.02	3.61
Tufted Titmouse	*Baeolophus bicolor*	1.91	0.35	1.53	0.09	0.00	0.00
Turkey Vulture	*Cathartes aura*	0.32	0.35	0.12	0.04	0.17	0.86
White Ibis	*Eudocimus albus*	0.00	0.00	0.00	2.88	7.31	3.44

Table 22 continued. Percent composition of avian species recorded from visual or audible observations in each plant community.

Common Name	Scientific Name	Cypress Strand	Pine Flatwood	Hardwood Hammock	Freshwater Wetland	Transitional Wetland	Access Road
White-Eyed Vireo	*Vireo griseus*	10.17	6.40	10.71	1.93	8.50	6.01
Wild Turkey	*Meleagris gallopavo*	0.00	0.00	0.12	0.00	0.00	0.00
Wood Duck	*Aix sponsa*	0.00	0.00	0.00	0.09	0.00	0.00
Wood Stork	*Mycteria amaricana*	0.16	0.00	0.00	0.36	1.19	0.52
Yellow-Bellied Sapsucker	*Sphyrapicus varius*	0.00	0.12	0.00	0.00	0.17	0.00
Yellow-Rumped Warbler	*Dendroica coronata*	7.95	0.00	0.00	0.00	2.04	4.47
Yellow-Shafted Flicker	*Colaptes auratus*	0.16	0.12	0.00	0.00	0.00	0.00
Yellow-Throated Warbler	*Dendroica dominica*	0.00	0.70	0.00	0.00	0.00	0.00

Amphibians

Seven audible anuran surveys conducted in 2004 throughout the Picayune Strand Restoration Project area (**Figure 21**) (Addison et al., 2006). The only sites surveyed that have permit reporting requirements are those east of Merritt Canal (Sites A9–A14); therefore only data from these sites are reported in this baseline report.

Nine species of frogs and toads were documented at these sites (**Table 23**). The eastern narrowmouth toad (*Gastrophryne carolinensis*), the green tree frog (*Hyla cinerea*), and the non-indigenous greenhouse frog (*Eleutherodactylus planirostris*) were recorded at all survey sites. The non-indigenous Cuban tree frog (*Osteopilus septentrionalis*) and the pig frog (*Rana grylio*) were recorded at five of the six sites. The southern toad (*Bufo terrestris*) was recorded at half of the sites. The Florida cricket frog (*Acris gryllus dorsalis*), oak toad (*Bufo quercicus*), and squirrel treefrog (*Hyla squirella*) were only recorded at Site A14.

In terms of summed call intensity, the green treefrog was the most abundant at four out of seven sites, equaled call intensity with the oak toad at one site, and was second most abundant at the remaining site (**Table 23**). The non-indigenous greenhouse frog was the most abundant at one site and, along with other species, was the second most abundant at three sites. The pig frog was second most abundant at two sites. The non-indigenous Cuban tree frog (*Osteopilus septentrionalis*) and the native southern toad were each second most abundant at one site, following the greenhouse frog.

Table 23. Percent composition for amphibian species recorded east of Merritt Canal.

Common Name (* denotes non-indigenous species)	Scientific Name	Percent Composition of Amphibians					
		A9	A10	A11	A12	A13	A14
Cuban treefrog *	*Osteopilus septentrionalis*	0.00	14.29	18.60	19.05	7.69	12.50
Eastern narrowmouth toad	*Gastrophryne carolinensis*	15.38	9.52	16.28	14.29	15.38	9.38
Florida cricket frog	*Acris gryllus dorsalis*	0.00	0.00	0.00	0.00	0.00	3.13
Green treefrog	*Hyla cinerea*	23.08	38.10	32.56	38.10	30.77	21.88
Greenhouse frog *	*Eleutherodactylus planirostris*	30.77	19.05	2.33	19.05	23.08	12.50
Oak toad	*Bufo quercicus*	0.00	0.00	0.00	0.00	0.00	21.88
Pig frog	*Rana grylio*	15.38	14.29	23.26	9.52	0.00	15.63
Southern toad	*Bufo terrestris*	15.38	4.76	0.00	0.00	23.08	0.00
Squirrel treefrog	*Hyla squirella*	0.00	0.00	6.98	0.00	0.00	3.13

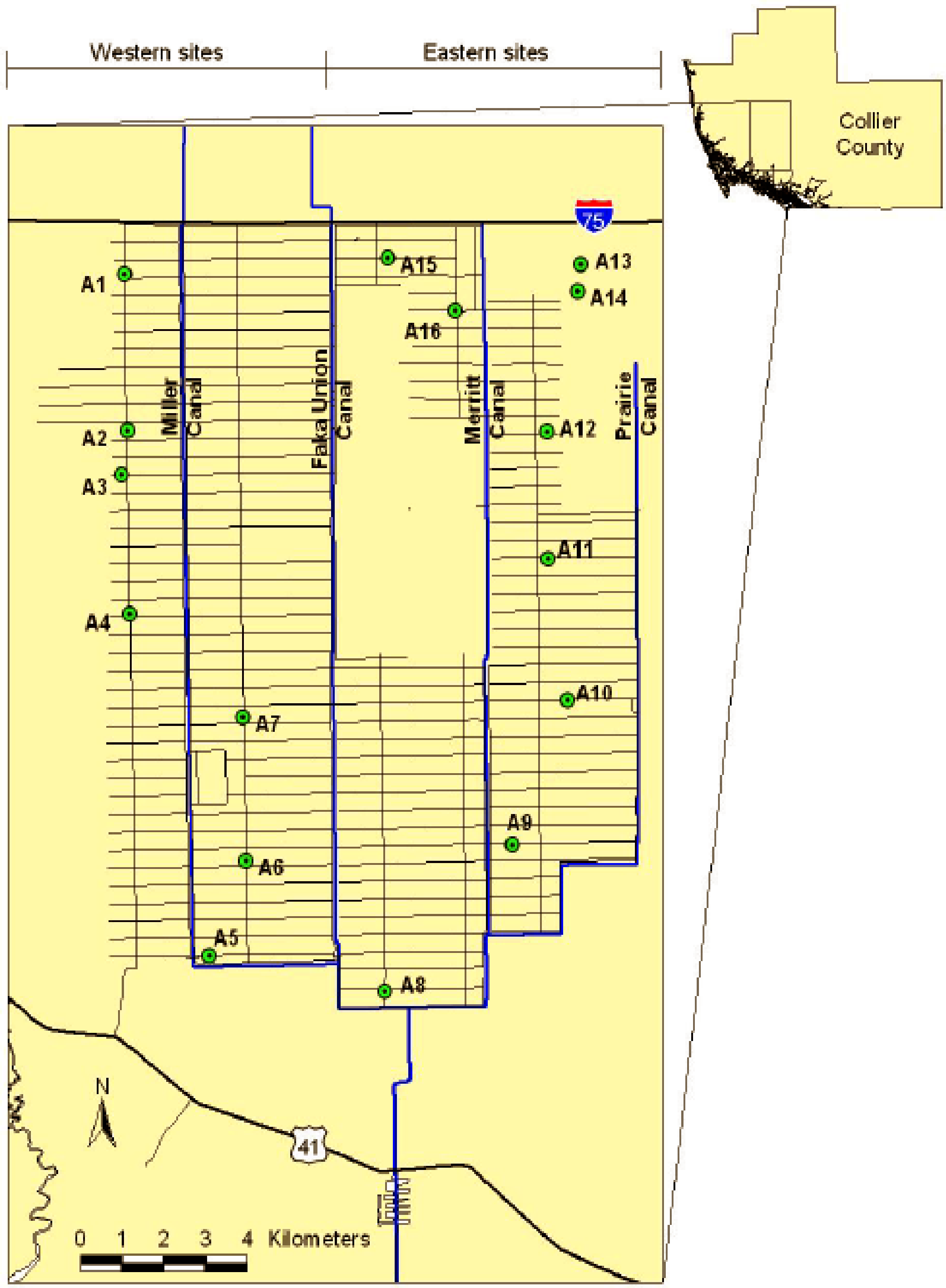

Figure 21. Location of audible anuran survey sites. Only sites east of Merritt Canal are presented in this report.

Threatened and Endangered Species

Baseline data was collected for three threatened and endangered species: wood stork, Florida panther, and West Indian manatee. The wood stork is discussed above in the *Birds* section. Baseline data has not yet been analyzed for the Florida panther or West Indian manatee.

Incidental Wildlife Observations

Incidental wildlife observations were recorded during sampling events (Addison et al., 2006). A total of 98 species of animals (60 avian, 11 amphibian, 11 mammalian, and 16 reptilian species) were recorded from incidental wildlife observations at sample sites (**Table 24**). These data were useful in recording the occurrence of birds and other animals, but may not be applicable in documenting faunal changes due to hydrologic restoration.

Table 24. Incidental wildlife observed in Picayune Strand 2001–2004.

Common Name	Scientific Name	Common Name	Scientific Name
AVES			
American Bittern	*Botaurus lentiginosus*	Killdeer	*Charadrius vociferous*
American Crow	*Corvus brachyrhynchos*	Least Bittern	*Ixobrychus exilis*
American Kestrel	*Falco sparverius*	Little Blue Heron	*Egretta caerulea*
Anhinga	*Anhinga anhinga*	Mourning Dove	*Zenaida macroura*
Barred Owl	*Strix varia*	Northern Bobwhite	*Colinus virginiacus*
Belted Kingfisher	*Ceryle alcyon*	Northern Cardinal	*Cardinalis cardinalis*
Black Vulture	*Coragyps atratus*	Northern Harrier	*Circus cyaneus*
Black-Necked Stilt	*Himantopus mexicanus*	Northern Mockingbird	*Mimus polyglottos*
Blue Jay	*Cyanocitta cristata*	Osprey	*Pandion haliaetus*
Blue-Gray Gnatcatcher	*Polioptila caerulea*	Ovenbird	*Seiurus aurocapillus*
Boat-Tailed Grackle	*Quiscalus major*	Palm Warbler	*Dendroica palmarum*
Carolina Wren	*Thryothorus ludovicianus*	Pied-Billed Grebe	*Podilymbus podiceps*
Cattle Egret	*Bubulcus ibis*	Pileated Woodpecker	*Dryocopus pileatus*
Chuck-Will's-Widow	*Caprimulgus carolinensis*	Purple Gallinule	*Porphyrula martinica*
Common Grackle	*Quiscalus quiscula*	Purple Martin	*Progne subis*
Common Ground-Dove	*Columbina passerine*	Red-Bellied Woodpecker	*Melanerpes carolinus*
Common Moorhen	*Gallinula chloropus*	Red-Shouldered Hawk	*Buteo lineatus*
Common Nighthawk	*Chordeiles minor*	Red-Winged Blackbird	*Agelaius phoeniceus*
Common Yellowthroat	*Geothlypis trichas*	Roseate Spoonbill	*Ajaia ajaja*
Downy Woodpecker	*Picoides pubescens*	Sandhill Crane	*Grus canadensis*
Eastern Meadowlark	*Sturnella magna*	Snowy Egret	*Egretta thula*
Eastern Phoebe	*Sayornis phoebe*	Swallow-Tailed Kite	*Elanoides forficatus*
Glossy Ibis	*Plegadis falcinellus*	Tree Swallow	*Tachycineta bicolor*
Gray Catbird	*Dumetella carolinensis*	Tufted Titmouse	*Baeolophus bicolor*
Great Blue Heron	*Ardea herodias*	Turkey Vulture	*Cathartes aura*
Great Crested Flycatcher	*Myiarchus crinitus*	White Ibis	*Eudocimus albus*
Great Egret	*Ardea alba*	White-Eyed Vireo	*Vireo griseus*
Great Horned Owl	*Bubo virginianus*	Wild Turkey	*Meleagris gallopavo*
Green Heron	*Butorides virescens*	Wood Stork	*Mycteria amaricana*
Hairy Woodpecker	*Picoides villosus*	Yellow-Billed Cuckoo	*Coccyzus americanus*

Table 24 continued. Incidental wildlife observed in Picayune Strand 2001–2004.

Common Name	Scientific Name	Common Name	Scientific Name
AMPHIBIA			
Cuban Treefrog*	*Osteopilus septentrionalis*	Oak Toad	*Bufo quercicus*
Eastern Narrowmouth Toad	*Gastrophryne carolinensis*	Pig Frog	*Rana grylio*
Florida Frog Cricket	*Acris gryllus dorsalis*	Pinewoods Treefrog	*Hyla femoralis*
Green Tree frog	*Hyla cinerea*	Southern Leopard Frog	*Rana utricularia*
Greenhouse Frog*	*Eleutherodactylus planirostris*	Southern Toad	*Bufo terrestris*
Little grass Frog	*Pseudacris ocularis*		
MAMMALIA			
Armadillo	*Dasypus novemcinctus*	Feral Pig*	*Sus scrofa*
Bobcat	*Lynx rufus*	Florida Black Bear	*Ursus americanus*
Cotton Mouse	*Peromyscus gossypinus*	Marsh Rabbit	*Sylvilagus palustris*
Eastern Gray Squirrel	*Sciurus carolinensis*	Raccoon	*Procyon lotor*
Eastern Spotted Skunk	*Spilogale putorius*	White-Tailed Deer	*Odocoileus virginianus*
Evening Bat	*Nycticeius humeralis*		
REPTILIA			
American Alligator	*Alligator mississippiensis*	Florida Red-Bellied Turtle	*Pseudemys nelsoni*
Black Racer	*Coluber constrictor priapus*	Florida Softshell Turtle	*Trionyx ferox*
Brown Anole*	*Anolis sagrei sagrei*	Green Anole	*Anolis carolinensis*
Dusky Pygmy Rattlesnake	*Sistrurus miliarius barbouri*	Peninsula Ribbon Snake	*Thamnophis sauritus sackenii*
Eastern Coral Snake	*Micrurus fulvius*	Six-Lined Racerunner	*Cnemidophorus sexlineatus*
Florida Banded Water Snake	*Nerodia fasciata pictiventris*	Southeastern Five-Lined Skink	*Eumeces inexpectatus*
Florida Cottonmouth	*Agkistrodon piscivorus conanti*	Southern Ringneck Snake	*Diadophis punctatus punctatus*
Florida Kingsnake	*Lampropeltis getula*	Yellow Rat Snake	*Elaphe obsoleta quadrivittata*

ESTUARINE RESOURCES

Unlike most of South Florida, Collier County's estuarine areas remained virtually unaltered until the 1960s when severe pressure for residential and agricultural development occurred. Canals within the project area are part of the Faka Union Canal system. The Faka Union Canal system degrades marine habitat in Faka Union Bay by sending it too much fresh water too fast. The high concentration of fresh water lowers salinity as it discharges into Faka Union Bay. The canal system also affects the area of optimum-salinity habitat in nearby bays of the Ten Thousand Islands region (**Figure 4**) by diverting to Faka Union Bay fresh water that would otherwise have entered these other systems as surface or groundwater flows. These alterations in the timing and quantity of fresh water flowing into the estuaries has an impact on natural biodiversity by affecting food availability, predation pressure, reproductive success, and most likely has caused chronic and acute stress to these fishes and turtles (USACE and SFWMD, 2004). Estuaries within the Ten Thousand Islands region include the following river/bay systems, from west to east (**Figure 4**):

- Royal Palm Creek/Palm Bay
- Blackwater River/Blackwater Bay
- Whitney River/Buttonwood Bay
- Pumpkin River/Pumpkin Bay

- Wood River, Little Wood River and Faka Union Canal/Faka Union Bay
- Fakahatchee Bay

The alteration in natural salinity conditions has caused a reduction in oyster reef and submerged aquatic vegetation and displacement of mangrove zones. These conditions have caused prolonged salinity stresses and have eliminated or displaced a high proportion of the benthic, midwater, and fish plankton communities from the bay. Such suppressed plankton development has resulted in very low relative abundance of midwater fish and also a considerable drop in shellfish harvest levels. The impact on commercial and recreational fisheries has been significant. At the extreme east and receiving drainage primarily from the Fakahatchee Strand State Forest is Fakahatchee Bay, which is considered relatively unchanged from its historic condition and is used as a basis for comparison.

Benthic Habitat Mapping

Benthic habitat mapping has been conducted in Faka Union Bay, Fakahatchee Bay and Pumpkin Bay (**Figure 22**). These studies determined the distribution of potential seagrass and oyster habitat. They provide a baseline data set for comparison with future change that may result from watershed restoration efforts or other future factors such as sea-level rise and climate change. The knowledge of benthic habitat distribution patterns will also assist ongoing investigations of species diversity and fish habitat suitability. Only Pumpkin Bay baseline results are reported below. Faka Union and Fakahatchee Bay baseline information will be reported in a future update to SFERs.

PUMPKIN BAY

The benthic mapping results in Pumpkin Bay reveal a very shallow estuary with limited submerged aquatic vegetation (SAV) (**Figure 22**) (Locker and Jarret, 2006). A few clusters of SAV might reach 50 percent cover. In Fakahatchee Bay, it was found that water depths of about 30 cm and greater corresponded to little or no SAV. This same relationship is hinted at in central Pumpkin Bay where a small area of deeper water is barren of SAV. Oyster bed characteristics are similar to other bays except that the lower Pumpkin River seems to host much less oyster accumulation.

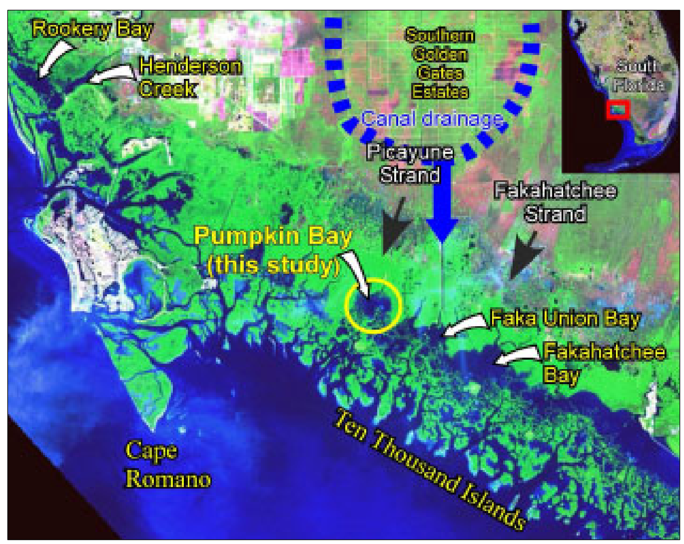

Figure 22. Location of benthic mapping studies.

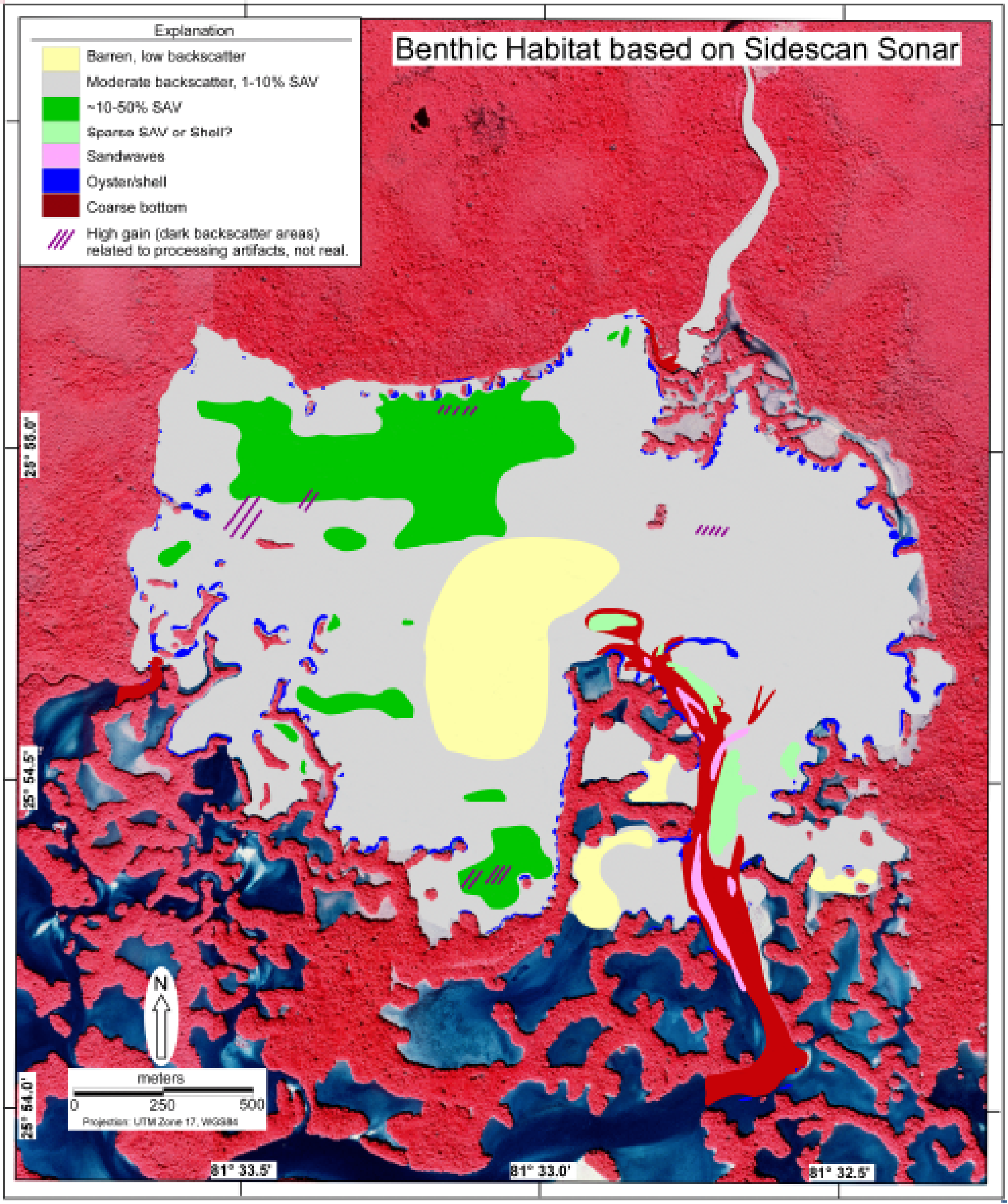

Figure 22. Benthic habitat map of Pumpkin Bay.

Pumpkin Bay shares similarities with both Faka Union Bay and Fakahatchee Bay (Locker and Jarret, 2006). Eastern Pumpkin Bay is sandy and Pumpkin River is accumulating mud, similar to the Fakahatchee Bay/River system. However, western Pumpkin Bay holds a mud layer similar to that found in Faka Union Bay, and may represent input of mud due to Southern Golden Glade Estates dredging activities in the 1960s. The pathways for such mud input is unclear, as it would seen to involve more surficial sheetflow rather than the direct input through drainage canals. Still, eastern Pumpkin Bay remains relatively clear of mud suggesting limited input that did not affect the entire bay.

If a comparison is made between Pumpkin Bay (impacted by reduced fresh water inflow) and Fakahatchee Bay (considered more natural), it appears that SAV is underdeveloped in Pumpkin Bay (Locker and Jarret, 2006). Increased salinity would be a possible cause, and much of the bay, especially the eastern bay area, has water depths suitable for seagrasses. With improved estuarine salinity patterns, expansion of seagrasses into the eastern bay area and a patchy development of denser SAV distribution overall should result.

WATER QUALITY

Water quality samples are collected at surface water and groundwater sites within the Picayune Strand Restoration Project area (**Figures 23** and **24**). Surface water collection sites required for compliance with the Prairie Canal filling permit are provided in **Figure 25**. Baseline water quality data is still being analyzed and more detailed information will be provided in an updated baseline report in a future SFER. Water quality monitoring sites that will be used for long-term assessment of the project are presented in **Figure 26**. Three sites (MI1, MI2 and MI3) have been added within the mangrove interface region of the estuary.

Physical and chemical conditions of surface waters in the study area's Class III freshwater bodies generally meet state water quality standards (USACE and SFWMD, 2004). Groundwater quality is also within potable drinking water standards. Faka Union Canal and estuaries receiving flow from the Faka Union basin meet standards for dissolved oxygen, fecal coliform, turbidity and chlorophyll. However, receiving estuaries from the Faka Union Basin are listed as impaired water bodies due to the concentrations of bacteria found in shellfish.

Data from monitoring sites located at the inflows of the project area along Faka Union and Merritt Canals indicate mean phosphorus concentrations of 15 parts per billion (ppb) (USACE and SFWMD, 2004). The estuarine sampling site located at the outfall of the Faka Union Canal weir averaged 20 parts per billion (ppb). An outlying concentration of 150 ppb was also obtained at the estuarine site. Indications of algal blooms have not been found, but downstream estuarine systems are classified as extremely oligotrophic; impairments from sustained high levels of nutrients would be a concern.

Total coliform have been detected in increasing concentrations at upland watershed monitoring sites associated with the Faka Union Canal (USACE and SFWMD, 2004). This may be due in part to an increase in the number of septic systems as new houses are being built in the Northern Golden Gate Estates. Active fields to the west (Belle Mead) and fallow fields along the western boundary of the project area have been identified as sources for high levels of residual pesticides in soil samples. The pesticide chlordane was found in soils collected at the ends of accessible roads within western portion of the project area, indicating that illegal dumping has occurred. Reflooding of these farmlands for hydrologic restoration could lead to mobilization of these pollutants and result in food web contamination in the reflooded marsh area and the downstream estuaries.

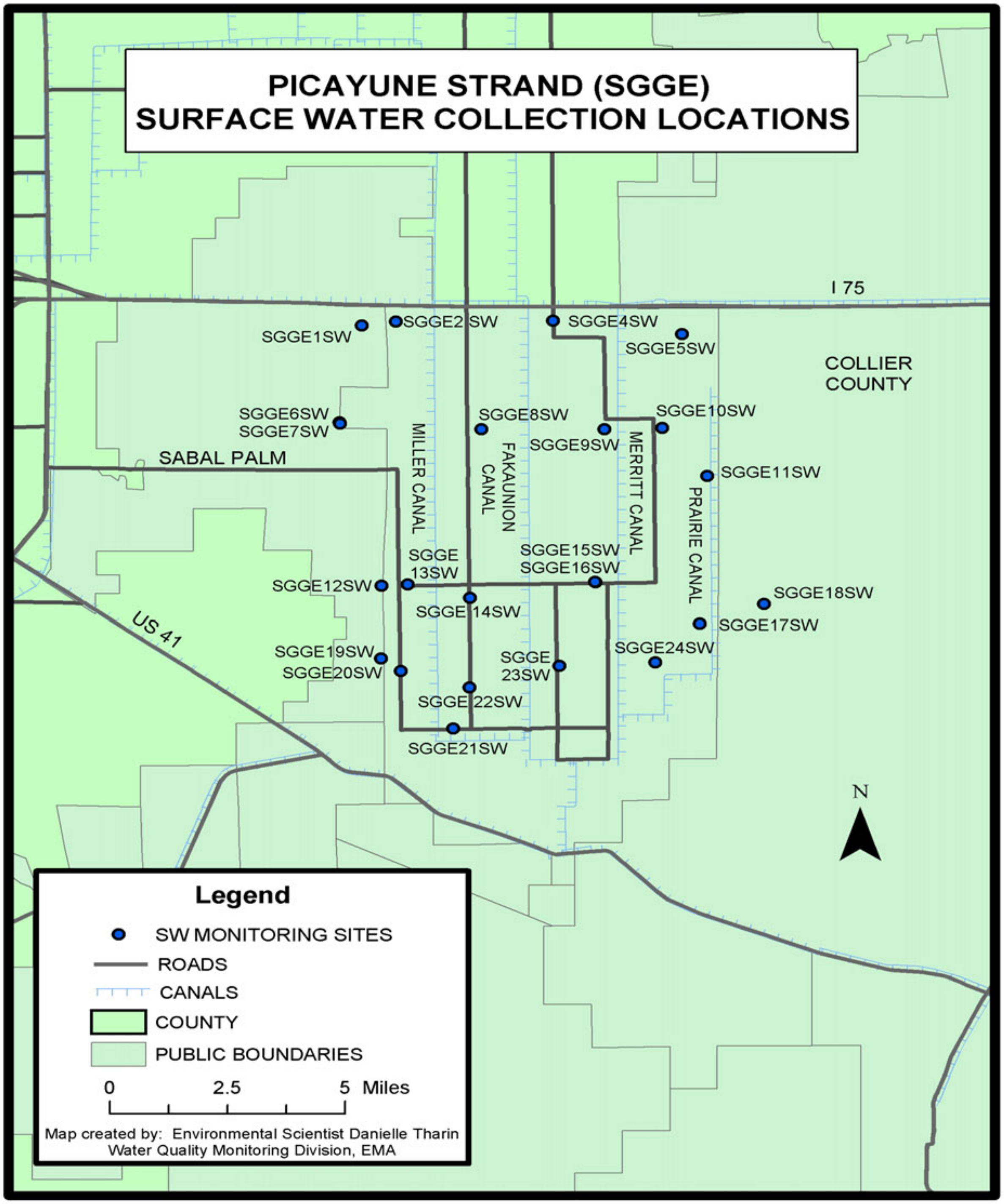

Figure 23. Baseline surface water collection locations for the Picayune Strand Restoration Project.

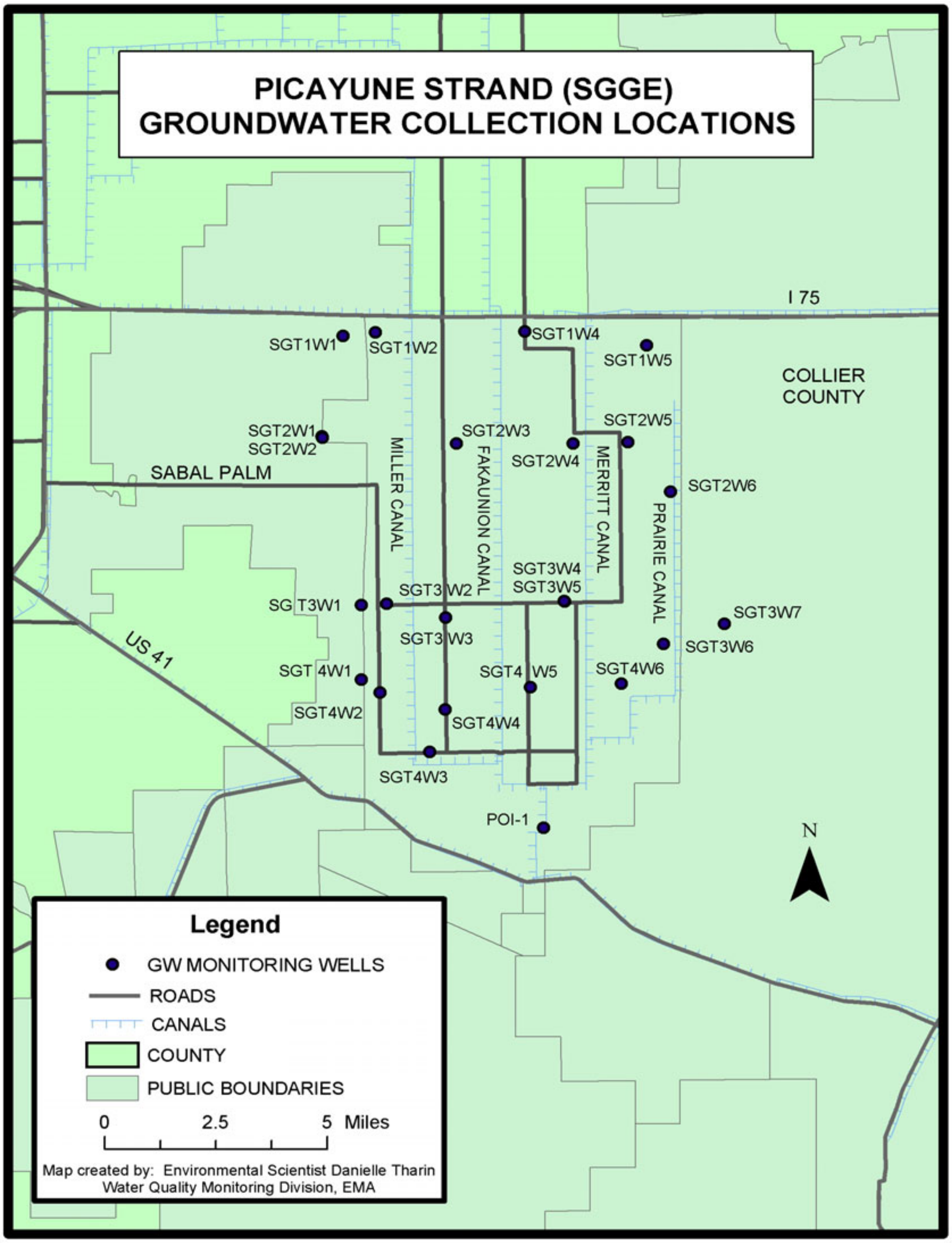

Figure 24. Baseline groundwater collection locations for the Picayune Strand Restoration Project.

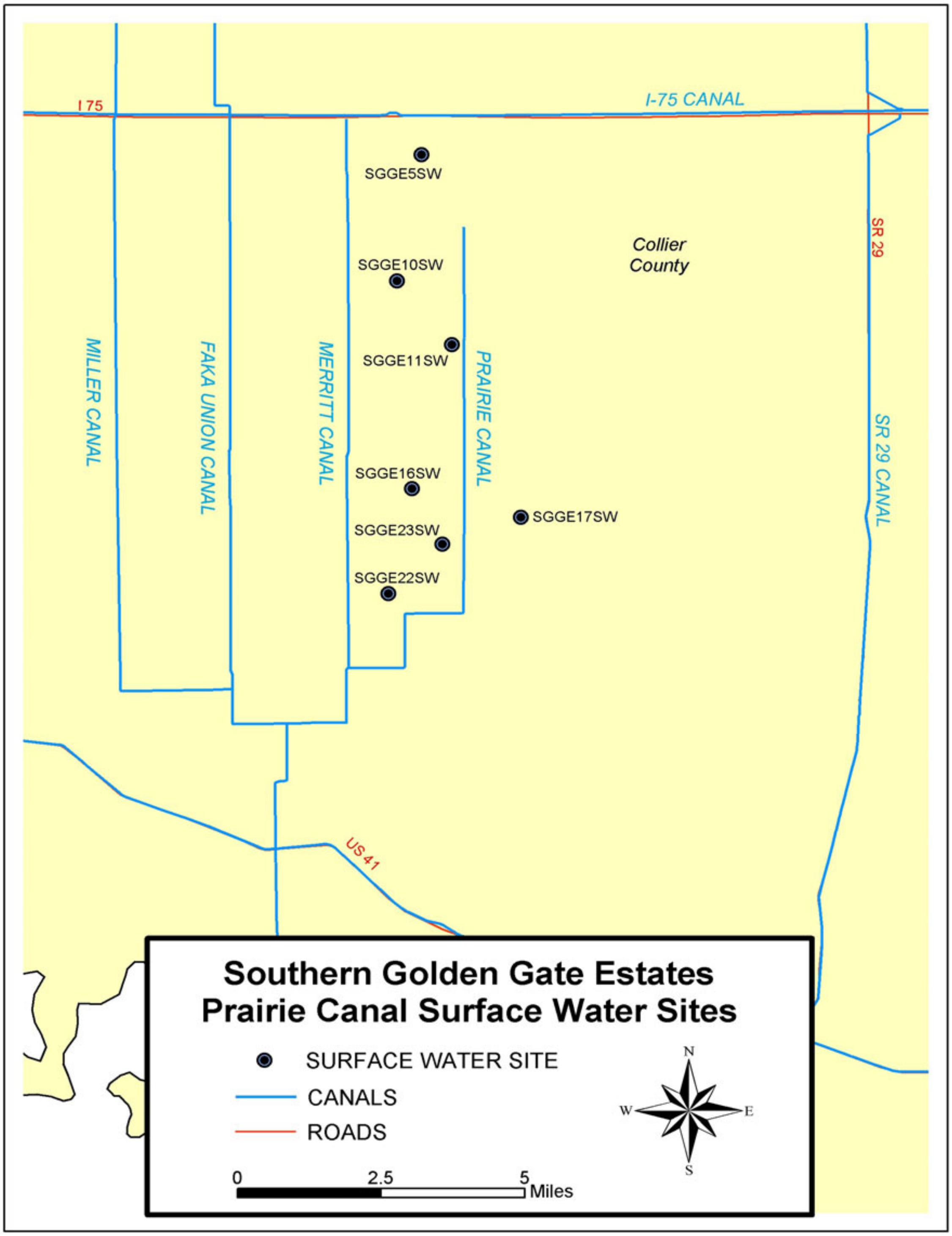

Figure 25. Prairie Canal surface water compliance sites.

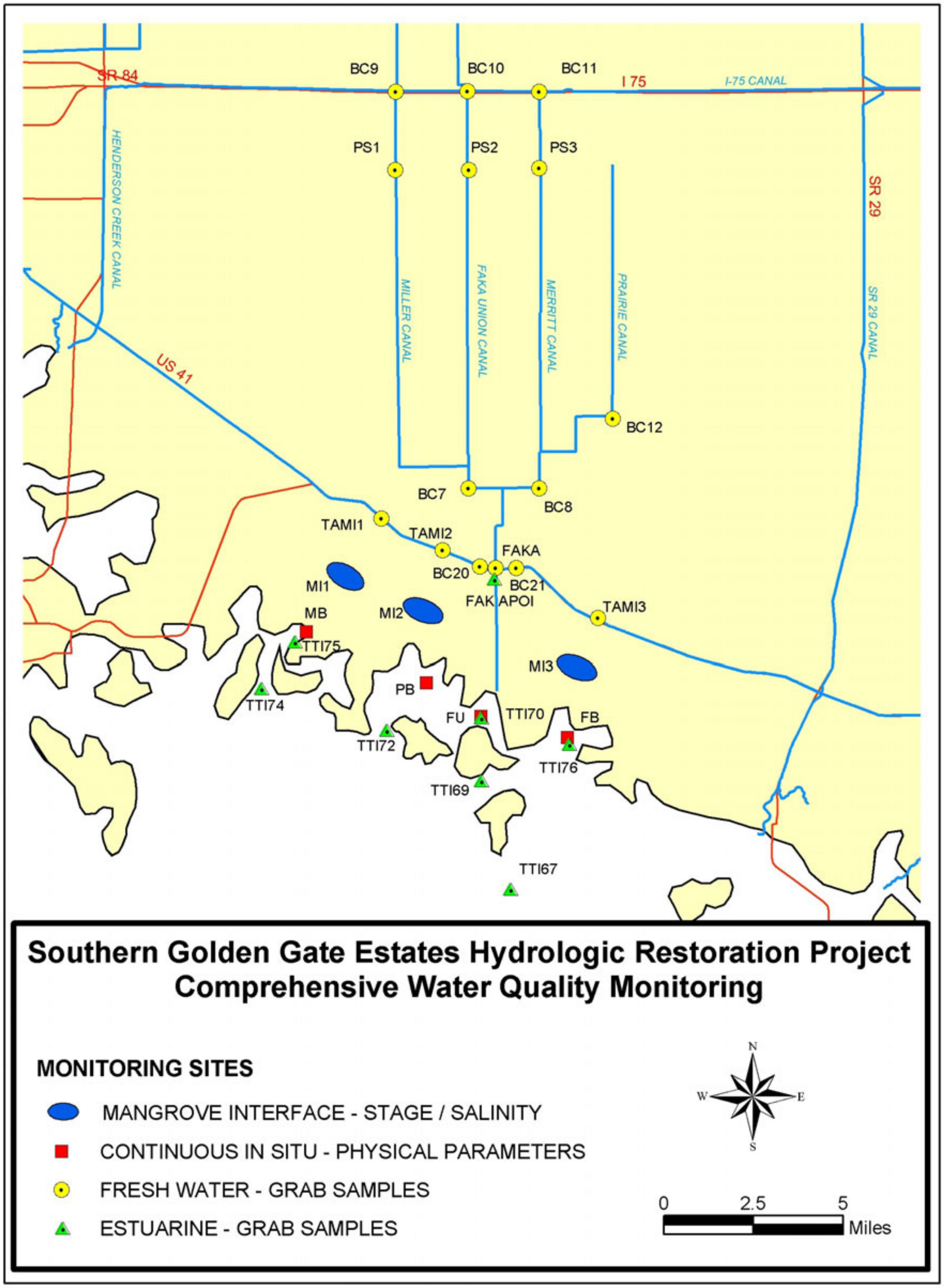

Figure 26. Long-term assessment water quality monitoring sites for the Picayune Strand Restoration Project.

CURRENT STATUS

PROJECT STATUS

Construction has begun. Over 160 structures and/or developed properties have been demolished. This process included removing of 7,660 cubic yards of miscellaneous demolition material, 514 tons of scrap metal, 1,345 tons of concrete, and 169 tons of old tires at cost of $1.47 million. Seven miles of Prairie Canal, the easternmost canal along the border shared with Fakahatchee Strand Preserve State Park (**Figure 1**), has been filled and excess spoils, a weir structure, and a bridge have been improved. Prairie Canal prior to filling, shortly after is was filled, and after plants began growing on filled canals are presented in **Figures 27**, **28** and **29**, respectively. All roads east of Merritt Canal (**Figure 1**) have been removed (**Figure 30**). This required returning approximately 65 miles of roadway to grade, filling adjacent ditches, and removing spoil piles (**Figure 31**). Remediation was accomplished on approximately 28 acres of contaminated soils on the western boundary. These construction activities were completed at an approximate cost of $7.58 million. Additional road removal and canal plugging (**Figure 3**) still need to be performed. Pump station design is being finalized and design of other features has begun.

Figure 27. Prairie Canal prior to filling.

Figure 28. Prairie Canal after filling was completed.

Figure 29. Plants migrating into filled in canal.

Figure 30. Road removal.

Figure 31. Spoil from road removal.

MONITORING

Two of the permits that authorized now-completed construction have detailed monitoring requirements. The first permit, 2000308480 (IP-HWB), authorized backfilling of Prairie Canal and restoring roadways to natural grade. The other permit, SAJ-2005-6598 (IP-TRW), authorized the placement of fill associated with degrading additional roads. Both permits require monitoring and reporting prior to construction (baseline), during construction, and following construction. The intent of the monitoring is to determine if the anticipated hydrologic, vegetative, wildlife and estuarine benefits of the project are being achieved, and to support the adaptive management process over the 50-year life of the project. The restoration plan proposes to monitor ecosystem responses to the changes in hydroperiod depth and duration and changes in flows to the estuaries. The purpose of this appendix is to report the system's baseline condition and response to changes during and following construction.

The monitoring currently required is quite extensive. This level of monitoring is not necessary to track restoration success nor is it sustainable. Modifications to permit monitoring requirements are currently being discussed with the issuing authority. Authorization of the Comprehensive Everglades Restoration Plan (CERP) included the directive to utilize adaptive management when planning, implementing, and monitoring projects. Fine-tuning monitoring and reporting as construction and restoration proceeds is an integral part of the directive to utilize adaptive management as a key element of CERP's goals.

HYDROLOGY

The District is already seeing beginnings of hydrologic restoration from the filling of Prairie Canal during winter 2006–2007. Water levels are higher near the filled Prairie Canal than near the unfilled Merritt Canal along both Transect 2 (**Figure 32**) and Transect 3 (**Figure 33**).

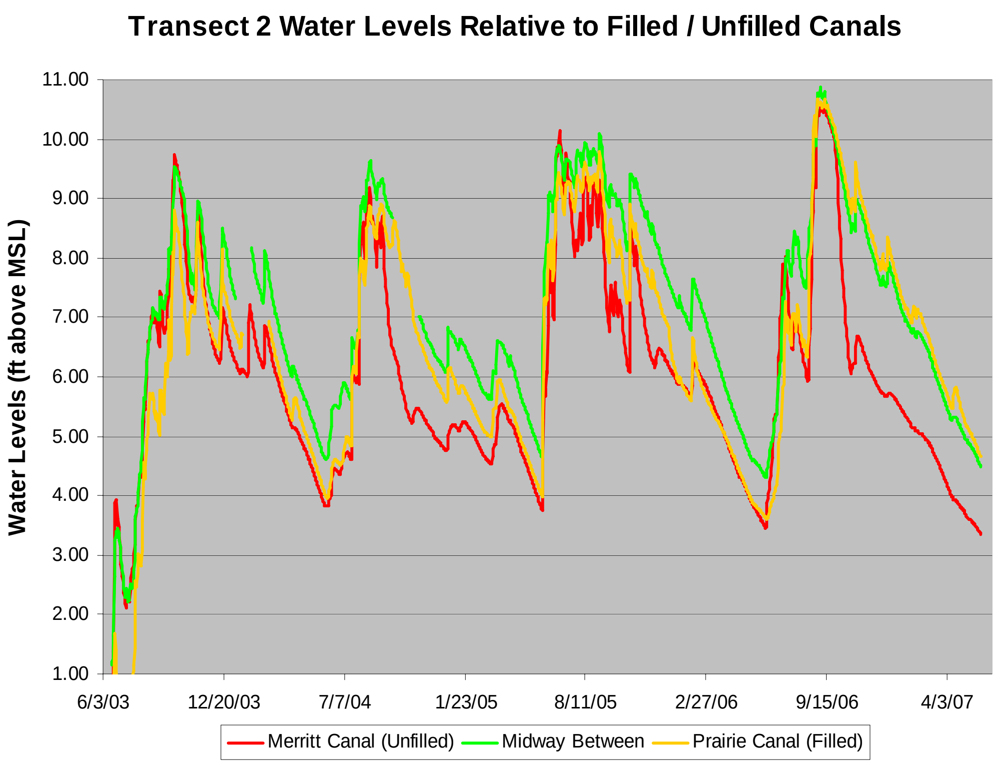

Figure 32. Transect 2 (see **Figure 12**) water levels relative to filled and unfilled canals.

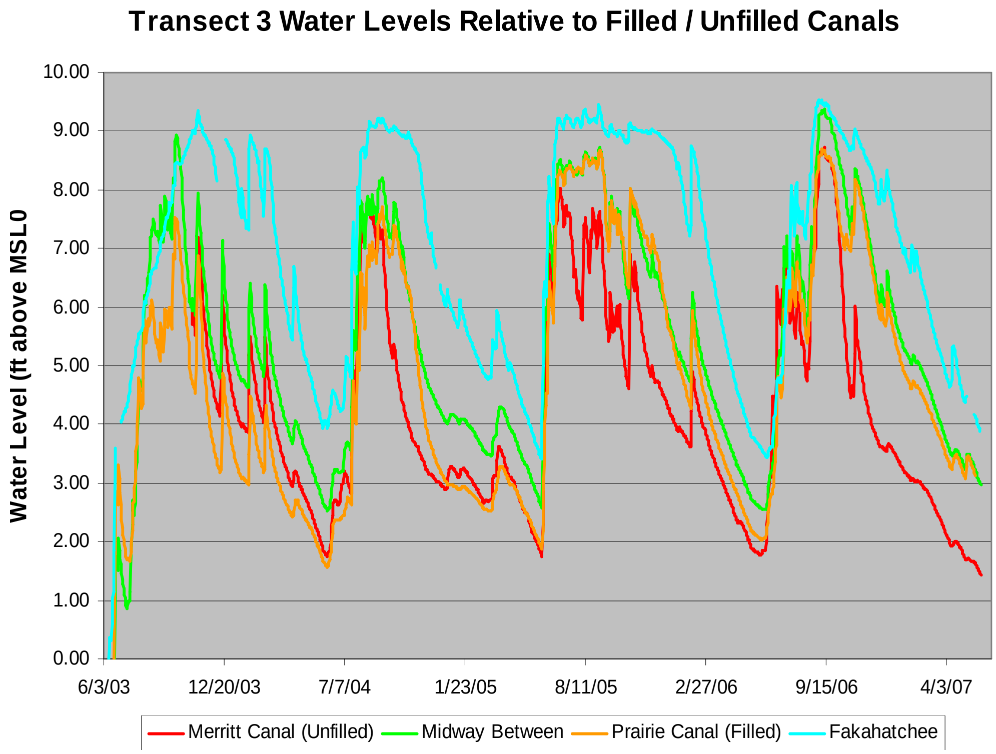

Figure 33. Transect 3 (see **Figure 12**) water levels relative to filled and unfilled canals.

EXOTIC AND NUISANCE SPECIES

Successful restoration of Picayune Strand will require the virtual elimination and long-term control of nuisance exotic and native plant species populations. Nuisance species will be monitored and removed when they are first invading a restoration site after construction rather than after they have become established. Exotic species most likely to be problems in the project area include Brazilian pepper, melaleuca, cogon grass (*Imperata cylindrica*), torpedo grass (*Panicum repens*), vaseygrass (*Paspalum urvillei*), smut grass (*Sporobolus indicus*), natal grass (*Rhynchelytrum repens*), tropical soda apple (*Solanum viarum*), Burma reed (*Neyraudia reynaudiana*), downy rosemyrtle (*Rhodomyrtus tomentosa*) and ceasarweed (*Urena lobata*). Nuisance native species of concern include cattails (*Typha* sp.), and primrose willow (*Ludwigia peruviana*). Although it is a native species, reducing the dominance, density, and recruitment of cabbage palm is necessary since one of the primary differences observed on the 1940 and 1995 Natural Resource Conservation Service vegetation maps (**Figure 5**) is its dramatic spread, which has greatly increased fire impacts on the area.

Restoration of Prairie Canal Phase 1 was completed in spring 2004. The initial field survey for this phase was done in May 2005 (Barry and Duever, 2005), and the first control treatment was done in May 2006. The assessment included the area within and up to 50 feet from the edge of the disturbed land associated with the road and logging tram restoration footprints, as well as other sites where the land surface is altered during restoration. **Figure 34** indicates the locations these species were found along the footprint of the filled canal. Majority of new exotics were located on spoil used to fill the canal, probably because it is a raised surface, to allow for settling of the fill material, and was only shallowly inundated for short periods during the 2004 wet season. More scattered new individuals were present on the area from which the spoil was removed. Species encountered included Brazilian pepper (**Figure 35**), Burma reed (**Figure 36**), mature cogon grass, cattail, bamboo, lead trees (*Leucaena leucocephala*), natal grass, an exotic bracken fern (*Pteris tripartita*), ceasarweed, smut grass, and vaseygrass. Some species were removed or treated while others are being monitored to determine if treatment is necessary.

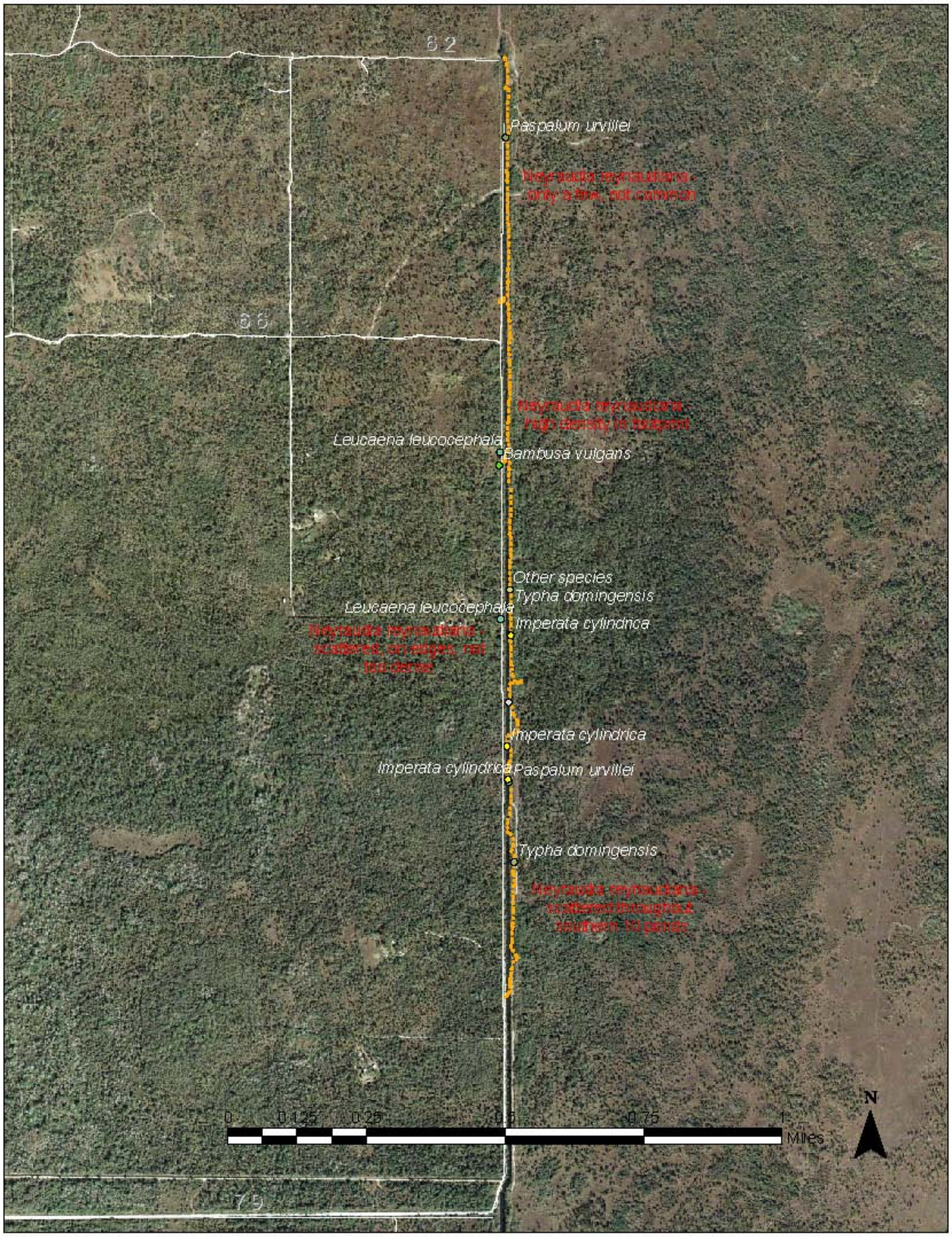

Figure 34. Location of exotic and nuisance species along the Prairie Canal footprint.

Figure 35.Young Brazilian peppers on the surface of a filled section of Prairie Canal.

Figure 36. Burma reed (*Neyraudia*), on filled portions of Prairie Canal.

LITERATURE CITED

Addison, D.S., M.J. Barry, I.A. Bartoszek and D.W. Ceilley. 2006. Pre-Restoration Wildlife Surveys in the Southern Golden Gate Estates (2001–2004). Conservancy of Southwest Florida, Naples, FL, and Florida Gulf Coast University, Fort Myers, FL. Submitted to Florida Division of Forestry.

Barry, M. and M.J. Duever. 2005. Reconnaissance of Exotic Vegetation on Restored Section of Prairie Canal, May 28, 2005. South Florida Water Management District, Fort Myers, FL.

Barry, M.J. and S.W Woodmansee. 2006. Vegetation Sampling at Picayune State Forest, PSRA Vegetation Monitoring 2005–2006. Prepared for South Florida Water Management District, Fort Myers, FL. December 18, 2006.

Belden, R.C. 1988. The Florida Panther. Pages 515–532 in *Audubon Wildlife Report 1988/1989*. National Audubon Society; New York, New York.

Doyle, T.J. and S.L. Gonnion. 2006. Assessing the Distribution and Abuncance of Wood Storks and Wading Birds in the Picayune Strand Restoration Project, Progress Report. United States Fish and Wildlife Service, Ten Thousand Island National Wildlife Refuge. September 6, 2006.

Harlow, R.F. 1959. An Evaluation of White-Tailed Deer Habitat in Florida. Florida Game and Freshwater Fish Commission Technical Bulletin, 5:1–64; Tallahassee, Florida.

Leighty, R.G., M.B. Marco, G.A. Swenson, R.E. Caldwell, J.R. Henderson, O.C. Olson and G.C. Willson. 1954. Soil Survey (Detailed-Reconnaissance) of Collier County, Florida. USDA Soil Conservation Service.

Locker, S.D. and B.D. Jarrett. Establishing Baseline Conditions Prior to Picayune Strand Restoration. University of South Florida, St. Petersburg, FL. July 14, 2006.

Maehr, D.S. 1990. Florida Panther Movements, Social Organization, and Habitat Utilization. Final performance report, Study No. 7502. Florida Game and Freshwater Fish Commission, Tallahassee, Florida.

Maehr, D.S. 1992a. Florida Panther. Pages 176–189 in S.R. Humphrey, ed., In: *Rare and Endangered Biota of Florida, Volume I: Mammals*. University Press of Florida; Gainesville, Florida.

Maehr, D.S., E.D. Land and J.C. Roof. 1991. Social Ecology of Florida Panthers. *National Geographic Research and Exploration*, 7(4):414-431.

Nelson, D.A., C.T. Theriot and R.K. Metzger. September, 2001. The Distribution and Abundance of Wading Birds in the Southern Golden Gate Estates and Surrounding Areas. Final Report. U.S. Army Corps of Engineers Jacksonville District, Jacksonville, Florida.

NRCS. 1989. Twenty-six Ecological Communities of Florida. Natural Resources Conservation Service United States Department of Agriculture, NRCS Technical Guide, 146 pp.

Ogden, J.C. 1994. A Comparison of Wading Bird Density Colony Dynamics (1931–1946 and 1974–1989) as an indication of ecosystem conditions in the southern Everglades. Pages 533–570, S. M. Davis and J. C. Ogden (eds.). In: *Everglades–The Ecosystem and Its Restoration*. St. Lucie Press, Delray Beach, Florida.

Ogden, J.C., S.M. Davis, T.K. Barnes, K.J. Jacobs and J.H. Gentile. 2005. Total System Conceptual Ecological Model. *Wetlands*, 25(4):955–979.

Reed, P.B., Jr. 1988. National List of Plant Species that Occur in Wetlands: Southeast (region 2). U.S. Department of the Interior, Fish and Wildlife Service, Biological Report 88(26.2) 124pp. Amended on USFWS 1996. http://www.fws.gov/nwi/bha/list96.html 1996 National List of Vascular Plant Species that Occur in Wetlands.

SFWMD and NRCS. 2003. Southern Golden Gate Estates Watershed Planning Assistance Cooperative Study. South Florida Water Management District, Big Cypress Basin, and Natural Resources Conservation Service, United States Department of Agriculture. October 2003 Final Report.

USACE and SFWMD. 2004. Comprehensive Everglades Restoration Plan Picayune Strand Restoration (Formerly Southern Golden Gates Estates Ecosystem Restoration) Final Integrated Project Implementation Report and Environmental Impact Statement.

Wade, D.J. Ewel and R. Hofstetter. 1980. Fire in South Florida Ecosystems. Southeastern Forest Experiment Station, Asheville, NC. 125 pp.