A Watershed Analysis of Permitted Coastal Wetland Impacts and Mitigation Methods within the Charlotte Harbor National Estuary Program Study Area

Figure 1: Great blue heron landing on black mangrove on San Carlos Bay.
Source: J. Beever 2010.

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The Charlotte Harbor National Estuary Program is a partnership of citizens, elected officials, resource managers and commercial and recreational resource users working to improve the water quality and ecological integrity of the greater Charlotte Harbor watershed. A cooperative decision-making process is used within the program to address diverse resource management concerns in the 4,400 square mile study area. Many of these partners also financially support the Program, which, in turn, affords the Program opportunities to fund projects such as this. The entities that have financially supported the program include the following:

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Executive Summary

This project identifies the regional effects of the current wetland impact permitting process and program of compensatory wetland mitigation and evaluates the success of state and local mitigation strategies implemented in the Charlotte Harbor National Estuary Program study area, focusing on coastal (marine and estuarine) habitats. Management criteria and implementation success are assessed for both private and public mitigation lands.

This project implements the Charlotte Harbor National Estuary Program (CHNEP) Comprehensive Conservation Management Plan (CCMP) Quantifiable Objective FW-2: Restore and maintain saltwater and freshwater wetland systems; and Priority Action FW-C: Restore freshwater and estuarine wetlands areas. This project directly addresses the national priority to improve the effectiveness of compensatory mitigation. The outputs of this project can directly inform the development of mitigation performance standards for south Florida. In addition, this project will assist in determining the adequacy of compensatory mitigation for managing cumulative wetland impacts under the Federal CWA 404/401 program in Southwest Florida. Finally, the project will provide a unified evaluation of wetlands impacts within the CHNEP Study Area which can then be presented to all partner organizations in a non-regulatory environment.

There is a substantial amount of healthy, fully functioning wetland habitats in the coastal CHNEP area. By far, the majority of the watersheds are in a native, relatively undisturbed condition. To a large extent this is the result of long-term conservation efforts initiated and championed by the citizens of the CHNEP communities that was translated through private, state and federal efforts into conservation lands, parks, National Wildlife Refuges, Aquatic Preserves, and conservation easement areas. Local, state and, to a lesser extent, federal land acquisition, conservation, and restoration efforts have borne the fruit of a large functional estuarine ecosystem.

The most recent assessment of the CHNEP estuarine habitats from CHNEP, the Florida Department of Environmental Protection (FDEP), the South Florida Water Management District (SFWMD), the Southwest Florida Water Management District (SWFWMD), Mote Marine Laboratory and other sources gathered in this report is that there are:

- 455.68 hectares (1,126 acres) of sandy beach,
- 26,404.78 hectares (63,831.96 acres) of mangroves,
- 6,196.15 hectares (15,310.99 acres) of salt marsh,
- 99.96 hectares (247 acres) of oyster bars,
- 26,404.78 hectares (65,247.52 acres) of seagrass,
- 11,054.81 hectares (27,317 acres) of unvegetated tidal flats, and
- 53,225.96 hectares (131,524 acres) of unvegetated shallow subtidal bottoms.

The extent of deep subtidal unvegetated bottoms varies depending on the waterward boundary considered for the CHNEP Study Area. If this is restricted to within the bays, estuaries and lagoons, deep subtidal unvegetated bottom totals 28,631.96 hectares (70,751 acres). If it extends

out to the mapped boundaries of the watersheds as depicted in the CCMP, the total is 203,463.30 hectares (502,768 acres).

During the 2004-2008 study period 10,186 Environmental Resource Permit (ERP) actions occurred in the total CHNEP Study Area. Of these, 1,834 occurred on the coastal shoreline and/or in emergent estuarine wetlands (Coastal Permits). The majority of ERP actions occurred in the Peace River, Caloosahatchee River, and Estero Bay watersheds. The majority of the Coastal Permit ERP actions occurred in the Caloosahatchee River, Pine Island Sound/ Matlacha Pass and Estero Bay Watersheds.

We examined in the field 118 sites utilizing three wetland functional assessment methods, Wetland Rapid Assessment Procedure (WRAP), Uniform Mitigation Assessment Method (UMAM), and Hydrogeomorphic Method (HGM). Of the three functional assessment methods used in the field in the course of this study for evaluating water management district and/or Department of Environmental Protection ERP projects in the CHNEP southwest Florida counties of Charlotte, Lee and Sarasota Counties, HGM was the most effective in identifying and quantifying the wetland functions of coastal wetland ecosystems (mangroves, salt marsh, intertidal and subtidal). UMAM and WRAP provided to be of utility, but generally deliver a mitigation ratio in both function and acres that is less than one, so that a system-wide net loss of both wetland function and wetland acreage occurs.

Within the 118 evaluated projects, a total of 491.9 acres of coastal wetlands were subject to review for potential impacts. The largest area of coastal wetlands on a project site was 29.98 hectares (74.08 acres). Some submerged bottom sites had no emergent wetlands. A total of 21.48 hectares (53.08 acres) of on-site coastal wetland loss was permitted. This is a 10.79% loss of on-site wetlands between the pre-project condition and post-project condition. The largest on-site wetland loss for a single project site was 4.5 hectares (11.12 acres). On average, a permit included 0.19 hectares (0.46 acres) of coastal wetland loss. This fits with a general pattern in which many individual projects have an apparently small wetland impact of less than 0.2 hectares (½ acre), but contribute to a cumulative effect that can sum to more substantial acreage.

All three wetland functional assessment methods function as designed and produce a result that is similar if not exact in its assessment of coastal wetlands, but yield somewhat different mitigation results.

While the total area of wetland acreage and functional decrease can appear relatively small over the 5 year study period relative to the total extent of wetlands that continue to exist, it is important to understand that this permitted wetland elimination is gradually reducing the total extent of coastal wetlands in watershed of the CHNEP, while it is the general perception both by the public and the regulatory entities that there is no wetland functional loss occurring in the balancing process of the use of functional assessment tools.

The process also has the consequence of relocating wetland functions out of impacted watersheds and toward the only watershed able to provide approved off-site mitigation in the same category of coastal wetland habitats that is being impacted: the wetland mitigation bank. While the functional assessment evaluations within the permits issued show a mathematical

balance sheet for the total service area that is equal to or better than parity for a project that utilizes a mitigation bank, with rare exception, there is a real loss of wetland acres and function in the donor watershed, and an increase in function, but not new acres, of wetlands created in the receiving watershed.

Estuarine environments require careful management. The estuaries in the CHNEP study area are heavily influenced by fresh water regulation and intense human use. Restoration and maintenance of high environmental quality should aim to sustain the coastal economic base for tourism, fishing, recreation and the quality of life for area residents. To this end, it is essential that the wetland regulatory process maintain and protect these resources.

Introduction and Project Description

The Charlotte Harbor National Estuary Program (CHNEP) watershed extends approximately 209 kilometers (130 miles), from the northern headwaters of the Peace River in Polk County to southern Estero Bay in Lee County. Coastal shoreline within the CHNEP Study Area extends approximately 3,964 kilometers (2,463 miles), from the Dona and Roberts Bays in Sarasota County to southern Estero Bay. The Greater Charlotte Harbor region is divided into seven sub-basins by hydrological, ecological and management distinctions. In each of these sub-basins, rainfall collects in wetlands, runs to streams and rivers through a rich variety of plant and animal habitat, soils, and surficial geology to the most productive estuaries measured in the continental United States. The CHNEP watershed encompasses approximately 1,222,965 hectares (3,022,013 acres), and includes connected waters in Charlotte, DeSoto, Hardee, Lee, Polk, and Sarasota Counties. Historically, the watershed had over 34,000 hectares (86,000 acres) of coastal wetlands however, over 41 percent of that, or 1,674 kilometers (1,020 miles) has been lost or significantly altered. The most significant coastal wetland losses have been along estuarine rivers and creeks, and on barriers islands.

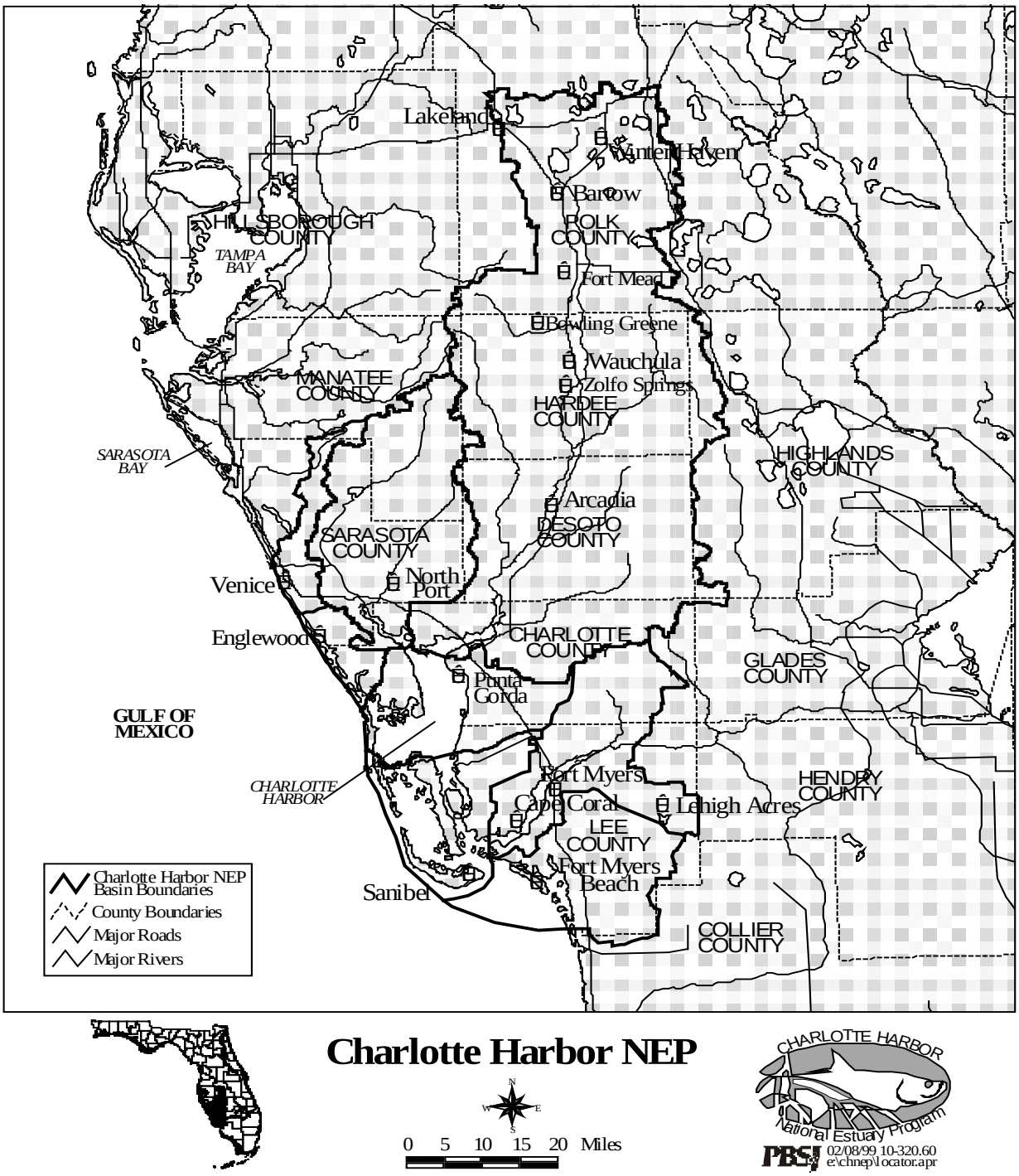
Within the project area, development has accelerated greatly over the past decade. Estimates indicate that in 1995, approximately 17.6 percent of the CHNEP watershed was comprised of urban land uses (residential, commercial, and industrial) concentrated in the western developed corridor. In 2000, the Southwest Florida Regional Planning Council (SWFRPC) projected that urban land use would increase to 25 percent by 2025. Current projections indicate that Charlotte and Lee Counties can be expected to reach build-out before 2060, with an urban land use of 34%, resulting in an almost continuous band of urban development along the southwest Florida coast with population spillover into adjacent inland counties reaching as far as West Palm Beach. As a component of this development, many individual coastal wetlands dredge and fill permit applications are processed annually by SFWMD, SWFWMD, FDEP and the US Army Corps of Engineers (USACOE). Most of these coastal wetland impacts are proposed to facilitate residential and commercial developments that range in size from single units to large gated communities to regional dock facilities. Impact minimization is pursued by the regulatory agencies, and the final permits frequently include mitigation requirements. Mitigation is often accomplished through conservation easements and deed restrictions with the property remaining in private ownership. Public agencies or private conservation organizations are not usually involved in the management of these lands, and monitoring of mitigation success is limited.

This project was intended to describe and evaluate the regional success of the use of coastal wetland mitigation strategies implemented in the CHNEP Study Area. This required establishing the acreage of private mitigation, how well these lands are managed, and the overall success rate of these actions, how well regional mitigation goals are being met and any changes in quantity of coastal wetlands subject to permitted mitigation since the SWANNC decision (Solid Waste Agency of Northern Cook County *V.* United States Army Corps of Engineers *et al*., 2001). Mitigation performed both within and outside the watershed was examined. To accomplish this, areas and types of permitted coastal wetland impacts were tabulated and mapped; assigned mitigation actions were tabulated and mapped by coastal wetland type and mitigation category (creation, restoration, preservation, etc.); and a sample of mitigation sites was visited and

evaluated for implementation success. The evaluation criteria incorporate regional mitigation goals and criteria that were established by regulatory and other resource management agencies.

Figure 2: Satellite view of Charlotte Harbor.

Source: Mote Marine Laboratory 2007 Technical Report No. 1169



Map 1: Overview of the Charlotte Harbor National Estuary Program (CHNEP) Boundary and Locations

The Management Conference of the Charlotte Harbor National Estuary Program, in conjunction with its partners (i.e., the Estero Bay Agency for Bay Management, the Southwest Florida

Regional Restoration Coordination Team), identified the need for a regional evaluation of compensatory wetland mitigation regulations and actual implementation to determine whether wetlands in the CHNEP coastal areas have been enhanced and to develop strategies to improve current regulations to ensure enhancement in the future. This study will serve as the needed regional evaluation. The results will be directly applicable throughout southwest Florida and the CHNEP study area, where coastal wetland permitting and mitigation are regulated by the same agencies in a similar manner. They should also be applicable elsewhere, where coastal wetland impacts are permitted based on requirements for private mitigation actions.

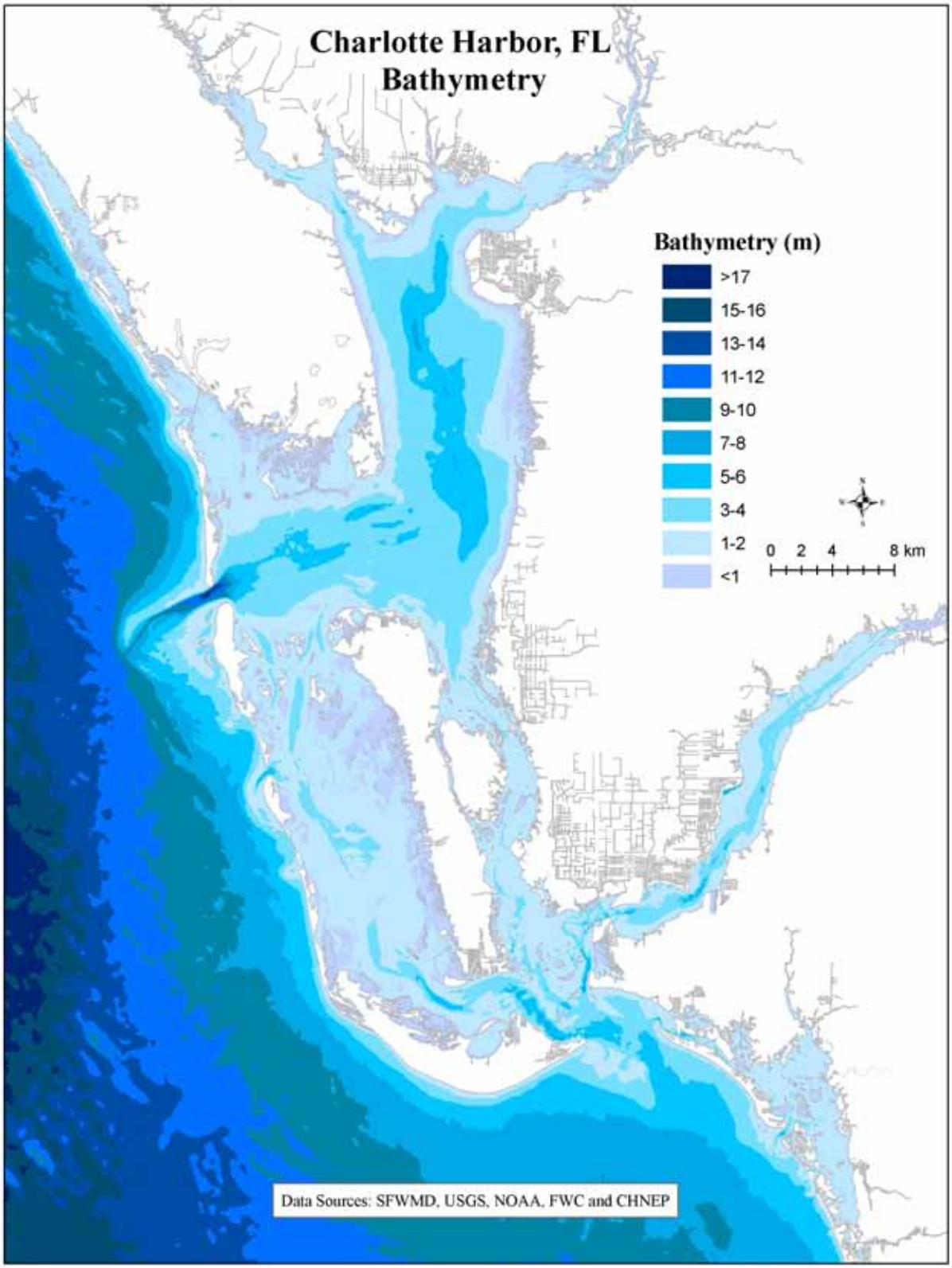
The Coastal Wetland Resources of the CHNEP Study Area

Estuaries are among the most productive environments on earth. When the freshwater creeks and rivers meet the salty waters of the Gulf of Mexico, they create a productive estuarine environment. Plants, animals and people take advantage of the places we call estuaries. Many species of freshwater and marine animals rely on the estuary and spend a portion of their life cycles in this environment.

A series of distinct but related bays and estuaries make up the coastal environment of southwest Florida. These bays and estuaries include Dona and Roberts Bay, Lemon Bay, Charlotte Harbor proper, Pine Island Sound and Estero Bay. Together they form one of the largest systems in the state and the most productive estuarine area of the west coast of Florida.
There are irregular and less than predictable tides. The tidal ebb and flow in the bay can be pretty erratic. There are a few days each month with a single low and a single high tidal stage. At other times there are two high and two low stages, but with a difference of only 0.15 meters (6 inches) and a period of only 3 hours between one of the highs and the next low. The tidal range from ebb to flood, wind effects not considered, can be as much as 0.76 meters (2.5 feet), but the range typically averages just 0.4 meters (1.2 feet).

Seasonal tidal variations can be very pronounced, particularly in winter. Strong and persistent north winds that accompany the periodic passages of cold fronts from late October into May can overcome the tidal effects and force a large volume of water outward into the Gulf, leaving many of the sand bars exposed.

Most of the natural tidal CHNEP is less than 2 meters (6.6 feet) in depth, including Dona and Roberts Bays, Lemon Bay, Gasparilla Sound, Myakka River, Peace River, most of Pine Island Sound, Matlacha Pass, and Estero Bay. Charlotte Harbor proper is the largest extent of waters deeper than 2 m (6 ft.), and deepens to 14 m (46 ft.) at the sound end of Gasparilla Island in Boca Grande Pass.



Map 2: Bathymetry of the CHNEP and nearshore Gulf of Mexico

Coastal Habitats of the CHNEP

Florida's growing population and development are replacing natural habitat. Without the proper habitats, plant communities and wildlife disappear. Florida remains one of North America's most important reserves of biological diversity, occupying an important transitional zone between tropical and temperate climates, with more than 1,300 fish and wildlife species and about 3,500 plant species. Preserving this biodiversity in the CHNEP study area requires protection and restoration of regional fish and wildlife habitat. High rates of land conversion and habitat modification create a critical need for regional wildlife habitat planning in the watershed.

When natural lands are broken up by development, habitat fragmentation results. The remaining isolated landscapes are often too small to support breeding pairs of animals and preclude intermixing of breeding populations. Also, the margins of these fragmented natural lands create "edge habitat" that alters species composition and can increase human impacts.

The CHNEP Study Area has lost more than 38 percent of its original wetland habitat — mostly to agricultural drainage, mining, and urban development. Land drained by connector ditches for farming accounts for the largest loss of freshwater wetlands. More recently, wetland conversions to farmland or open water have accelerated, especially in smaller unregulated wetlands.

Urban and rural development also destroys wetlands. Most elimination of wetlands goes through a permitting process that includes mitigation requirements. However, some wetland losses are currently permitted without mitigation requirements (SWFRPC, 2007). Spurred largely by citizen initiatives, local and state governments and private conservation organizations acquire extensive wetlands, including coastal and barrier island tracts. Public or private holdings now preserve extensive portions of the mangrove coast from Placida to Estero Bay. Extensive public "buffer uplands" further protect saltwater wetlands around Charlotte Harbor proper.

The habitats of the CHNEP estuary are diverse, overlapping, and comprise a vast number of combinations of physical and biological components. In order to focus the CCMP on management-scale planning, the Critical Harbor Habitats were grouped into several comprehensive submerged and emergent habitat types. These groups were based on the dominant physical and vegetation components, and they were centered on habitats at risk. The submerged habitats were defined as seagrasses, oyster reef hard bottom, tidal mud flats, and artificial reefs. The emergent habitats were defined as mangroves, salt marshes, and shorelines. The emergent habitats were as a group termed "Emergent Saltwater Wetlands" in order to distinguish them from the freshwater and tidal oligohaline wetlands discussed under the Inland Habitat section of this document

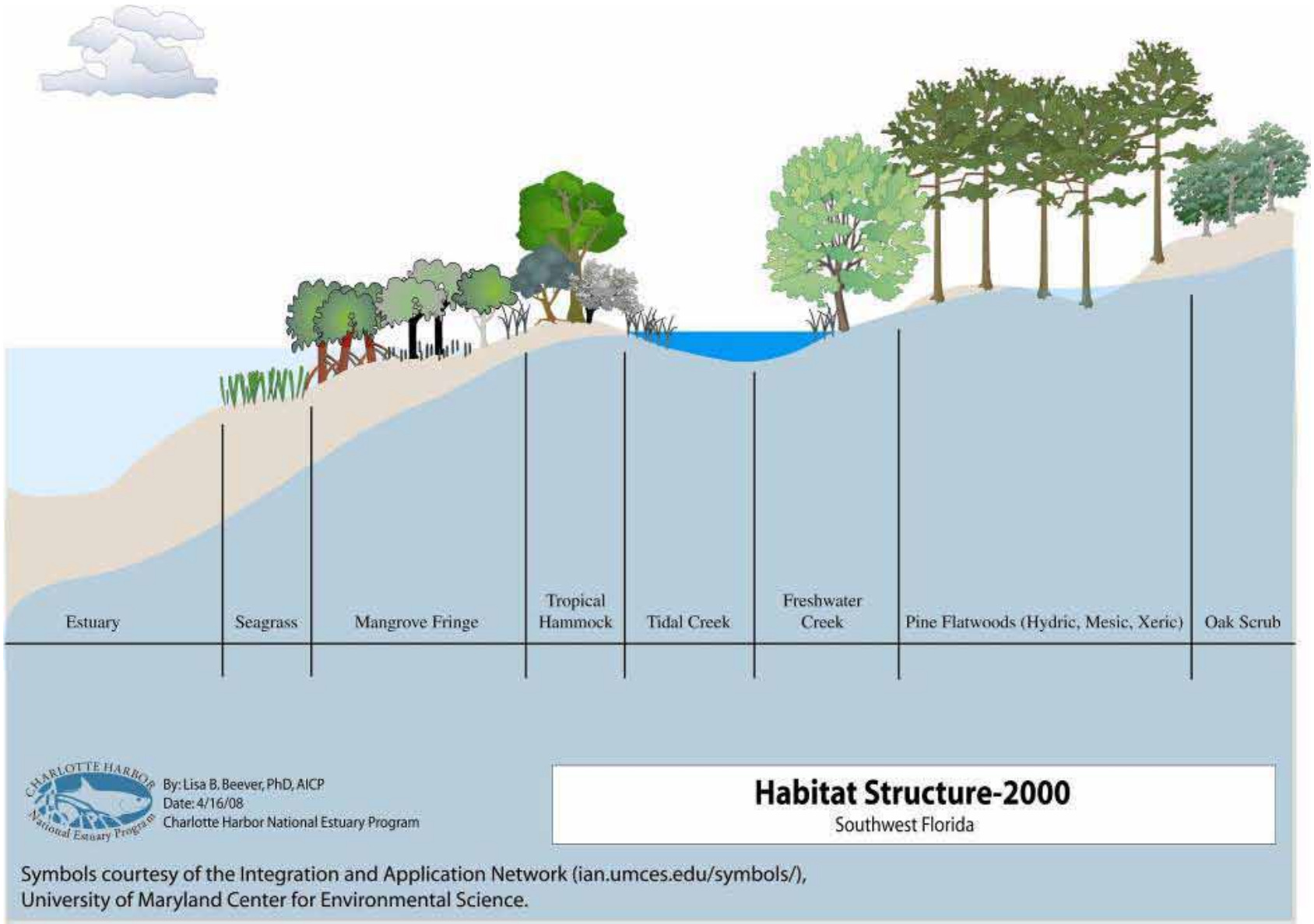
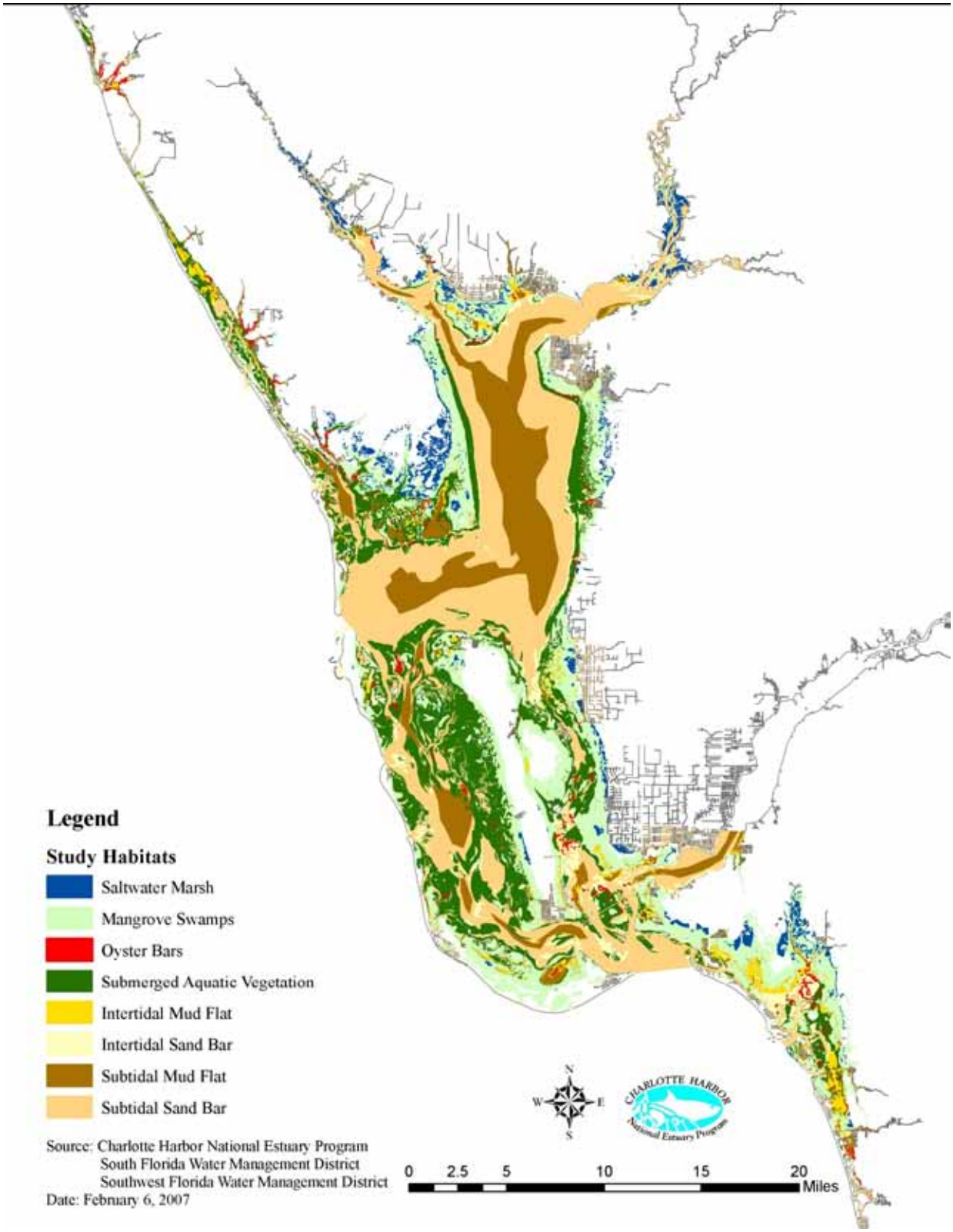


Figure 3: Typical shoreline profile for an estuary in the CHNEP study area.



Map 3: Submerged and Emergent Habitat Distribution in the CHNEP

Submerged Habitats

The submerged habitats were operationally defined as seagrasses, oyster reef/ hard bottom, tidal mudflats, and artificial reefs. These habitats provide food sources, solid foundations, and protective structure for living resources, and they exist throughout all of the study area segments studied. Although the current distributions of these habitats have been mapped and are presented in this document, their distributions remain in a state of constant slow change as sand shoals drift, seagrass meadows expand and are washed out by storms, oyster bars expand and are overtaken by mangroves, and dredge spoils and artificial reefs are deposited.

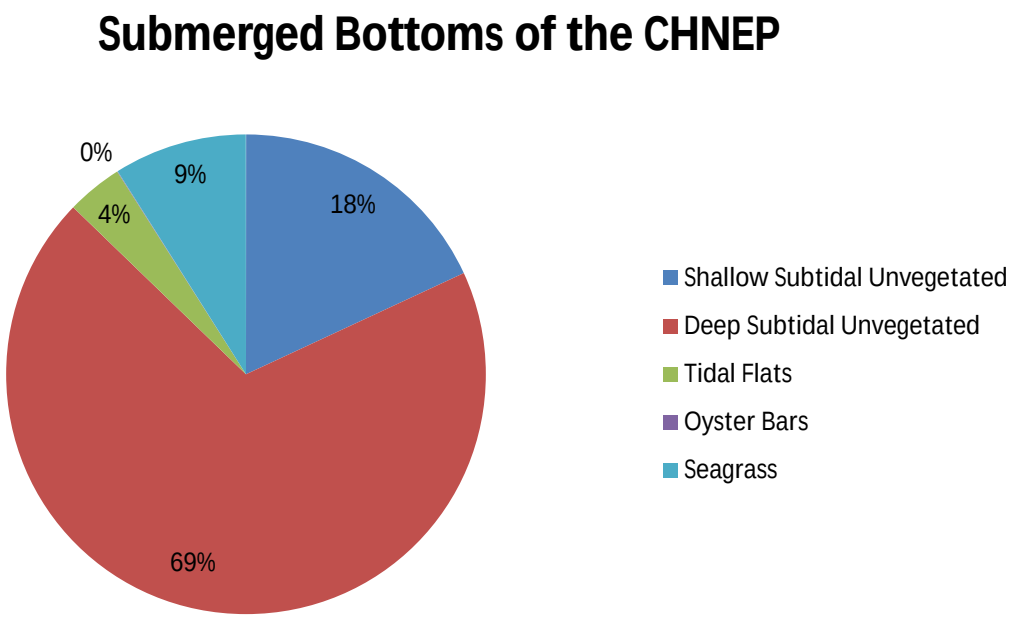


Figure 4: Relative proportion of submerged bottoms in the CHNEP Study Area
Using total boundary into Gulf of Mexico

Seagrass

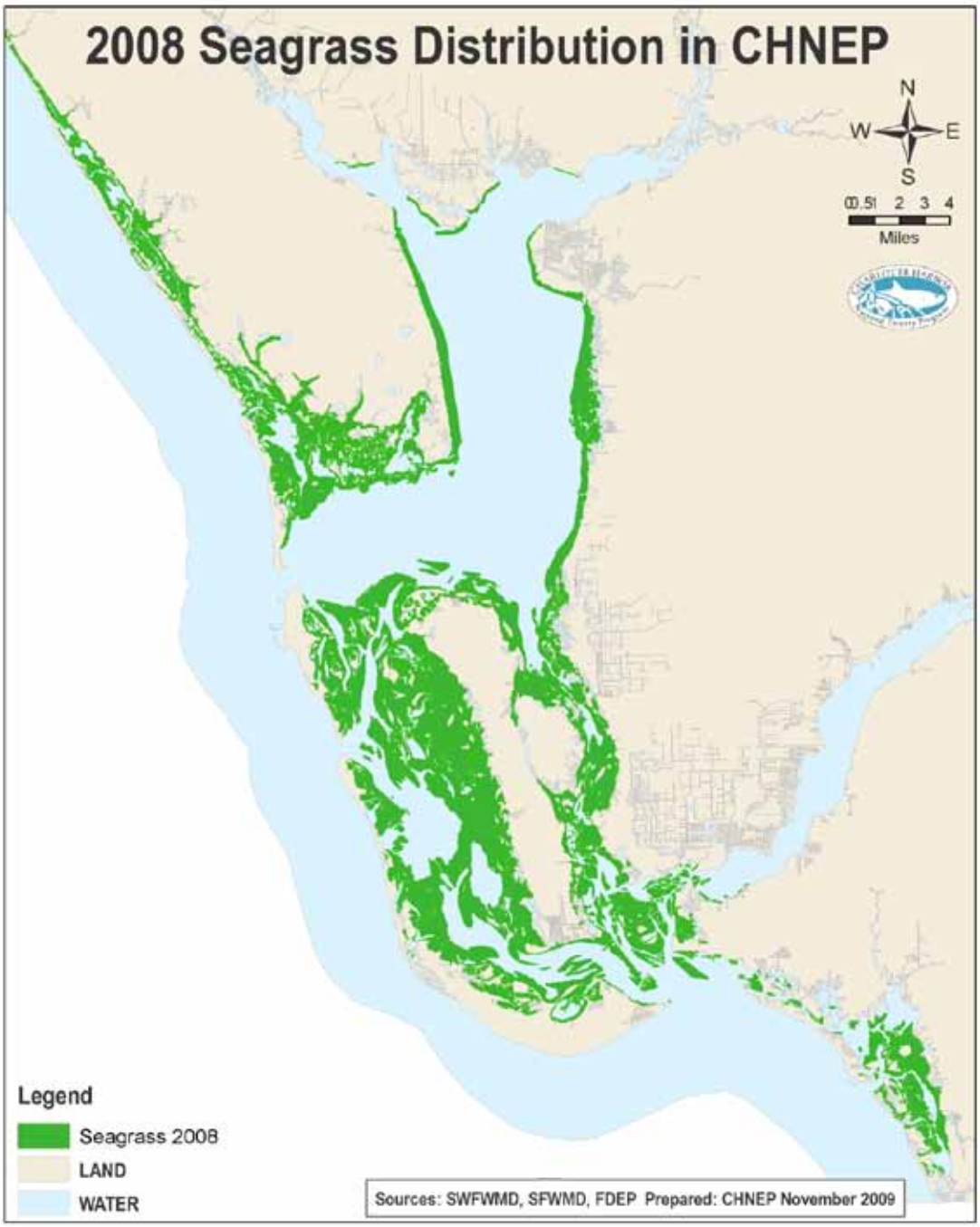
Seagrasses play several vital roles in the estuary. These plants "clean" the water by trapping suspended sediments. They provide food directly to manatees and sea turtles and indirectly support sport and commercial fisheries by supplying habitat for fish. Spotted seatrout (*Cynoscion nebulosus*), for example, live out their entire lives within seagrass beds. Seagrasses provide habitat for a wide variety of sea life, giving the beds a high recreation value for fishing, shelling and snorkeling.

Figure 5: Seagrass species of the CHNEP

Harris, *et al.* (1983) documented a 29 percent decrease in seagrass coverage across the study area between the 1940s and 1982, excluding Estero and Lemon Bays. Harris' study found that most of this loss was located in southern Charlotte Harbor and was a result of the dredging of the Intracoastal Waterway and construction of the Sanibel Island Causeway. These researchers also found losses throughout the Harbor and suggested that some of this had resulted from seagrasses receding out of deeper depths due to decreasing water clarity resulting from hydrologic changes and increased pollutant loads. Since systematic mapping of seagrass started in 1988, seagrass coverage has remained relatively stable (Corbett 2006), although there are indications of losses in the density of seagrass beds and change in less stable seagrass species, (Greenawalt-Boswell, *et al.* 2006).

Loss of seagrass by the scarring by boat propellers has been a significant issue in the entire Charlotte Harbor region. Because estuarine seagrass beds occur in shallow waters, they are vulnerable to the propeller dredging of inexperienced, imprudent, or uncaring boaters. A 1995 effort by the Florida Fish and Wildlife Research Institute (Sargent, *et al.* 1995) determined that the Charlotte Harbor region is one of the most heavily propeller scarred areas in Florida, and a more recent update by CHNEP (FWRI 2003) found an increase in the severity and extent of

scarring since the 1995 effort. Simultaneously, the estuaries have faced the pressures of a robust tourism industry and a rapidly growing population: an increase in inexperienced boaters and increased dock and marina construction. A study of docks constructed over grass beds in Pine Island Sound and San Carlos Bay found that boat propeller dredging was associated with roughly one-third of the docks as well as the formation of a seagrass "shadow", or area of seagrass loss, correlating with the total size of each dock (Loflin 1995).



Map 4: 2009 Seagrass Distributions in the CHNEP Study Area

Five species of marine and estuarine seagrasses occur in the shoal waters of the Charlotte Harbor complex. Four of the five species are commonly found in shallow waters (less than 2 m. or 6 ft.) of the Harbor. Two of these species can be found in 4-10 m. (13-30 ft.) of water elsewhere in Florida where the water is much clearer. Seagrasses are most likely depth limited by the transparency of the water to light in Charlotte Harbor, as in Tampa Bay and the Indian River Lagoon (Hall *et al.*, 1991; Kenworthy *et al.*, 1991).

Factors affecting water transparency include seasonal changes in total light each day; physical characteristics associated with absorption; and scattering of light caused by dissolved organics, suspended material, and water depth. Microscopic plant and animal life, when abundant enough, can affect light levels when in the water column and when found as epiphytes on seagrass blades. Excessive nutrients may be an important factor influencing the production of epiphytes on seagrasses and the loss of seagrasses with higher turbidity (Wetzel and Neckles, 1986; Neckles, 1991). One seagrass genus (*Halophila*) may actually prefer lower light levels. *Halophila* is generally found in water deeper than 2 m. (6 ft.) (Kenworthy *et al.*, 1991), and may be a sporadic inhabitant of the Harbor. Dixon and Leverone (1993) have summarized the literature on light requirements for *Thalassia* and *Halodule.* Another species, *Vallisnaria americana* can be found in fresh and very low salinity waters. In the Charlotte Harbor complex, it is most common in the Caloosahatchee River. Small patches can be found in the oxbows of the Peace River below the State Road 761 bridge. Elsewhere in the study area, *Vallisnaria* is uncommon. Surveys of this species to determine area measurements have not been conducted by any state or federal agencies in the Charlotte Harbor complex.

Other factors limiting seagrass growth include salinity, and limiting factors may also act together differentially to limit growth. For example, each seagrass species has a general range of salinity tolerances. *Thalassia, Syringodium,* and *Halophila* are most likely to be limited by light levels within their preferred salinity ranges. Low salinity and high color levels appear to control distribution of seagrasses toward each river mouth, making *Halodule* and *Ruppia* most common in very shallow water (McNulty *et al.*, 1972). Inorganic nitrogen may seasonally affect epiphytic growth on seagrasses since nitrogen is the likely limiting macro-nutrient in the Harbor.

Information on the general distribution of seagrasses in Charlotte Harbor has a varied foundation. McNulty *et al.*, (1972) estimated about 9,463 hectares (23,383 acres) of submerged vegetation. This estimate was made by using many different sources and may not have been verified by on-site inspections. The first attempt at a comprehensive study was completed by the Florida Department of Natural Resources (FDNR) in 1982 (Harris *et al.*, 1983). Black and white aerial photographs taken in 1946 and 1951exist in Florida Department of Transportation (FDOT) files, and have been digitized by the Florida Marine Research Institute (FMRI). False color infrared aerial photographs were taken in 1981-1982 by FDOT, interpreted by FDOT and the results analyzed by FMRI. Verification of the aerial interpretations was done in most areas except for Estero Bay (per. comm., Ken Haddad). Harris *et al.* (1983) compared gross fisheries habitat changes between 1945 and 1982. Seagrass coverage was extensively analyzed and estimated to be 9,073 hectares (22,421 acres) in 1982 in Charlotte Harbor (quads: El Jobean, Punta Gorda SW, Punta Gorda, Punta Gorda SE, Bokeelia, Port Boca Grande, and Matlacha).

Seagrass Habitat Status

Seagrass abundance and diversity is an indirect measure of an estuary's health. Clear water without excessive nutrients fosters seagrass growth, provided the salinity regimes are appropriate. Turbid water and high nutrient levels, which foster excessive growth of phytoplankton and periphyton are not conducive to healthy seagrass beds. As mentioned above, seagrasses are also sensitive to salinity and have preferred and tolerable salinity and temperature ranges. Seagrasses become stressed when salinities exceed these ranges. Physical alterations, such as construction of the Sanibel Causeway, have been determined to harm seagrasses by altering water flow patterns, resulting in stressful salinity changes. The Intracoastal Waterway has also had negative impacts to seagrasses due to direct removal of seagrasses, changes in sediment structures and alteration of flow patterns. As in most Florida estuaries, there has been a regional decrease of seagrass coverage (Chamberlain and Doering 1998a) within the Charlotte Harbor system, compared to historic conditions. Declines in seagrass areas negatively impact the fish and invertebrate communities and can also cause destabilization of sediments and shifts in primary productivity from benthic macrophytes to phytoplankton.

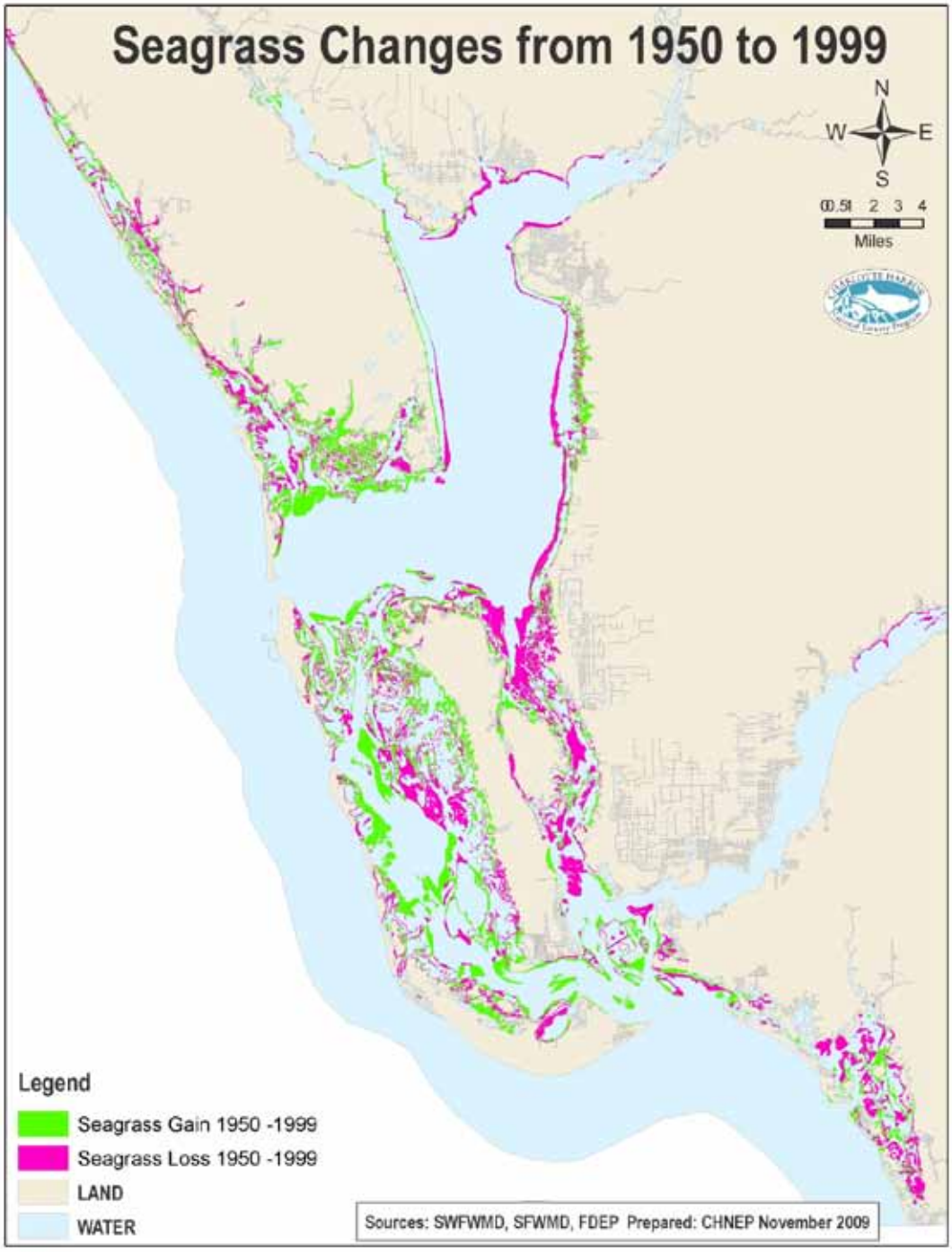
In 1999, the FDEP's Charlotte Harbor Aquatic Preserve (CHAP) staff, initiated seagrass mapping studies at 52 stations in Charlotte Harbor during the months of October through December. Long-term fixed monitoring documents declines or improvements in seagrass health and is thus a useful tool for detection of site-specific changes over time. Detailed monitoring helps to discern between naturally occurring impacts, such as storms, and human-introduced impacts, such as propeller scarring. Site monitoring has also provided data to aid in the interpretation of aerial photography and the production of seagrass maps (Mote Marine Lab 2007).

The Charlotte Harbor complex was reported to have a decline in seagrasses by Harris *et al.*, (1983).The study area included most of the Charlotte Harbor NEP area, less Lemon Bay and the Caloosahatchee River. They reported a decline in area of seagrasses of 29%. Adjusting for the lack of ground verification in Estero Bay by removing this system from the calculations, the total decline was about 26%, and was not uniform across basins. The largest change, an estimated loss of 35%, occurred within Pine Island Sound. This represented 71% of the total estimated change from 1945 to 1982, or 18.5% of the 26% total. Harris *et al.* (1983) provided an extensive discussion of the potential causes. High on the list of suspected causes were the construction of the Intracoastal Waterway, and the Sanibel bridges and causeways, finished in 1962.

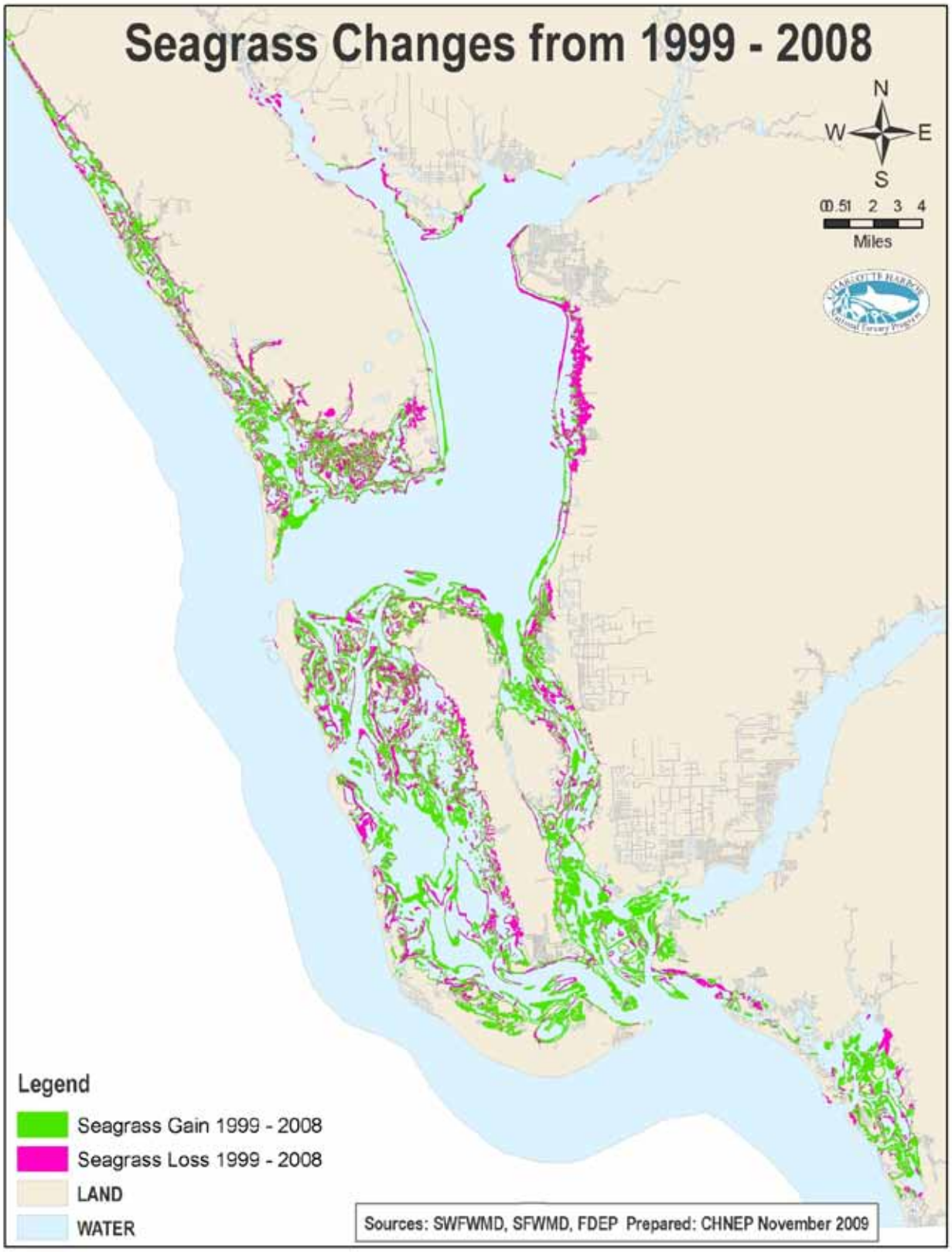
In the same study, seagrasses in Charlotte Harbor proper declined by approximately 39.5%, representing 3.6% of the 26% total. However, Tomasko *et al.*, (in press) and unpublished SWFWMD data suggest that Charlotte Harbor seagrass coverage is dependent on freshwater discharge and can be variable, losing coverage in very wet (rainy) years and regaining coverage in dry years.

The FMRI recently published (Sargent *et al.*, 1995) an assessment of damage by propeller scarring throughout the state. Estimates of seagrasses were provided county by county and were based on Geographic Information System (GIS)-based source data from 1982 and 1987. Lee County was estimated to have 20,441 hectares (50,510 acres) and Charlotte County 5,742 hectares (14, 190 acres). Since about 59% of all the seagrass area from Tampa Bay south to the

Collier County line occurs in the Charlotte Harbor complex, it was estimated that the relative amount of scarring in the Charlotte Harbor complex represented 12.5% of the state total. Only Citrus and Monroe counties had greater percentages at 15.8% and 17.3%, respectively.



Map 5: Seagrass Changes in the CHNEP 1950 to 1999



Map 6: Seagrass Changes in the CHNEP from 1999 to 2008

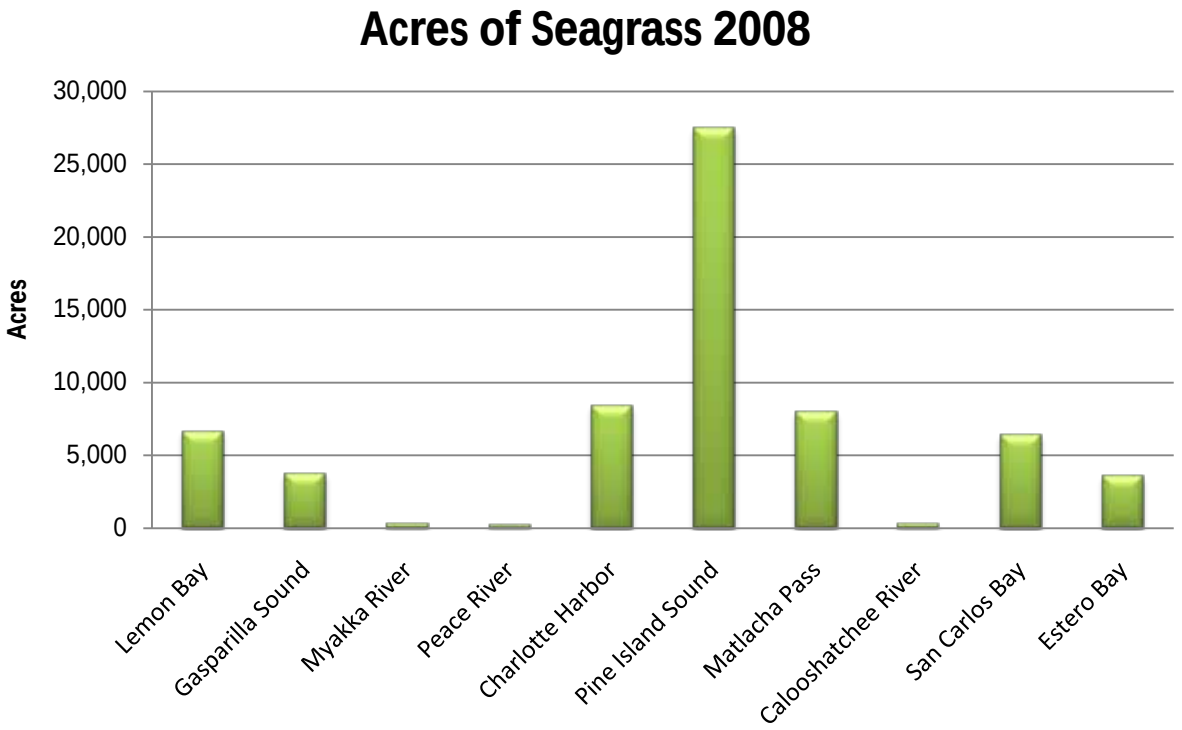


Figure 6: 2008 seagrass acres by watershed.

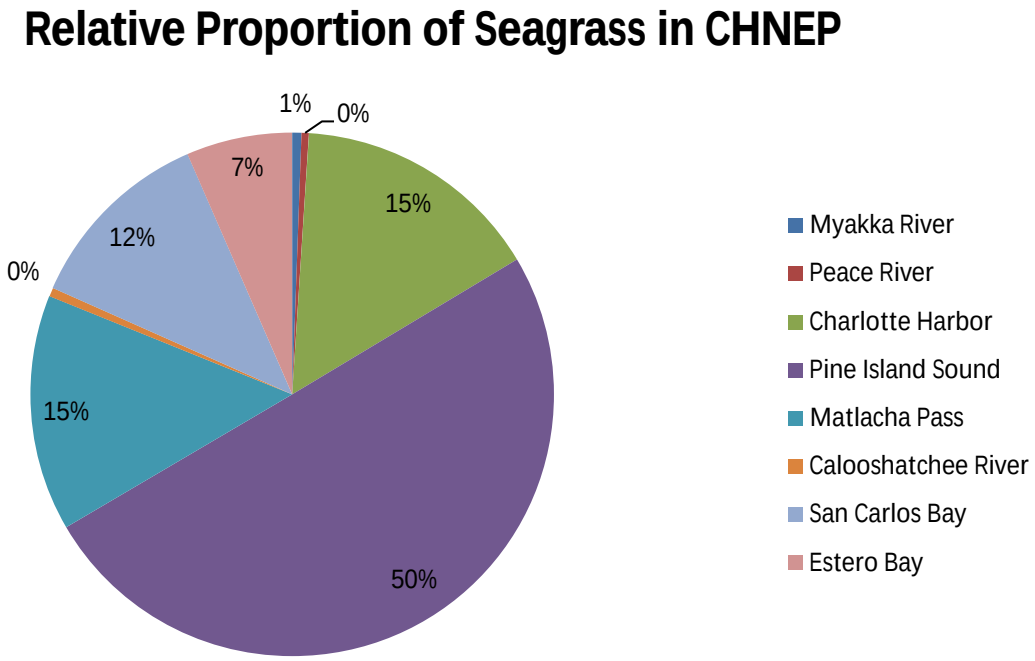


Figure 7: 2008 relative proportions of seagrass by watershed

Oyster Reef/ Hard Bottom

Hard bottom communities are found throughout the Charlotte Harbor NEP study area. Although they include a variety of sessile invertebrates (e.g., gorgonian colonies, encrusting sponges) they are commonly represented by intertidal oyster reefs associated with mangrove forests and shoal areas. The hard substrate formed by oyster colonies creates critical harbor habitats for higher trophic level vertebrates including sport fish (gray snapper, snook, sea trout, red drum, and sheepshead). They are also exploited by avian predators (American oystercatcher, fish crow, and white ibis) at low tide.

Oysters are filter feeding bivalves, a class of the Phylum Mollusca. There are a number of different species of oysters, but the most common is the Eastern, or Virginia, oyster, *Crassostrea virginica*. Oysters are a highly prized seafood item for human consumption and were an important component of the diet of native Floridians as well as the first settlers. Adult oysters spawn male and female gametes into the water column where the eggs are fertilized and quickly develop into a planktonic larval stage called a veliger. The veliger remains in the water column until it encounters a suitable location for settlement. The suitability of the location is determined by the composition of the substrate (other oyster shell is the most preferred) and salinity. The most common settlement sites for oysters on Florida's west coast are mangrove prop roots and existing oyster bars. Throughout Florida oyster populations have been impacted by alterations of fresh water flows to estuaries, dredge and fill activity, and water quality problems. Within the study area oysters are most abundant in the area outside the mouth of the Caloosahatchee River, where oyster bars have already formed (Mote Marine Laboratory 2007). At present, there are no commercial harvests of oysters within the Charlotte Harbor system.

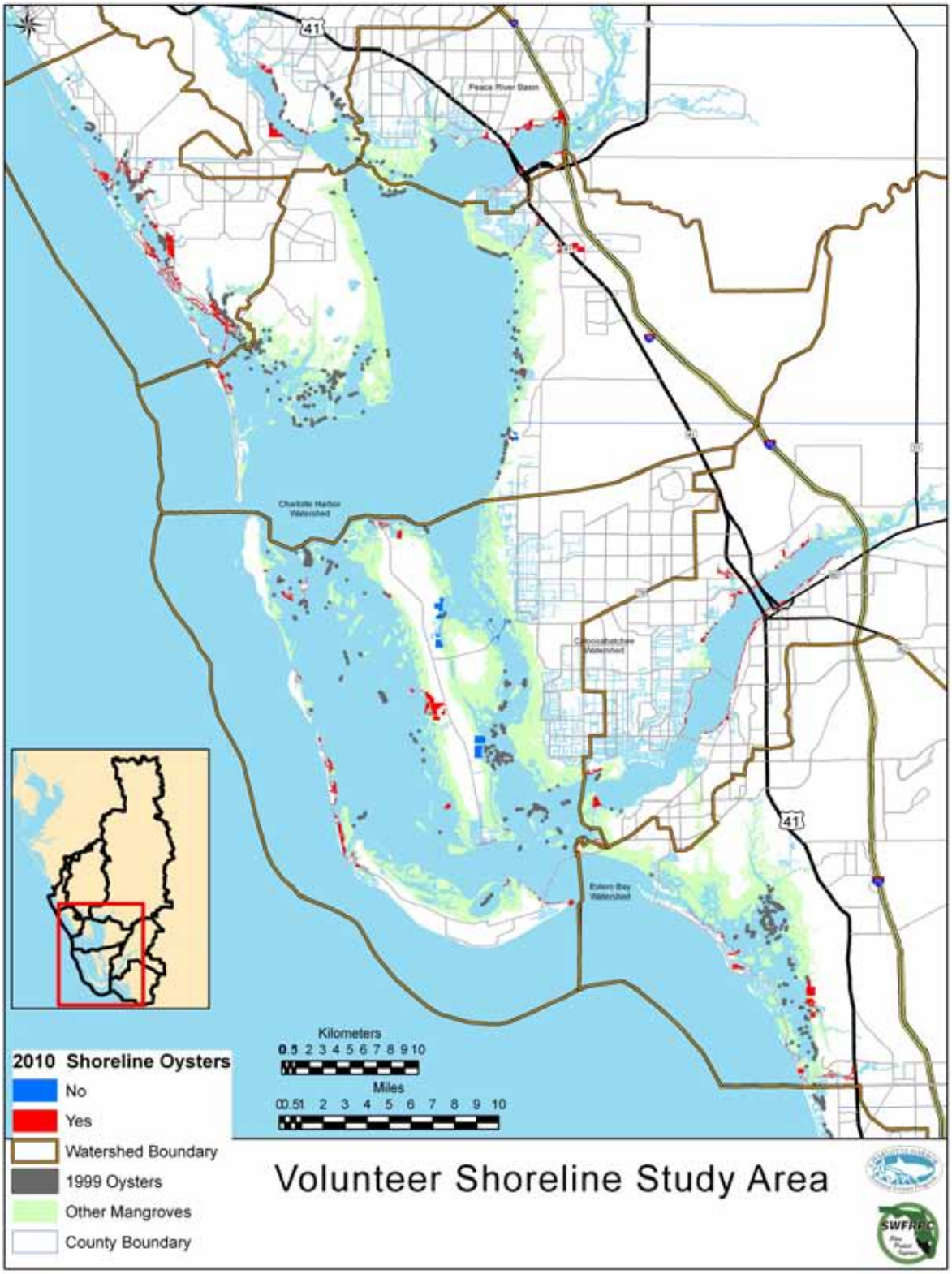
Like seagrasses, oysters have a modifying effect on their environment. The typical oyster bar is formed as annual generations settle and grow at the same location. As the bar grows vertically it eventually becomes intertidal. Additional vertical growth is then inhibited by the action of waves, desiccation through exposure and an increase in temperature extremes due to exposure. A typical Charlotte Harbor oyster bar consists of irregular clumps of individuals growing on top of one another. Oysters also modify the substratum. As oysters die and break apart, the surrounding sediment becomes infused with shell fragments.

Oysters are filter feeders, removing phytoplankton, particulate organic carbon, sediments, pollutants, and microorganisms from the water column. They are efficient at filtering and sorting fine particulate material. Not all of the material that is filtered enters the gut. Particulates that are sorted and rejected are expelled from the mantle cavity as small packets of fine sediment and organic material known as pseudofaeces. This material settles within the cracks and crevices of the oyster bar and serves as food for small burrowing organisms such as polychaete worms. One researcher developed a list of 303 species that depend on oyster bars either directly or indirectly (Wells 1961). The oyster shell substrate also provides refuge for other bivalves and small crustaceans such as mud crabs and amphipods. These oyster-associated organisms occur in a much greater abundance than the oysters that comprise the structure of the bar (Mote Marine Laboratory 2007).

Oyster Habitat Status

There has not been a comprehensive Harbor-wide assessment of oyster distribution and status. Studies of oysters have been conducted at the mouth of the Caloosahatchee River (Volety *et al*, 2003) and distributions noted within the Peace and Myakka Rivers (Estevez 2001, 1986, 1985) (Mote Marine Laboratory 2007).

Oysters require salinity levels above 4-5 ppt (parts per thousand) (Loosanoff 1932) with an optimal salinity range between 14 and 28 ppt (Chanley 1958, Galtsoff 1964). At higher salinity levels, saltwater predators such as oyster drills, large gastropods (Hofstetter 1977, White and Wilson 1996) and the protozoan parasite *Perkinsus marinus* (Volety 1995), can decimate oyster beds. Within the Peace River and Caloosahatchee River estuaries increased oligohaline conditions upstream have limited the distribution of oysters (Mote Marine Laboratory 2007). (Also see: http://www.fgcu.edu/cwi/research1.htm.)



Map 7: Oyster Distribution

Unvegetated Subtidal Bottoms and Tidal Mud Flats

The majority of the benthic estuarine habitats of the CHNEP are not vegetated. These habitats are abundant yet can be impacted by human activity such as dredge and filling, boating impacts and introduction of pollutants. Unvegetated habitats are broken down into groups based on tidal exposure and sediment composition: intertidal sand bar often exposed at low tide; submerged sand bar rarely or never exposed at low tide; and intertidal mud flats often exposed at low tide.

Submerged (subtidal) mud flats are rarely or never exposed at low tide. The difference between sand and mud habitat is obvious at the extremes but the distinction becomes less discrete when sand becomes muddy or mud becomes sandy. Tidal flats can be located in areas of both high and low wave energy where a gently sloping bottom in shallow water becomes exposed at low tides. High energy areas exhibit sand flats because the fine mud and clay particles are continuously washed out of the substratum, while low energy protected areas exhibit mudflats because fine particulates are able to settle out of the water column. Sand bars, both intertidal and submerged are often found in the vicinity of inlet passes. In some areas the sand bars or shoals are vegetated with seagrasses (Mote Marine Laboratory 2007).

Tidal mud flats provide critical harbor habitats throughout the Charlotte Harbor system. Despite their sometimes barren appearance, tidal flats are productive areas vegetated with epibenthic and drift algae, and inhabited by invertebrates such as crabs, oysters, clams, and worms. They are exploited as feeding areas by a diverse group of wading birds including white ibis, American oystercatcher, reddish egrets, and little blue herons, and they provide protected staging and resting areas for smaller migratory birds. The tidal flats in this region consist of estuarine beaches, areas waterward of mangroves, salt barrens at higher elevations, dredge spoil areas, mud flats, and channel shoals.

The geographic distribution of intertidal areas in the Charlotte Harbor system is one of the most dynamic of all of the critical Harbor habitats. This is due to the shifting nature of the relatively exposed sediments and the impacts of anthropogenic activities. These anthropogenic activities include sediment resuspension from shipping, dredge spoil disposal, channel maintenance, shoreline hardening, and breakwater construction. The distribution of intertidal areas was compiled by the FMRI based on National Oceanic and Atmospheric Administration (NOAA) nautical charts. The data were delineated from 1:10,000 scale navigation charts of Harbor areas, and 1:40,000 scale charts from other inner coastal areas.

Artificial Reefs

Artificial reefs are a type of hard bottom community that is created by man to improve recreational fishing. Pieces of hard materials such as concrete rubble, rock, and bridge demolition debris are placed in deeper waters to provide habitats for sport fish. “Reef balls”, concrete structures made just for the purpose, tires, and whole derelict ships have also been used with varying degrees of success. These areas function as habitat by attracting food fishes, providing shelter for juvenile predatory fishes, and attachment sites for deeper water sessile organisms such as sponges, mussels, and tunicates. The distribution of artificial reefs within the study area includes six areas of Charlotte Harbor proper shown as numbered in Table 1 below: south of the Cape Haze bar (7); three areas off Alligator Creek on the Harbor's northeast side

(3,4,9); near Hog Island near the mouths of the Myakka and Peace Rivers (10); and waterward of the Bokeelia shoals (11).

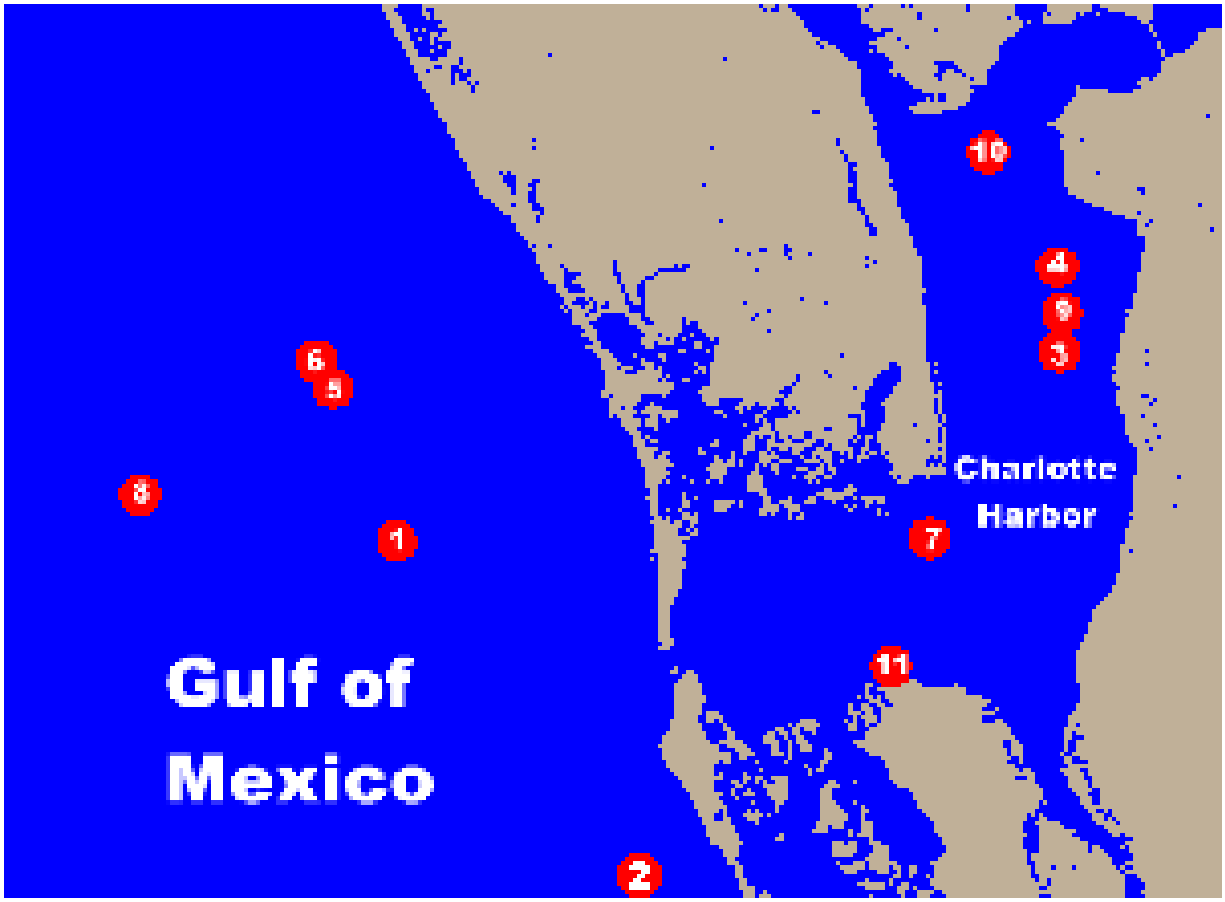


Table 1: Locations of artificial reefs in the Charlotte Harbor Study Area

Located:	Loran C: 14122.1, 44183.2 (26 48.748N, 82 25.110W)		
Material:	Bridge Rubble		
Deployed:	12/31/60		
Depth:	22 ft		
Located:	Loran C: 14114.1, 44070.6 (26 38.200N, 82 17.083W)		
Material:	667 Yards of concrete pilings and rubble		
Deployed:	7/3/1981		
Located:	Loran C: 14162.8, 44024.7 (26 49.887N, 82 05.543W)		
Material:	1100 tons bridge rubble	concrete culverts	228 tons concrete culverts
Deployed:	12/31/1983	6/13/1987	3/1/1991
Depth:	12ft	12ft	12ft
Located:	Loran C: 14166.8, 44031.7 {26 51.340N, 82 05.514W)		
Material:	1027 tons concrete culvert		

Deployed:	12/31/1987		
Depth:	11ft		
Located:	Loran C: 14126.3, 44209.7 (26 52.102N, 82 26.484W)		
Material:	550 tons concrete culvert		
Deployed:	5/1/1992		
Depth:	43ft		
Located:	Loran C: 14126.3, 44209.7 (26 52.210N, 82 26.510W)		
Material:	176 tons concrete culverts	196 tons concrete culvert	175 tons concrete culvert
Deployed:	5/15/1992	5/19/1992	5/21/1992
Depth:	43ft	43ft	43ft
Located:	Loran C: 14144.6, 44039.6 (26 45.770N, 82 09.340W)		
Material:	5 concrete vault, triangular steel & concrete units		
Deployed:	5/10/1995		
Depth:	21ft		
Located:	Loran C: 14108.5, 44241.5 (26 49.234N 82 31.961W)	Loran C: 14108.7, 44240.8 (26 49.221N 82 31.879W)	
Material:	60ft steel ferry & concrete boxes/pilings	70ft steel barge & 30 concrete pieces	
Deployed:	3/12/1999	5/21/1999	
Depth:	55ft	56ft	
Located:	Loran C: 14165.1, 44026.2 (26 50.511N 82, 05.306W)		
Material:	105 concrete reef balls		
Deployed:	5/7/1999		
Depth:	12ft		
Located:	Loran C: 14169.4, 44064.9 (26 54.80N 82 07.62W)		
Material:	Tire bundles		
Located:	Loran C: 14138.69, 44020.57 (26 42.15N, 82 09.08W)		
Material:	Concrete rubble		

Emergent Saltwater Wetlands

Emergent habitats are defined as intertidal habitats that maintain vegetation that extends both above and below the waterline at normal high tides. These habitats include mangroves, salt marshes, exotic vegetation, armored shoreline and unvegetated shoreline.

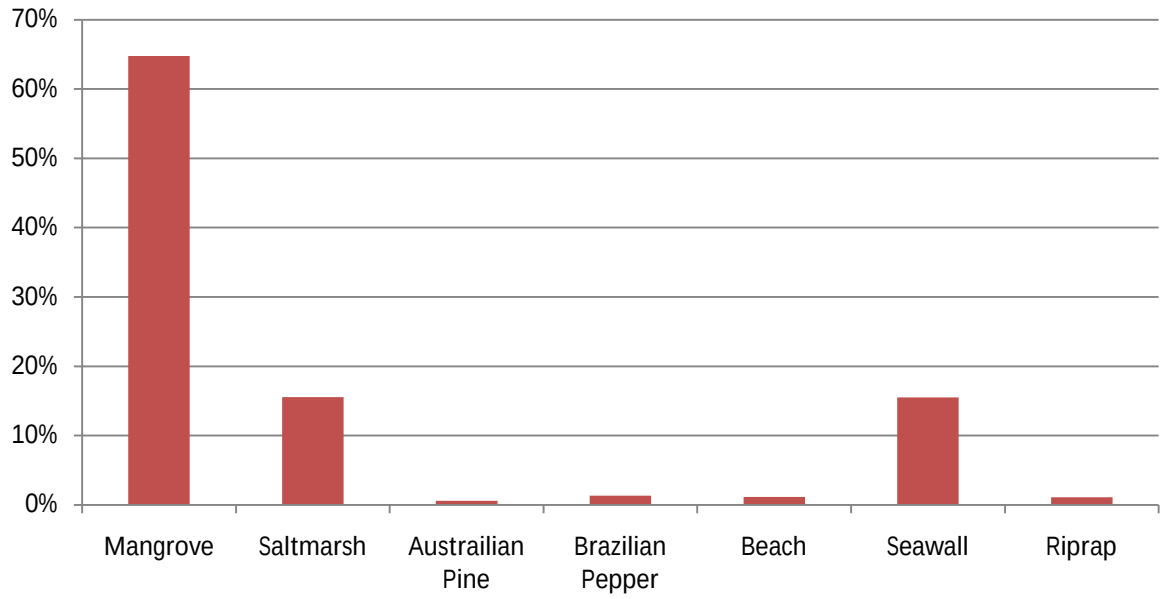


Figure 8: Proportional distributions of emergent wetlands and shoreline conditions of the CHNEP Study Area

Mangroves

Mangrove trees are the most dominant emergent vegetation in the CHNEP study area and mangrove forests form a distinctive broad margin around the estuaries of the CHNEP. They cover 63,831.96 acres and may extend inland several kilometers (miles) from open water.

Four mangrove species occupy the inner, low energy shorelines of the estuary. These trees generally range at maturity from 3.7 to 18.3 meters (12 to 60 feet) in height, but may occur as stunted morphotypes on tidal flats, such as high marshes, that have elevated salinities. The four mangrove species found in southwest Florida include red mangroves *(Rhizophora mangle*), which typically inhabit the areas closest to the water's edge; black mangroves (*Avicennia germinans*) that are generally upland of red mangroves, often within a shallow basin; white mangroves (*Laguncularia racemosa*), which are usually upland of black mangroves; and buttonwoods (*Conocarpus erectus*) which occur in areas upland of white mangroves.

The sense of synonymy for mangroves is unusual in that the same term is used to describe both the individual tree species and the total plant community including the individual tree species. Synonyms for the term mangrove include tidal forest, tidal swamp forest, mangrove community, mangrove ecosystem, mangal (Macnae 1968), and mangrove swamp. The Florida Land Use Classification and Cover System (FLUCCS) (FDOT 1985) identifies mangroves generally as

612, Mangrove Swamps, and specifically as 6121 Red Mangrove, 6122 Black Mangrove, 6123 White Mangrove, and 6124 Buttonwood.

The mangrove forests of South Florida are a vital component of the estuarine and marine environment. From the tree tops to the roots in the mud, mangrove forests provide critical harbor habitats for many of the living resources of the estuary: a major detrital base to organic food chains, significant habitat for arboreal, intertidal and subtidal organisms, nesting sites, cover and foraging grounds for birds, and habitats for less apparent reptiles and mammals. The relationship between mangroves and their associated marine life cannot be overemphasized. The mangrove forest provides protected nursery areas for fishes, crustaceans and shellfish that are important to both commercial and sports fisheries.

The branches of these trees provide nesting sites, hunting perches, and protection for a very diverse group of arboreal arthropods, such as mangrove tree crabs and mangrove skipper butterflies, and estuarine birds including roseate spoonbills, white ibis, wood storks, heron species, egret species, pelican species, ospreys, and bald eagles. The partially submerged prop roots of red mangrove trees support a great diversity of living resources including oysters, barnacles, tunicates, snook, red drum, mangrove snapper, and other organisms, both adult and juvenile.

The value and central role of mangroves in the ecology of South Florida has been well established by numerous scientific investigations directed at primary productivity, food web interactions, listed species, and support of sports and commercial fisheries (Odum *et al* 1982). The approximately 554,515 acres of mangroves remaining in central and south Florida are a unique and critical component of Florida's bay and estuarine ecosystems. Mangroves perform vital, irreplaceable roles in providing food for commercially important species such as striped mullet and pink shrimp. Mangrove systems have the highest measured annual productivity of any ecosystem measured in the world. They are critical to the world’s carbon balance. This ecosystem is a Florida habitat unique in the continental United States.

Mangroves have a significant ecological role as habitat for endangered species, threatened species, and species of special concern. For several of these species, the habitat is critical and vital to their continued survival. Mangroves serve as storm buffers by functioning as wind breaks and through prop root baffling of wave action. Mangrove fine roots stabilize shorelines and fine substrates, reducing potential turbidity, and enhancing water clarity. Mangroves improve water quality and clarity by filtering uplands runoff and trapping waterborne sediments and debris. Unaltered mangroves contribute to the overall natural setting and visual aesthetics of Florida's estuarine water bodies. Through a combination of the above functions, mangroves contribute significantly to the economy of the coastal counties of south Florida and the state of Florida.

Over the years, dredge-and-fill operations have reduced mangrove habitat in the CHNEP study area by about 25%. In addition to direct loss, urban and agricultural runoff changes water flows to interfere with the beneficial functions performed by mangrove systems. The high cost of developing mangrove habitat is ultimately paid by taxpayers in terms of flood damage, shoreline

erosion and water quality corrections. Despite increased regulation, cutting and trimming continues to threaten mangroves.

Mangroves are tropical species restricted by frost and vegetative competition to intertidal regions in tropical and subtropical sheltered waterbodies. Mangroves in the subtropical regions of south Florida represent the northern limits of these tropical species that have been able to colonize because of the warm ocean waters and warm currents along the Florida coastline combined with dependably warm winters (Tomlinson 1986). However, the distribution of mangroves in North America has changed through geologic time. When the red mangrove evolved in the Cretaceous, southwest Florida was a great coral reef in shallow seas. There may have been a few mangroves surrounding small islands and on the coastline in what is currently Georgia. By the Eocene, when black and white mangroves evolved, mangroves extended as far north as South Carolina. During the Pleistocene Ice Ages, mangroves were absent from the Florida coastline and *Spartina* marshes dominated the estuarine intertidal. During the past few centuries mangrove distribution has changed in response to short-term climatic fluctuations. Currently, mangrove distribution appears to be expanding northward in response to a warmer climate.

Red and white mangroves have been reported as far north in Florida as Cedar Key on the west coast. Black mangroves occur further north than reds and whites and have been reported as a shrub more extensively around the Gulf of Mexico where vegetated shorelines have survived development. Over 90 percent of the mangroves in Florida occur in the four southern counties of Lee, Collier, Dade, and Monroe.

The availability of fresh water and nutrients influences the location, size, structure, and productivity of mangrove communities in south Florida. Mangroves reach their greatest abundance in southwest Florida where a positive interaction occurs between fresh water, nutrients, and shorelines with low slope and low wave energy. Along parts of the west coast (Charlotte Harbor, Sarasota Bay, and Boca Ciega Bay), mangrove communities support the continued existence of barrier islands against tidal and wave forces. The Everglades system changes from fresh water to an extensive mangrove community at its seaward margin of Florida Bay. Mangrove communities typically maintain their population to the carrying capacity of the environment (Tomlinson 1986). Associated vegetation usually occurs adjacent to a mangrove community along transition zones, but such associates are not restricted to mangrove communities. Several salt marsh grasses (e.g., *Juncus* spp.) occur with mangroves along transition zones of saline marshes. Smooth cordgrass (*Spartina alterniflora*) communities colonize near red mangrove roots, but are eventually displaced by red mangroves (Gilmore and Snedaker 1993).

Fluctuations in sea-level rise along the Florida peninsula can limit the distribution of mangroves, particularly if the rate of sea level rise exceeds the rate of mangrove forest growth and substrate accretion and if the landward slopes provide no suitable habitat for forest retreat as sea level rises (Wanless 1998). The construction of seawalls behind mangrove forests prevents such shoreline adjustment.

The local distribution of mangroves is affected by a variety of interacting factors primarily including microclimate, substrate type, tidal fluctuation, terrestrial nutrients, wave energy, and,

salt water, but also by sea level rise and shore erosion, interspecific competition, and seed dispersal. The interrelations of these factors can alter the intertidal distribution of mangrove species. Mangroves are unique in that their morphological specializations, such as aerial roots, vivipary, and salt excretion, are excluding abilities that allow them to adapt to the variety of these different rigorous environmental factors.

Mangrove ecosystems are a mosaic of different types of forest, with each type providing different physical habitats, topology, niches, microclimates, and food sources for a diverse assemblage of animals. Mangroves have important structural properties including the trapping and, under certain conditions, stabilization of intertidal sediments and the formation of organic soils and mucks, providing protection from wave and wind erosion, provision of a dendritic vegetative reef surface in the subtidal and intertidal zones, and the complex of a multi-branched forest with a wide variety of surface and subsurface habitats.

Red mangroves are distinguished by the presence of a dendritic network of aerial prop roots extending from the trunk and lower branches to the soil. The prop roots are important adaptations to living in anaerobic substrates, providing gas exchange, and an anchoring system, as well as absorbing ability. Within the soil, micro-roots stabilize fine silts and sands, maintaining water clarity and quality. Red mangroves may attain heights of 25-38 m (82-125 ft.) in the rich deltas of riverine forests, but average 8-10 m (26-33 ft.) on most fringing shorelines, and occur as smaller trees at their northern extents or in marginal habitats such as the coral rock salt ponds of the Florida Keys. Red mangrove bark is grey and the interior wood red. Red mangroves can form a variety of crown shapes from short continuous scrubby crown to uneven discontinuous crowns. As trees gain size and age and put down large prop root supports, significant lateral as well as vertical growth occurs. This habit of spreading laterally has contributed to the nickname of ”walking trees”. The leaves are shiny, deep green on the top surface with a paler underside. Flowers are small and white with four petals and four bracts, and are wind pollinated. The germinated seed remains attached to the branch while it produces long (25 to 30 cm (10 to 12 inch)) pencil or torpedo-shaped propagules.

Black mangroves have distinctive horizontal cable roots that radiate from the tree with short, vertical erect aerating branches (pneumatophores) extending 2-20 cm (1-8 inches) above the substrate. The trees grow straight and erect attaining heights of 40 m (131 ft.), and averaging 20 m (66 ft.). Black mangrove bark is dark and scaly. Black mangrove leaves are narrow, elliptic or oblong, shiny dark green above and pale, almost cream green with short dense hairs below. The upper surface of leaves can be encrusted with salt excreted by the tree. The bilaterally symmetric white flowers are showy and pollinated by members of the Hymenoptera order of insects, which includes honeybees (Tomlinson 1986). The black mangrove is the source of mangrove honey. The germinated seed produces propagules the size and shape of lima beans (Odum and McIvor 1990). Black mangroves are shade tolerant and sun intolerant when immature, but become shade intolerant with maturation (Snedaker 1982). This produces different growth forms in immature and mature trees, and can result in mature black mangroves being overtopped or shaded by adjacent mangroves, landward trees, exotic vegetation or structures (Brown *et al.* 1988).

White mangroves grow either in tree form or shrub form up to heights of 15 m (50 ft.) or more. The growth form tends to be erect. Some white mangroves form erect, blunt-tipped pneumatophores if growing in anaerobic or chemically stressed soils. White mangrove bark is light colored and relatively smooth. Leaves are fleshy, flattened ovals with rounded ends. The same pale green color is on both upper and lower surfaces. Two glands that excrete salt and extra floral nectar are found at the apex of the petiole. Small yellowish flowers are found in alternate rows on the terminal ends of branches. These germinate small (1-1.5 cm (0.4-0.6 inch)), football-shaped propagules. In the northern part of their range, white mangroves may not propagate on the tree and true propagules are not formed.

Buttonwoods grow to 12-14 m (40-46 ft.) in height in a shrub or tree form, but do not produce true propagules in Florida (Tomlinson 1986). Buttonwood bark is grey and very furrowed, providing attachment sites for epiphytes. Leaves are thin, broad to narrow, and pointed. There are two morphotypes: the green buttonwood, with medium green leaves, found on peninsular Florida; and the silver buttonwood, with pale pastel green leaves, historically limited to the Florida Keys but now widespread by nursery practices. It is thought the silver buttonwood is an adaptation to the rocky, dry habitats associated with the islands. Two glands that excrete extra floral nectar and salt are found at the apex of the petiole. Tiny brownish flowers are found in a sphere on the terminal ends of branches. These produce a seed cluster known as the button. Buttonwoods are able to grow in areas seldom inundated by tidal waters. The mangrove adaptations to the osmotic desert of salt water also allowed buttonwoods to utilize arid areas of barrier islands and coastal strands. Because of its landward range and intolerance of anaerobic soils, the buttonwood is legally considered a wetland plant, but not a mangrove in Florida Statutes.

All four mangrove species flower in the spring and early summer. Propagules fall from late summer through early autumn.

Mangrove forest canopy heights depend upon climate; particularly freeze limits, topography, substrate type and the extent of human disturbance, with undisturbed mature mangrove communities having a continuous canopy that is high, dense and complex, whereas in naturally disturbed mangrove areas, the canopy is lower with more irregular growth (Tomlinson 1986). Dense mangrove forests do not typically have understory plant associations, except for mangrove seedlings.

Areas of tree fall or other openings in the canopy provide opportunity for other halophytic plants and young mangroves to flourish in the newly available sunlight. Mangrove associates, including up to 30 species of vascular plants, occur in transitional areas with mangroves, but are not restricted to mangrove communities. Several salt marsh grasses (e.g., *Juncus, Sporobolus, Monanthachloe, Distichlis spicata*) and succulent herbs (*Salicornia, Sesuvium, and Batis* spp.) occur with mangroves along transition zones of saline marshes. Smooth cordgrass (*Spartina alterniflora*) communities often colonize bare emergent areas near red mangrove roots, but are eventually displaced by mangrove shadowing (Gilmore and Snedaker 1993).

Six mangrove community types have been characterized based on their different geomorphic and hydrological processes (Lugo and Snedaker 1974). *Overwash mangrove forests* are islands

frequently inundated, or over-washed, by tides resulting in high rates of organic matter deposition and usually containing red mangroves of a maximum height of 7 m (23 ft.). *Fringe mangroves* form thin forests bordering water bodies with standard mangrove zonation, attaining maximum height of 10 m (33 ft.). *Riverine mangroves* are in the flood plains and along embankments of tidal creeks and rivers but are still flooded by daily tides. Red, black, and white mangroves are usually present, and the canopy layer can reach heights of 18-20 m (60-66 ft.). *Basin mangrove forests* occur in depressions along the coast and further inland that collect precipitation and sheetflow and that are tidally influenced. These forests can attain heights of 15 m (50 ft.). Red mangroves are more common along the coastal areas, while blacks and whites dominate further inland. Influences from daily tides decrease further inland. In areas where salinity is concentrated by evaporation and major tidal flushing occurs seasonally, black mangroves dominate. *Hammock forests* grow on higher elevated, typically highly organic ground, and rarely exceed 5 m (16 ft.) in height. These are often surrounded by other wetland types, both freshwater and salt water marsh, and may be historical islands. *Scrub or dwarf forests* are found in peninsular south Florida and the Florida Keys and rarely grow taller than 1.5 m (5 ft.), which may be a result of fewer available nutrients on rocky substrates. Two contrasting conditions produce these forests: low-nutrient, oceanic-salinity waters, as in the Keys, and, the most landward, frost-cropped edges of forests, as at the landward limits of the mangrove forest adjacent to high marsh.

The process of propagule dispersal, sorting, and colonization is highly variable and is influenced by a variety of physical and biological factors which may contribute to the zonation of mangroves (Rabinowitz 1978b). Vegetative dispersal and establishment is accomplished mainly through propagules. Dispersal of mangrove propagules is primarily accomplished by water currents and tides. Although propagules can be carried to a variety of areas, often mangroves are established only for the short term in sub-optimal, inhospitable areas which have high fetch, shallow soils, high wave action or other environmental stresses.

Mangroves are considered pioneer species because of their ability to establish on otherwise unvegetated substrates. Once individuals begin to colonize a disturbed area, same-age communities are established with little variance in the structure because new development of successive colonizers is arrested by the closed canopy.

The standard zonation of mangroves consists of red mangroves in the lower and middle intertidal zone, black mangroves in the upper intertidal areas that are occasional flooded and white mangroves in patches on higher elevated grounds that are less frequently flooded. Buttonwoods are located further inland in areas that are within the limits of the highest tides (Tomlinson 1986). While this pattern can be found on low-slope shorelines with low wave-action, organic soil, even salinity gradient, warm water, and sheet flow delivery, in reality mangrove zonation is often more complex and mixed forests of red, black, white , and buttonwoods are often observed.

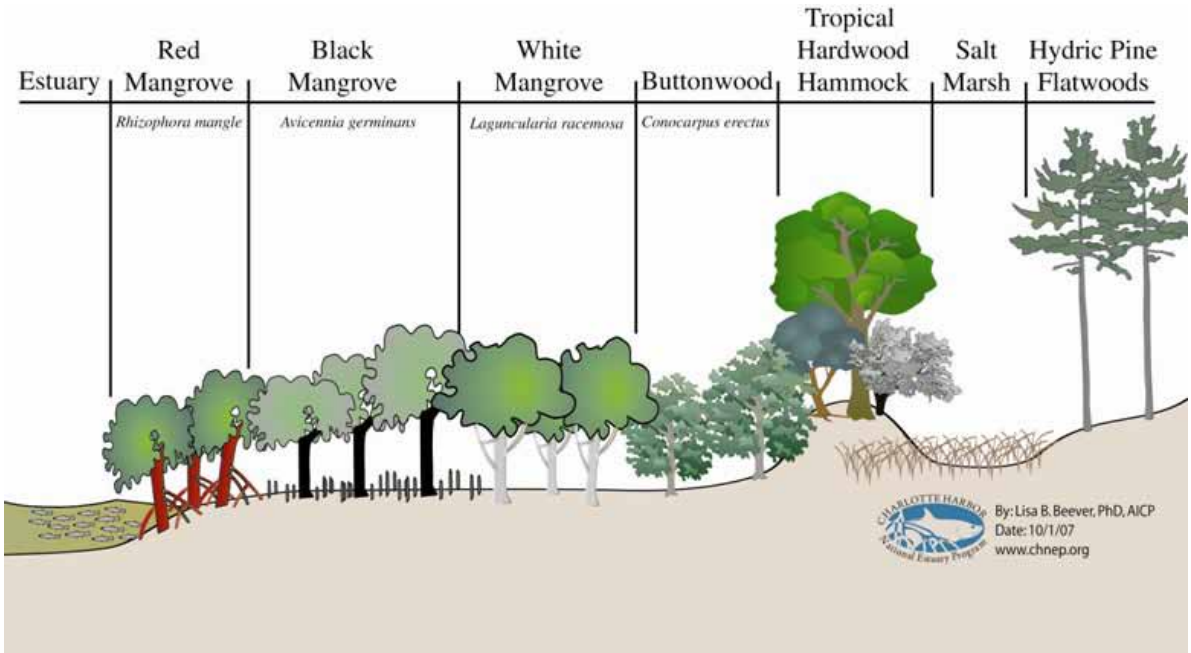


Figure 9: Diagrammatic cross-section of typical mangrove fringing forest zonation in the CHNEP system

Historically, succession theory viewed red mangroves as the younger colonizing or pioneer stage which was located more seaward, with black and white mangroves as more mature stages located more landward, and adjacent tropical hardwood forests as the climatic stage (Davis 1940). Mangrove forests were considered different than other vegetative communities in not experiencing traditional plant succession, but replacement succession primarily as a function of sea level rise, where mangroves must either keep up with the rise in sea level or retreat from rising water levels. On shorter time scales, the community was thought to experience fluctuations in habitat type and species composition as a result of changes in such factors as hydrologic pattern. Current thinking, however, now considers mangrove distribution and zonation within and between forests to be the result of a variety of edaphic and site-specific historical factors. The determinate factors can be very different in different locations (Rabinowitz, Smith).

Mangroves can grow on many different types of substrates and can affect their substrate through peat formation and altering sedimentation. Mangroves are found on fine inorganic muds, muds with high organic content, peat, sand, rock, coral, oysters and some man-made surfaces if there are sufficient crevices for root attachment. Mangroves grow better in areas of low wave energy along shorelines, river deltas, and flood plains where fine sediments, muds, and clays accumulate and peats will form (Odum *et al.* 1982). Fluctuating tidal waters are important for transporting nutrients, controlling soil salinities, and dispersing propagules. Mangroves are richer along coasts with high levels of rainfall, heavy runoff, seepage, and a resultant increase in sedimentation which provides a diversity of substrate types and nutrient levels higher than that of sea water (Tomlinson 1986). Red, black, and white mangroves can grow in completely anaerobic soils (Lee 1969). Black mangroves grow best in soils of high salinity. Red mangroves grow best in areas of estuarine salinity with regular flushing. White mangroves grow best in

areas with freshwater input on sandy soils. Mangroves have a harder time surviving in soils with salinities of 70-80 ppt. (Day *et al.* 1989). Red mangrove is limited by soil salinity above 60 to 65 ppt. (Teas 1979). White mangroves grow stunted at 80 ppt. and black mangroves can grow at soil salinities of greater than 90 ppt.

Mangroves can modify soils by organic contributions and peat formation particularly in southwest Florida and the north shoreline of Florida Bay. This peat appears to be primarily from red mangrove root material and can reach thicknesses of several meters. Mangrove peat has a low pH (4.9 to 6.8). When mangrove soils are drained by human activity they experience dramatic increases in acidity due to oxidation of reduced sulfur compounds in the formerly anaerobic soils. This creates “cat clays” (pH 3.5 to 5.) that can kill all vegetation, including the mangroves.

Mangroves are facultative halophytic species. Salt water is not required for growth. Mangroves are limited to areas that have partial inundation of brackish or saline water and cannot persist solely in fresh water principally as the result of interspecific competition from much faster growing freshwater wetland plants. Salinity is addressed by salt exclusion and storing salt in the red mangrove or salt-secretion in black and white mangroves, and the buttonwood.

Mangroves are able to grow in a wide variety of surface waters in a range of salinities from 0 to 40 ppt. Coastal salinities generally range from 18 to 30 ppt. throughout southwest Florida, except in parts of the Caloosahatchee River that experience hypersaline conditions of over 40 ppt. when the flow of freshwater is denied by lock closures and in isolated back bays.

Mangroves are able to grow in waters from high to low macro-nutrient concentrations and are able to remove nutrients, thereby improving culturally nutrified waters. Mangrove forests can be important nutrient sinks for an estuary.

Due to special adaptations to anaerobic soils, mangroves can grow in areas of very low dissolved oxygen concentrations. Since photosynthesis is occurring above the water column mangroves can grow in waters of relatively high color and turbidity. Mangrove leaf litter contributes to the tannin colors of estuarine waters while stabilizing and settling turbidity. Mangroves can contribute total organic carbon (TOC) to surrounding waters and particulate organic carbon (POC) as part of the net primary productivity export to the food web. Mangrove forests can also act as sinks for non-metallic (sulfur) and metallic minerals (iron and copper) when forming peat.

The biomass of mangroves and the mangrove forest is dominantly below ground. Measures of biomass in a 1.5 m (5 foot) tall canopy show 712 dry kg/ha in the leaves; no fruit and flowers; 3,959 dry kg/ha in the wood, 3,197 dry kg/ha in the roots, and 1,140 dry kg/ha in leaf litter. In contrast a 6 m (20 foot) tall canopy has from 5,843 to 7,031 dry kg/ha in the leaves; 28 to 131 dry kg/ha in fruit and flowers; 57,960 to 128,510 dry kg/ha in the wood, 17,190 to 27,200 dry kg/ha in the roots, and 22,730 to 98,410 dry kg/ha in leaf litter. The standing crop of a short canopy whether young, naturally stunted or hedged is from 3.6% to 8.3% of an untrimmed mature red mangrove fringe. With reduced standing crop, annual gross primary production (GPP) can be expected to be proportionally less.

No direct measures of GPP of trimmed or otherwise impacted red mangrove systems are available. The natural red mangrove GPP has been measured by Hicks and Burns (1975) and is inversely related to salinity as follows: at 7.8 ppt. average surface salinity GPP was 8.0 $gC/m^2/day$ (35,332 kgC/ha/yr) (gC is grams of carbon); at 21.1 ppt. average surface salinity GPP was 3.9 $gC/m^2/day$ (17,224 kgC/ha/yr); and at 26.6 ppt. average surface salinity GPP was 1.6 $gC/m^2/day$ (7,066 kgC/ha/yr).

The annual net primary productivity (NPP) of a 1.5 m (5 ft.) tall red mangrove system is 18% of the annual NPP of a mature system which produces 20.5 metric ton C/ha/yr (Teas 1979).

The NPP exported from natural red mangrove fringe, in the form of utilizable mangrove detritus has been measured at 9.9 metric tons/ha/yr by Pool *et al.* (1975). Teas derived 10.6 metric tons/ha/yr for mature red mangroves and 1.3 metric tons/ha/yr for shrubby 1.5 m (5 ft.) tall red mangrove fringes. The lowest reported NPP export for a mature red mangrove canopy of 7.3 metric tons/ha/yr. Short canopy provides only 12% to 19% of the detrital export of a mature untrimmed red mangrove fringe.

The primary production ability of mangrove leaves varies. The upper canopy contains "sun leaves" which are smaller with heavy cuticle and tannin cells which protect against the heat and ultraviolet encountered in the upper parts of the tree. The lower canopy is composed of "shade leaves" which have larger surface area, more chlorophyll, less cuticle and which are oriented to obtain maximum light in shade conditions. Once a leaf is formed to one of these morphologies it cannot be changed. Lugo *et al.* (1975) demonstrated that, in red and black mangroves, the "sun leaves" demonstrated twice the photosynthetic rate of "shade leaves". At night, "shade leaves" have four times the respiration rate of the "sun leaves". Because of these morphologic differences, when a red or black mangrove is topped, frozen, or defoliated, the tree loses its most efficient leaves, and leaves that are not adapted to the heat, light, and UV of the canopy situation are then left exposed to adverse conditions. As a result both GPP and NPP are severely reduced until new "sun leaves" are set, if the tree lives. It is occasionally observed that "shade leaves" on surviving branches will wither, die, and drop under the heat of the sun when cutting is performed in the summer.

The age of a mangrove leaf and the tree as a whole affects both the net photosynthesis and the photosynthetic efficiency of the mangrove tree. In red mangroves, mature trees have a net photosynthesis of 1.38 $gC/m^2/day$ with a photosynthesis: respiration ratio of 6 (Lugo *et al.*, 1975). Thus, mature trees fix six times more energy than is utilized in metabolism. In contrast, young growing trees fixed 0.31 $gC/m^2/day$, an inverse ratio of photosynthesis to respiration of -0.16. Growing mangrove trees responding to losses of vegetation (freezing, cutting, herbicides, etc.) must utilize energy to grow, while the uncut tree accumulates biomass which will then be available to the estuary as exported detritus.

All mangrove tree species are particularly susceptible to herbicide damage (Walsh *et al.* 1973; Tschirley, 1969; Orians and Pfeiffer, 1970; Westing, 1971; and Odum *et al.* 1974.) The red mangrove is particularly sensitive due to the small reserves of viable leaf buds. The stress of a single defoliation can be sufficient to kill the entire tree.

The detrital food base in natural mangrove systems follows seasonal cycles of leaf growth, chemical changes in leaf composition, and natural leaf drop. Although it is not yet fully investigated, a sequence of leaf chemistry changes occurs in the leaves which the red mangrove naturally drops. The naturally dropped leaf is the oldest leaf in the red mangrove leaf cluster, has had chlorophyll removed, giving it a yellow coloration from carotenes and xanthophylls, and has had other substances including excess sodium and chloride deposited in it. It is suspected that in most mangroves, the annual properly timed leaf fall is also a mechanism for the removal of excess salt prior to and concurrent with new growth and fruiting (Joshi *et al.* 1975 and Saenger 1982). It is not unlikely that essential, limited nutrients and trace elements are mobilized and removed from a leaf before it is dropped for use in the growth of new leaves.

Studies of south Florida estuarine food webs have found that 85% of the detrital food base is from red mangroves (Honde and Schekter 1978 and Lewis *et al.* 1985). This detritus is dominantly leaves but also includes leaf and propagule stalks, small twigs, roots, flowers and propagules. These are fragmented by processors into detritus, decaying organic material coated with and created by algae, fungi, bacteria and protozoa. This detritus is further fragmented, consumed and excreted by a number of primary consumers dominated by small crustaceans. The leaf base material itself is not directly consumed but the algae, fungi, bacteria and protozoal biomass on it is. This results in the excretion of a smaller detrital particle which again becomes the base for a detrital garden of microorganisms. This process is repeated many times utilizing the detrital particle to its full nutritive value to the estuarine ecosystem. Eventually the particle attains a small enough size for use by filter feeders and deposit feeders.

Entire trunks and large branches are not available to this system directly but have to be processed by a much slower system of marine and terrestrial borers and slow decay. If large volumes of cut material enter the aquatic or intertidal system in a short time period, one of two things occurs. If an abundant resident population of borers is present in the mangrove system and the weather is sufficiently warm at the time of cutting, unnaturally high abundances of wood boring animals develop in the slash, and through time their dispersed offspring attack the cut ends of the trimmed mangroves and healthy uncut trees. If the weather is cold, however, and the local population of borers is low or absent, then the slash sits, does not decay and can mineralize into unavailable cellulose. This has been directly observed in Lee County where mangrove branches cut in 1979 remain intact and mineralized today and the area where these piles are located has not recruited new mangroves.

The high level of animal diversity in a community of so few plant species occurs because of the wide variety of spatial and temporal microhabitats. The complexity index is a measure of microhabitat availability to wildlife. This index is one integrative measure that combines floral characteristics (number of species) (s), number of individuals with DBH > 10 cm (stand density) (d), basal area (b), and height (h). The index results in a quantitative description of the structural complexity of tropical vegetation. The complexity index of a mature southwest Florida fringe mangrove system is can attain 9.6. The complexity index of a basin mangrove forest can attain 23.4. The complexity index of short canopy mangroves is at best 1.5 (Pool *et al.* 1977). The specific functions and benefits of each microhabitat change along the land/sea gradient.

The complex structure of prop roots, pneumatophores and main trunks provides living spaces for numerous periphytic and epifaunal organisms, topological structures for a rich invertebrate fauna, shade for thermoregulation, and cover from predation for large populations of small fishes, nektonic and benthic crustaceans, annelids, mollusks, and echinoderms. This combination of shelter and food source makes the mangrove forest a rich nursery and feeding ground for the juvenile and adult forms of many commercially and ecologically significant species of fish and other vertebrates. Many animals associated with mangroves, oyster bars and open unvegetated waters by day, such as pomadasyid fishes, forage in grassbeds at night. Many estuarine fishes spend their early life in mangroves and then move as adults to complete life cycles in sea grass habitats. Species associated with prop roots include 74 species of epiphytic algae (Rehm 1974), eight species of crabs, nine species of polychaetes, plus 22 other species of invertebrates (Courtney 1975). The epiphytic algae have a NPP rate of 1.1 $gC/m^2/day$ (Lugo *et al.* 1975).

The highest quality sea grass beds are often associated with mangroves. Animals utilizing the mangrove/sea grass community include herbivores such as green sea turtles, manatees, sea urchins, blue crabs, fiddler crabs, and many fishes. The amount of direct grazing varies with location. In Charlotte Harbor and northern Indian River Lagoon many sea grass-grazing fishes are at their northern limit. Many other organisms, such as conch, scrape mangrove roots and sea grass blades for epiphytic algae and animals. If roots are undisturbed, mangroves and sea grass beds respond well to natural grazing.

The primary types of algal growth in the mangroves include: those that grow on the soft sediments; epiphytic species that utilize sea grasses, mangroves, or emergent marsh grasses; the algae that require a hard substrate to anchor such as oyster bars; and the unattached drift algae. The only algae able to remain in the soft sand and mud substrates utilized by mangroves are mat-forming algae and the Siphonales green algae which have creeping rhizoid anchors, including *Halimeda, Penicillus, Caluerpa, Rhipocephalus* and *Udotea*. These algae have limited substrate stabilization capability when compared to mangroves and sea grasses. They are able to survive in more shifting sediments, however, and are often considered as an early successional stage for vascular plant establishment. These algae provide primary food production and deposit large quantities of calcium carbonate or lime mud from their skeletons upon seasonal die-back.

The epiphytic algae are a diverse assemblage. Red algae (Rhodophyta) make up approximately 45% of the common species of epiphytes. Blue-green (Cyanophyta) and green algae (Chlorophyta) constitute 21% each of this total, and brown algae (Phaenophyta) represent the remaining 12%. Many animals feed directly on these epiphytes. Heavy growth of encrusting coralline algae, however, can cover their hosts. Blue green algal epiphytes can fix molecular nitrogen which is utilized by mangroves. Hard substrate algae consist of hundreds of species from all of the major macroalgal phyla. Natural bottoms of south Florida provide few hard, abiotic surfaces with old exposed shells (oysters, clams and whelks) and some areas of exposed bed rock constituting the principle natural areas of hard bottom. Mixed abundances of these plants occur where water quality and clarity is good. The drift algae species begin growth attached to a firm substrate, plant or inorganic object, and subsequently become detached by wave action, grazing or mechanical disturbance. Large masses travel like organic tumbleweeds on the tides and currents, providing shelter and food sources for many small invertebrates and

fishes, often where no other cover would be available. The drift algae of south Florida are commonly the red algae, *Gracilaria* and *Laurencia* that seasonally peak in abundance and concentration from July to December. The microalgal contributions to estuarine productivity and the food chain are often overlooked because of their microscopic size and seasonality. The diatoms and armored flagellates, which comprise the major abundance and diversity of phytoplankton and benthic, epiphytic, and epifaunal microalgae, are essential to zooplankton, the larval life stages of crustaceans and fish species, and filter-feeding mollusks including clams and oysters. Productivity of the phytoplankton community is seasonal with different species assemblages resulting from changes in temperature, day length, water quality and clarity, nutrient balance, and grazing pressures. Imbalances in these factors can result in algal blooms, including the notorious red tide. Although phytoplankton productivity is, on the average, one sixth of the macrophytic production system wide, its productivity is directly available, often at critical periods in consumer life cycles. In combination with bacteria and saprophytes, the epiphytic microflora mediate the productivity of mangroves, sea grass and salt marsh plants by converting of their detrital biomass to nutritive forms digestible by animals.

Naturally occurring, undisturbed unvegetated bottoms associated with mangroves are rich in animal biomass and can display high diversities of invertebrates and fishes. The principal sand and mudflat animal community is buried beneath and within the unvegetated substrates. This includes a diverse assemblage of bivalve mollusks: hard shelled clams, angel wings, surf clams, razor clams, stout tagelus, donax clams, semele clams, macoma clams, tellins, Venus clams, cockels, lucines, and many others. Burrowing segmented worms, filter feeding segmented tube worms, burrowing flatworms, ribbon worms, burrowing crustaceans, brittle starfish, sand dollars, acorn worms, and lancelets, all filter feed, deposit feed, scavenge, and hunt within the unvegetated substrate. Numerous species of gastropods also associated with mangroves live on and within sand and mudflats, often in amazing abundance, including Florida crown conch, whelks, nassa mud snails, horse conchs, tulip conchs, moon snails, horn shells, and ceriths. Predatory, bottom-feeding fishes flourish in these areas of naturally diverse often patchy bottom habitats. Many mobile invertebrates and fishes which avoid open, unvegetated areas during the day forage across these flats nocturnally. The intertidal flats support abundant burrowing crab colonies which forage in coordination with tidal cycles. Wading and shore birds, including sandpipers, dowitchers, willets, plovers, egrets, herons, and ibis hunt the denizens of the flats by probing the substrates and snatching the exposed invertebrates. Benthic microalgae are often present in more consolidated substrates providing a pale pink, green, brown or black hue to surface sand/mud layers. The natural unvegetated bottom observed today is often the sea grass bed, algal bed, oyster bar, or mangrove overwash island of tomorrow, given the proper conditions and freedom from disturbance.

Tidal creeks provide aquatic organisms from nearby oceanic or estuarine habitats access to the mangrove wetland forest. A multitude of predatory birds, fish, crustaceans, mollusks, reptiles, and mammals use this avenue to hunt and capture the abundance of available prey. Several endangered, threatened, and rare species use tidal creeks such as the common snook (*Centropomus undecimalis*), green sea turtle (*Chelonia mydas*), American crocodile (*Crocodylus acutus*), American alligator (*Alligator mississippiensis*), and the herbivorous West Indian manatee (*Trichechus manatus latirostrus*).

Inland from the fringe, the mangrove forest intermixes with salt marsh species and provides habitat to organisms that can withstand changing water levels. Common salt marsh species found in this ecotone are saltwort (*Batis maritima*), perennial glasswort (*Salicornia virginica or Sarcocornia ambigua*), and saltgrass (*Distichlis spicata*). As water levels change with daily tides and seasonal influences, the organisms here migrate to adjacent permanent water habitats. This area is an important foraging area during periods of low water because organisms become concentrated in small pools of water, making it easy for predators to capture prey. Juvenile endangered wood storks are especially dependent on these conditions.

Further inland, the mangrove forests mix with tropical hardwood hammock species. Organisms rely on the arboreal and terrestrial components of this transition community. Commonly associated hardwood species include cabbage palms (*Sabal palmetto*), Jamaica dogwood (*Piscidia piscipula*), West Indian mahagony (*Swietenia mahagoni*), stopper (*Myrtus verrucosa*), poison wood, black bead (*Pithecellobium keyense*), and gumbo limbo (*Bursera simaruba*) (Shromer and Drew 1982). The transition between these two adjacent communities provides an important ecotone, where species can take advantage of resources from both communities. Mammals and reptiles move from the hardwood forests to feed in the mangrove community. The lower reaches of tidal river mouths display a mixture of mangrove and salt marsh vegetation. Further upstream the less saline admixture of upland watershed drainage combined with estuarine waters provides a euryhaline zone which can support up to 29 species of vascular halophytic plants. In this ecotone between mangroves/salt marsh and the freshwater wetlands, the dominant plant species change in response to seasonal variations in salinity, water volume, air and water temperature, nutrient loading and grazing pressures. Diversion of fresh water by unnatural water control and water withdrawal projects and activities shifts plant species composition in favor of more salt tolerant plants. The gross productivity of riverine wetlands increases when surface freshwater input increases; however net production decreases because of osmoregulatory stress. The new productivity is optimal at medial salinity. In these moderate to low salinity waters, a wide variety of plant communities can develop, depending on sediment, elevation and season. Widgeon grass, a submerged grass tolerant of wide salinity changes, vegetates sandy shallow channels, providing habitat for fishes and invertebrates in similar fashion to sea grasses. River banks support a variety of emergents, including mangroves, three squares and bulrushes, fringerushes, *Juncus* rushes, spikerushes, cattails, giant reed, leather fern, saltgrass, knotgrass, cordgrasses, asters, pinks, coastal water hyssop, and many of the salt marsh herbs. The health of the mangrove estuary depends upon the health of its tributaries and headwaters. If the riverine wetlands are destroyed, the creeks channelized, and the water quality degraded in the watershed external of the boundaries of the mangroves, it is not possible for the mangroves to retain their total fishery and wildlife habitat values.

The distribution of mangroves in the Charlotte Harbor NEP study area was compiled from delineation completed in 1988 by the SFWMD and in 1990 by the SWFWMD (Table 10-14). The wetlands were delineated from color infrared aerial photographs. A series of maps from these data is presented and described in the following text. These data are currently being updated by both of the Water Management Districts using photographs made in 1995.

Status and Trends: Mangroves

The estimated 182,100 to 307,600 hectares (450,000-760,000 acres) of mangroves that remain in central and south Florida are a unique and critical component of Florida's bay and estuarine ecosystems. They deserve special protection, particularly in aquatic preserves because of the following:

Mangrove ecosystems are susceptible to both natural and human induced impacts. Large hurricanes are the primary natural factor that can cause excessive damage. The structure of mangrove forests is influenced by the presence or absence of hurricanes. Forests that experience high frequency of hurricanes have more simple structures than those with few or no hurricanes.

The two main human-caused changes affecting mangrove communities today are the effects of urbanization, and the alteration of fresh water hydroperiod by water management practices. Man can alter the distribution and structure of mangrove communities through direct destruction by cutting and by dredge and fill activities. Alterations in the natural fresh water flow regime through diking, impounding, and flooding activities in order to control mosquitoes and build waterfront structures affects the salinity balance and encourages exotic vegetation growth. As a result of changing natural sheet flow, mangroves have experienced a change in water and soil salinities. With the decline in natural fresh water flow through the Everglades, red mangroves have invaded former fresh water tributaries of the Taylor Slough drainage basin (Gilmore and Snedaker 1989). Australian pine tree and Brazilian pepper are two exotic plant species that invade mangrove communities as a result of changes in water flow.

The loss of mangrove productivity to Florida estuarine food chains is well documented for certain locations. Since the early 1900's, mangrove communities in south Florida have steadily disappeared (Snedaker *et al.* 1990). As of 1974, there were approximately 190,000 ha (469,500 acres) of mangroves remaining in Florida (Coastal Coordinating Council 1974). Northern Biscayne Bay has lost 82% of its mangrove acreage (Harlem 1979). Along the Indian River Lagoon, 92% or 13,083 ha (32,000 acres) of red and black mangroves was impounded for mosquito control between 1955 and 1974 (Gilmore and Snedaker 1993). In the Tampa Bay area, 44% of the tidal vegetation, including mangroves, was destroyed through dredge and fill activities over a 100 year period (Lewis *et al.* 1979). Lee County has lost 19% of its original mangroves (Estevez 1981). In the upper Florida Keys, over 15% or 8,306 ha (20,500 acres) of the original mangrove forests were cleared for residential and commercial construction purposes by 1991 (Strong and Bancroft 1994).

Statewide estimates vary on total mangrove loss. Conservative values of 3 to 5% were derived by Lindall and Saloman (1977). More recent work which includes destruction up to the time of Lindall and Saloman indicates a 23% statewide loss (Lewis *et al.* 1985). This value includes areas of mangrove area expansion such as Charlotte Harbor where there has been a 19% increase due to conversion of high marsh and salt flats through mosquito ditching.

While the effects of mangrove trimming, if performed properly in limited view windows, on productivity would be difficult to measure, the effects of mangrove hedging and improper trimming can be substantial, with losses of 8.6 tons of carbon/hectare/year when a 6 meter (20 foot) tall canopy is reduced to 1.5 meters (5 feet) in height. In an urbanized aquatic preserve

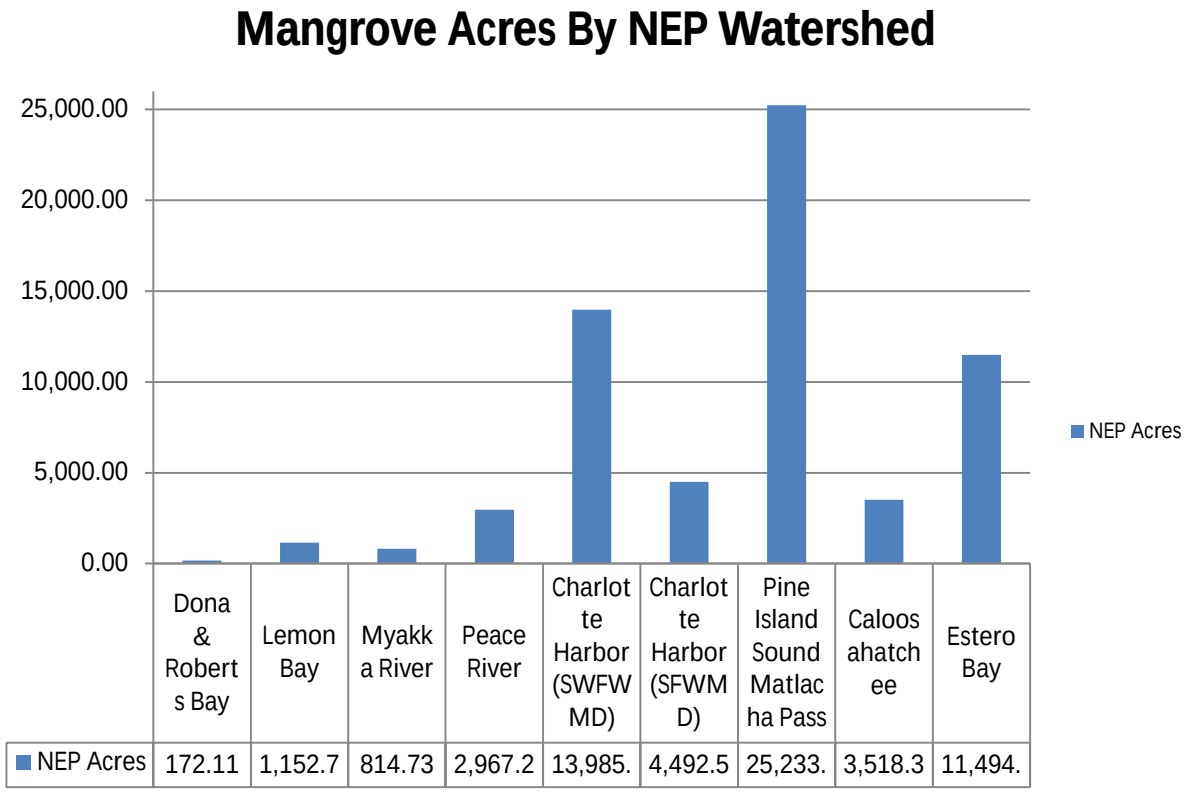
where the majority of the shoreline could be subjected to hedging, this could result in a local loss of approximately 87% of the annual productivity of the mangrove ecosystem. At Key Biscayne Golf Course in 1979, one acre of mature Coastal Band red mangroves were pruned to a height of 1.8 to 2.4 meters (six to eight feet) to provide a better view from the Golf Course restaurant. Within six months almost all of these trees were dead (Dade County Environmental Resource Management 1982).

A comparison of cut and adjacent natural mangrove fringes in seven of the eight Southwest Florida aquatic preserves was performed, utilizing standardized methods of measurement of mangrove productivity including standing crop (Heald 1971, Teas 1979, Pool et al 1975); and leaf parameters (Beever et al 1979, Twilley and Steyer 1988). Statistically significant reduction in net primary productivity export (83%), reduction of standing leaf crop (71%), reduction of flower production (95%), reduction of propagule production (84%), and reduction of leaf clusters (70%) resulted from the cutting of the 4.9 meter (16.1 feet) tall fringing red mangrove to 1.7 m (5.4 feet).. Similarly, reduction of net primary productivity export (72%), reduction of standing leaf crop (49%), reduction of propagule production (73%), and reduction of terminal branches (45%) resulted from cutting a 3.4 meter tall fringing white mangrove area to 1.3 m. Habitat utilization by associated large visible fauna was significantly reduced (79%) by mangrove trimming. For the parameters measured, no net positive benefit of mangrove trimming/cutting could be confirmed. The documented evidence of this study and existing literature (Beever 1988, Twilley and Steyer 1988) indicate that mangrove cutting is deleterious to the estuarine environment; the mangrove trees themselves, and the fauna which depend upon mangroves for habitat and primary production (Beever 1996).

Oil and its by-products can be extremely harmful to mangroves. Damage from oil spills has been documented and reviewed by Odum and Johannes (1975), and Carlberg (1980). Petroleum oils and by-products kill mangroves by coating aerial and submerged roots and by direct absorption by lipophyllic receptors on the mangrove. This leads to metabolic dysfunction from destruction of cellular permeability and dissolution of hydrocarbons in lipid portions of chloroplasts (Baker 1971). Attached fauna and flora are killed directly. Effects are also long-term and require years to complete. Some severe effects, including tree death can take place months or years after a spill (Lewis 1979a, 1980b). Little can be done to prevent damage once it has occurred. Common dispersants used to combat oil spills are toxic to vascular plants (Baker 1971). Damage from the actions of mechanical abrasion, trampling, compaction during cleanup can add rather than remove negative environmental impacts. Where oil drilling has occurred in association with mangrove shorelines significant adverse impacts have occurred (Longley *et al.* 1978).

At this time there are no reliable estimates of what proportion of Florida's mangroves are in aquatic preserves, in other public holdings and in private ownership. Overall there are approximately 670,000 acres of mangroves in Florida (NWI 1982).

Map 8: Distribution of Mangroves in the CHNEP Study Area in 2005



	Dona & Roberts Bay	Lemon Bay	Myakka River	Peace River	Charlotte Harbor (SWFWMD)	Charlotte Harbor (SFWMD)	Pine Island Sound Matlacha Pass	Caloosahatchee	Estero Bay
NEP Acres	172.11	1,152.7	814.73	2,967.2	13,985.	4,492.5	25,233.	3,518.3	11,494.

Figure 10: Mangrove acres by CHNEP watershed

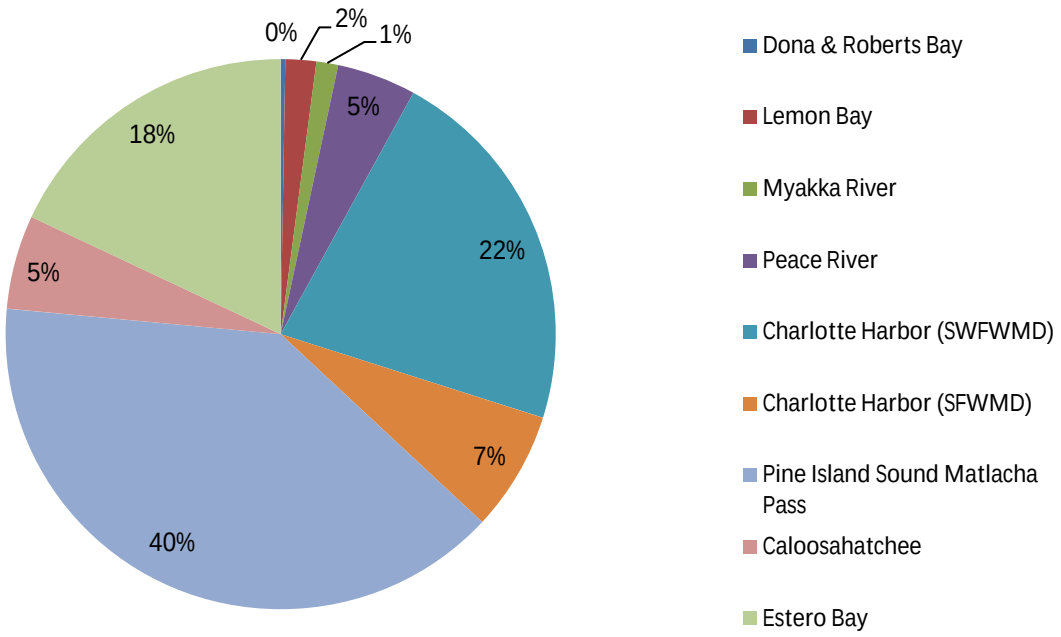
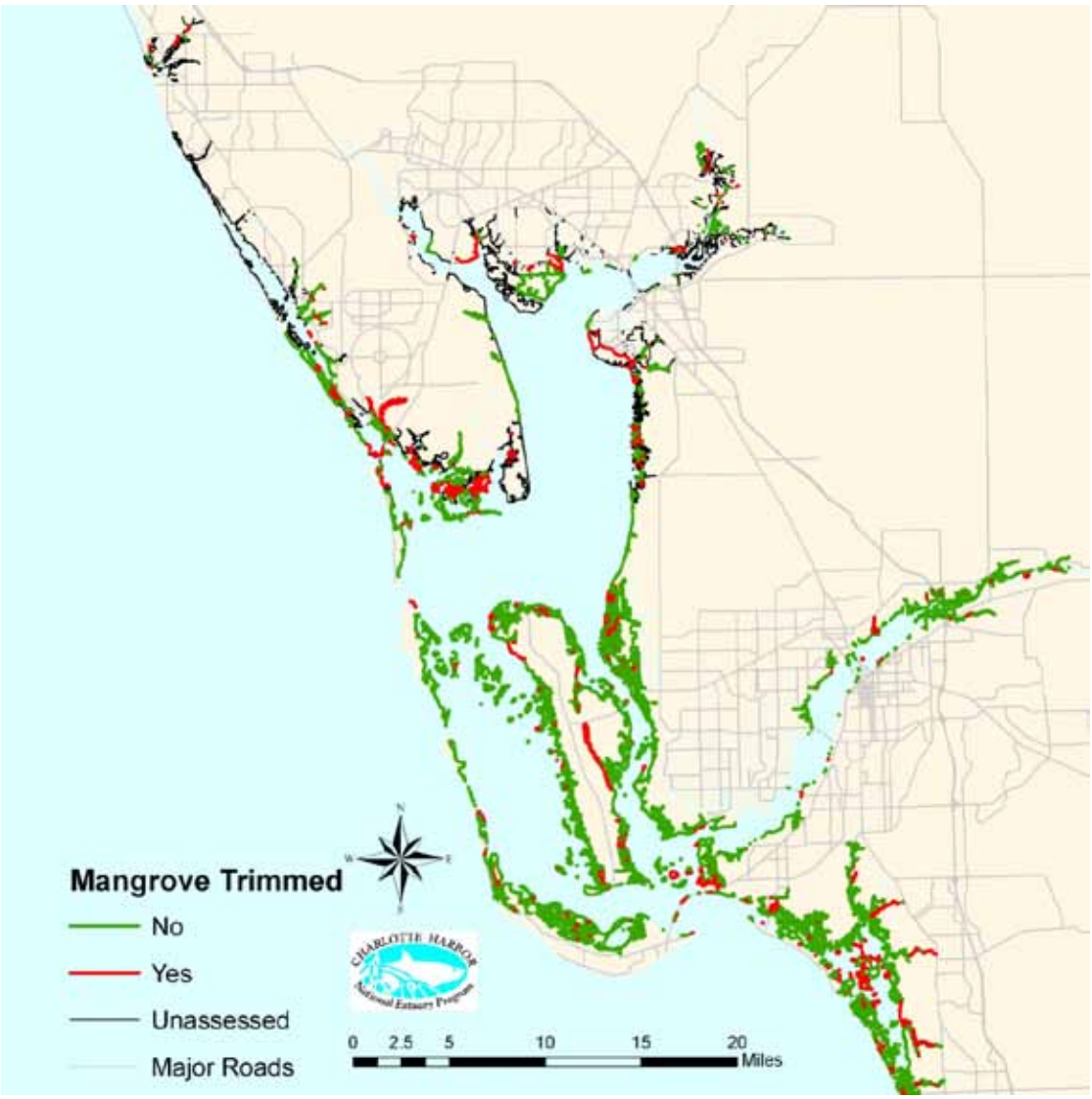


Figure 11: Proportion of mangrove acres by CHNEP watershed

Natural mangrove ecosystems provide an abundance of ecosystem functions and values to humans. The economic importance of mangroves to the state is significant. According to Bell *et al.* (1982), during 1980-1981, 5.25 million recreational and saltwater anglers spent 58.5 million angler days fishing and generated over $5 billion in direct and indirect income to the state economy. The monetary value of 4.7 tons of mangrove litter has been estimated by Leaird (1972) at $4,000 per acre per year, using the conversion rate of $1 = 10,000 kilocalories. Evaluation of mangroves in Lee County, utilizing conservative estimators, found that a mature 6 meter (20 ft.) tall canopy of red mangrove forest contributed $2,040.54 per year in commercial fisheries landings in 1970 dollars, not adjusted for inflation. A direct correlation between mangrove acreage and commercial fishery landings is evident: as mangrove acreage has been destroyed, approximately $7,000 of fishery value decline has occurred even though harvest effort and fishing method efficiency has increased over that same time frame. Smaller and shorter mangrove canopies, including trimmed canopies, contribute less to fishery values than taller, natural canopies because there is less NPP available as export from shorter canopies. A 1.5 m (5 ft.) height contributed $143.70 per acre/yr and a 10.7 m (35 ft.) tall canopy contributes $6,514.40 per acre/yr. in 1975 dollars, unadjusted for inflation. These values do not reflect recreational fisheries values which are from 5.6 to 6.5 times the primary sales of commercial fisheries (Lewis *et al.* 1982). Nor do they include the erosion protection value, the tourist income generated from tours, bird watching, canoeing and recreational non-fishing boating in mangrove estuaries, the water quality enhancement of point and non-point sources of water pollution, the privacy screen value and habitat value of these mangroves to endangered and threatened species. In kind replacement value of a dead mature red mangrove is in the thousands of dollars. One nurseryman gave a cost estimate of raising a red mangrove from seedling to age 15 then transplant of over $11,000, with survival as low as 30% (David Crewz, DNR pers. comm.). Total replacement cost for 1 acre of dead mangroves to age 15 would be approximately $4.4 million.

The two natural forces that may negatively impact mangrove forests, and which, due to exacerbating activities of human, may need human management intervention, are hurricanes and sea-level rise.

Extensive, periodic damage to mangrove ecosystems from large hurricanes is part of the environment that this system evolved with. Hurricane Donna in 1960 created extensive damage over an area exceeding 40,500 ha (100,000 acres) with 25% to 100% loss of mature trees (Craighead and Gilbert 1962). Mangroves were killed by direct shearing at 2 to 3 m (6 to 10 ft.) above the ground, complete wash-outs of overwash islands, and obstruction of air exchange through prop roots and pneumatophores by coatings of marl, mud and organics over the lenticels. The burial of these aerial roots was the largest cause of death. The entire aquatic system was subsequently negatively affected by the oxygen depletion caused by the decomposition of large amounts of dead organic material (Tabb and Jones 1962). Lugo *et al.* (1976) have hypothesized that severe hurricanes occur in South Florida on intervals of 25 to 30 years and that the ecosystem has adapted to this cycle by reaching maturity in the same cycles.



Map 9: Location of mangrove trimming in the CHNEP Study Area

Enforcement Problems

The level of compliance with mangrove trimming permitting rules in Florida is low (20% since Chapter 17-27 F.A.C. was implemented) and violations significantly outnumber permitted projects. Enforcement staffing levels of FDEP field personnel for south Florida averages one compliance staff person per seven counties and one enforcement staff person (independent of permitting) per 3.5 counties. This staff is responsible for all FDEP compliance and violations for all permits in all wetlands in FDEP jurisdiction, a daunting task. As a result, the ability of this staff to concentrate on and the time allotted to mangrove trimming violations is small compared to the extent of the resource and the number of permits and enforcement cases.

Salt Marshes

The salt marsh community of southwest Florida is perhaps one of the most unique and rare salt marsh systems in the United States. The mild subtropical climate of Florida supports a combination of temperate salt marsh vegetation and tropical mangroves that intermix to form an important transitional ecotone between land and sea. The salt marsh offers numerous ecosystem services including recreational, commercial, and aesthetic values to man. It provides the foundation of life to a variety of resident and transient organisms, especially the six federally-listed and 23 state-listed animal species found there. Although almost 66 percent of the remaining salt marsh habitat is protected in southwest Florida, this habitat continues to be lost to human-induced impacts such as dredge and fill operations, alterations of hydrology, and pollution.

Salt marshes are the most common emergent habitats in the riverine portions of the study area, and exist to some extent throughout the estuary. Salt marsh communities often occur in the transitional area between mangroves, fresh water marshes, and salt barrens.

Similar to mangrove habitats, the submerged and emergent portions of the salt marsh plants provide many different functions for living organisms in the estuary. The emergent tops of the marsh plants provide hunting cover for animals such as bobcats and gray foxes; nesting sites for unique aquatic mammals such as rice rats *(Oryzomys palustris);* hunting and display perches for birds such as redwing blackbirds, boat-tailed grackles, and green herons; and protective cover for many animals such as raccoons and marsh rabbits. The submerged portions of the marsh plants provide attachment sites for sessile organisms such as mussels and oysters; cover for intertidal aquatic animals such as fiddler crabs and killifish; and retain rich deposits of detrital food.

Over 50 percent of the salt marsh habitat adjoining the Charlotte Harbor system has been destroyed since 1945 (Charlotte Harbor NEP 1995). Recent mapping of the CHNEP watershed found approximately 3,963 kilometers (2,463 miles) of coastal shoreline encompassing approximately 90,000 ha (220,000 acres) from the Dona and Roberts Bays in Sarasota County to southern Estero Bay in Lee County. Within this area, there are 9,218 acres of salt marsh (CHNEP 2008). Currently, over 41 percent or 1,642 kilometers (1,020 miles) of coastal wetland shorelines have been lost or significantly altered in the CHNEP watershed. The most significant coastal wetland losses have been on estuarine rivers and creeks and on barriers islands and include substantial losses of salt marsh.

Mangroves primarily dominate the CHNEP tidal shoreline, although there are patches of transitional salt marsh habitat. Within these zones, dominant species include cordgrass (*Spartina spp.*), saltgrass (*Distichlis spp.*), glasswort (*Salicornia spp.*), and sea purslane (*Sesuvium* spp.) (Drew and Schomer 1984). Monotypic stands of black needlerush (*Juncus roemerianus*) are more common in slightly elevated areas with lower tidal inundation. Cordgrass and needlerush dominate salt marsh communities around the mouths of rivers (e.g., Myakka and Peace Rivers). The interior wetland habitat of Sanibel Island has expanses of salt marsh dominated by Baker's cordgrass and leather fern.

Salt marshes in Charlotte Harbor Estuary have been destroyed or directly impacted by construction activities for residential and commercial purposes including seawalls, drainage

ditches for agriculture and mosquito control, boat facilities, and navigation channels. Man-made hydrological alterations have reduced the amount of freshwater flow from some rivers (e.g., Peace River), while artificially increasing the flow through others (e.g., Caloosahatchee). Approximately 644 kilometers (400 linear miles) of man-made canals were built from the 1950s to the 1970s, resulting in the loss of salt marsh habitat (Charlotte Harbor SWIM 1993). The interior salt marshes of Sanibel Island were heavily altered from human construction activities, hydrologic changes, and exotic vegetation invasion (Clark 1976).

Limited data are available for determining the long-term trends in the extent of salt marshes. All existing estimates lump the distinct types of southwest Florida salt marsh into a single unified number. It is estimated that Florida contained approximately 163,652 ha (399,152 acres) of salt marsh coverage prior to European colonization (Cox *et al.* 1994). Since that time, an estimated 45,895 ha (111, 940 acres) or 28 percent of salt marsh habitat has been lost (Kautz *et al.* 1993). Of the current 117,757 ha (287,212 acres) of salt marsh habitat in Florida, over 66 percent, or 77,735 ha (189,597 acres), are located in existing conservation areas (Kautz *et al.* 1993, Cox *et al.*1994). Twenty percent of all Florida salt marsh is found in south Florida (Montague and Wiegert 1990), including the CHNEP study area.

Southwest Florida salt marshes were not significantly modified by human activities until the early 20th century when many areas were permanently altered to accommodate the speculative real estate development that led to a rapidly growing human population. The common practice of constructing bulkheads and filling salt marsh areas for residential and commercial development destroyed many salt marshes and also altered the natural hydrology. As a result, many salt marsh communities experienced changes in water and soil salinities, water levels, and tidal flushing regimes. Contaminants and pollutants have also been introduced into salt marshes. Exotic plant species are conveyed by a variety of means, including water transport, birds, illegal dumping of vegetation and land clearing. Many exotics initially colonize along roadways or similarly cleared areas. Disturbed or denuded areas are often invaded by exotics such as Australian pine and Brazilian pepper and melaleuca before native salt marsh seedlings can establish themselves.

Unregulated dredging and filling occurred in southwest Florida until the early 1970s when Federal and State governmental policies were implemented to minimize impacts on salt marshes. Current Federal and State regulations normally require some degree of mitigation to offset the alterations or losses of wetland habitat; however, salt marsh habitat continues to be destroyed or altered today as coastal development continues.

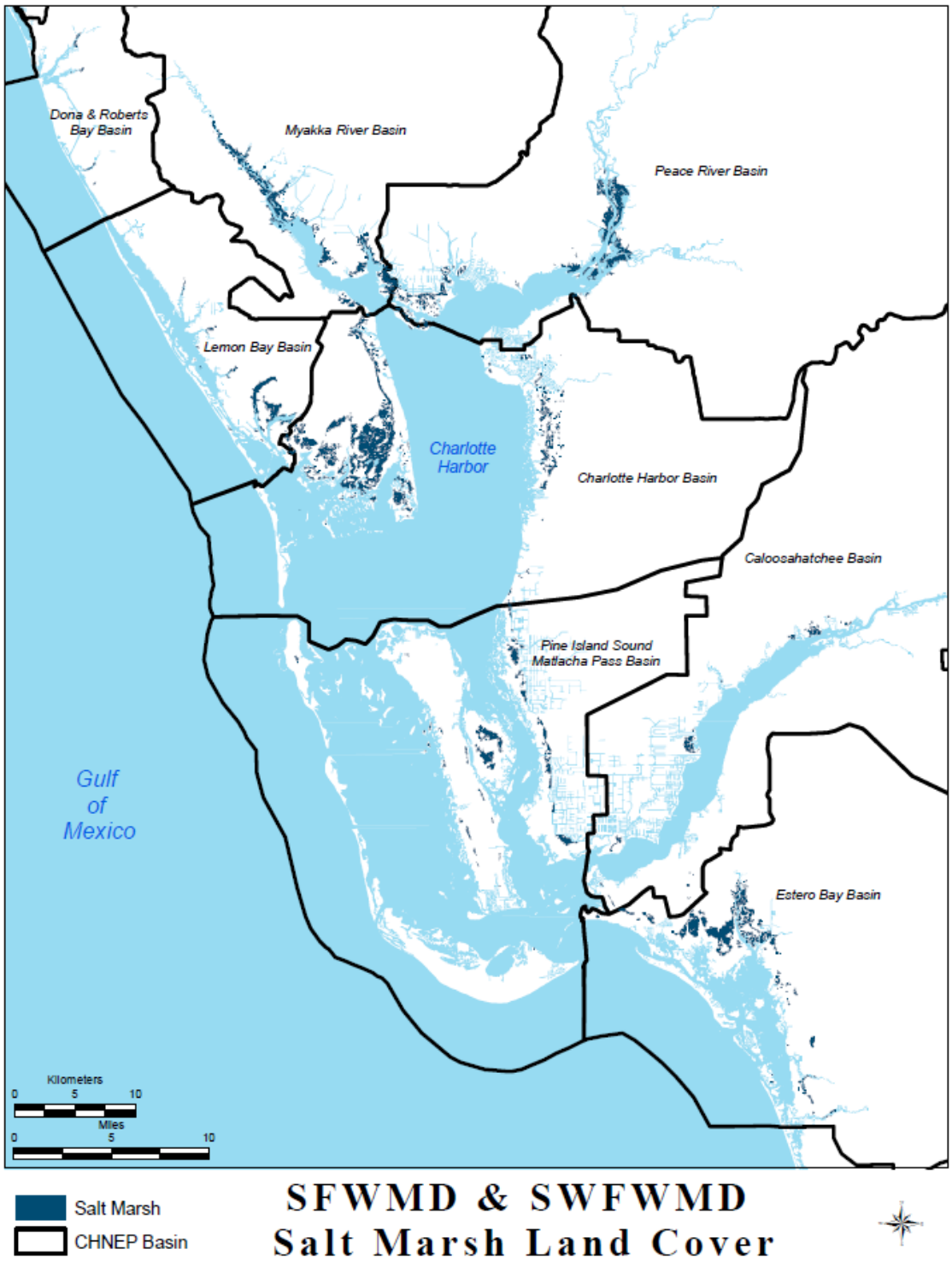
Efforts to control mosquitoes began in the early 1930s with the use of ditching, impoundments, and pesticide spraying (Montague and Wiegert 1990, David 1992). Salt marsh plants were killed from the semi-permanent flooding and salinity changes caused by impoundments. Management efforts to control the population of mosquitoes continue today, although substantial progress has been made to minimize negative impacts on salt marshes.

Natural disturbances on salt marshes include fires, storms and hurricanes, drought, and floods. These events usually have a short-term, localized effect on salt marsh habitat and the resilient community is generally able to recover fairly quickly. However, when disturbances occur closely together, or are coupled with human-induced impacts, the effects can be catastrophic to the salt

marsh community. Fires usually do not permanently affect salt marshes but may temporarily affect soil composition, species composition and biomass (Schmalzer *et al.*1991, Schmalzer and Hinkle 1992). Most salt marshes are affected by storm surge more than flooding or strong winds caused by tropical storms. One of the most significant impacts to salt marshes from hurricanes is the potential for rapid invasion of exotic vegetation into disturbed areas. South Florida has experienced 138 tropical storms from 1871 to 1981, with 78 of these reaching hurricane strength (Duever *et al.* 1994).

Sea-level change is an important long-term influence on all salt marshes. Depending on the rate and extent of local sea-level change, salt marsh systems will respond differently (Titus 1987, Wanless *et al.*1994). If rates of sea-level rise are slow, some salt marsh vegetation will migrate upward and inland and grow without much change in composition. If rates are too high, the salt marsh may be overgrown by other species, particularly mangroves, or converted to open bodies of water. If there is no accretion of inorganic sediment or peat, the seaward portions of the salt marsh become flooded so that marsh grass drowns and marsh soils erode; portions of the high marsh become low marsh; and adjacent upland areas are flooded at spring tide, becoming high marsh. Sea-level rise in southwest Florida has been relatively constant for the past 3,200 years at around 0.4 mm/yr (0.02 in/yr), but is now thought to be rising at rates of 3 to 4 mm/yr (0.12 to 0.16 in/yr), based on tide measurements from Key West (Wanless *et al.*1994). If sea-level rise continues at this rate, many of Florida's coastal salt marshes will be impacted.

The distribution of salt marshes in the Charlotte Harbor NEP study area was compiled from delineations completed in 1988 by the SFWMD and in 1990 by the SWFWMD. The wetlands were delineated from color infrared aerial photographs. A series of maps from these data is presented and descriptions given in the following text. These data are currently being updated by both of the Water Management Districts using photographs made in 1995.



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Map 10: Distribution of Salt Marshes in the CHNEP Study Area in 2005

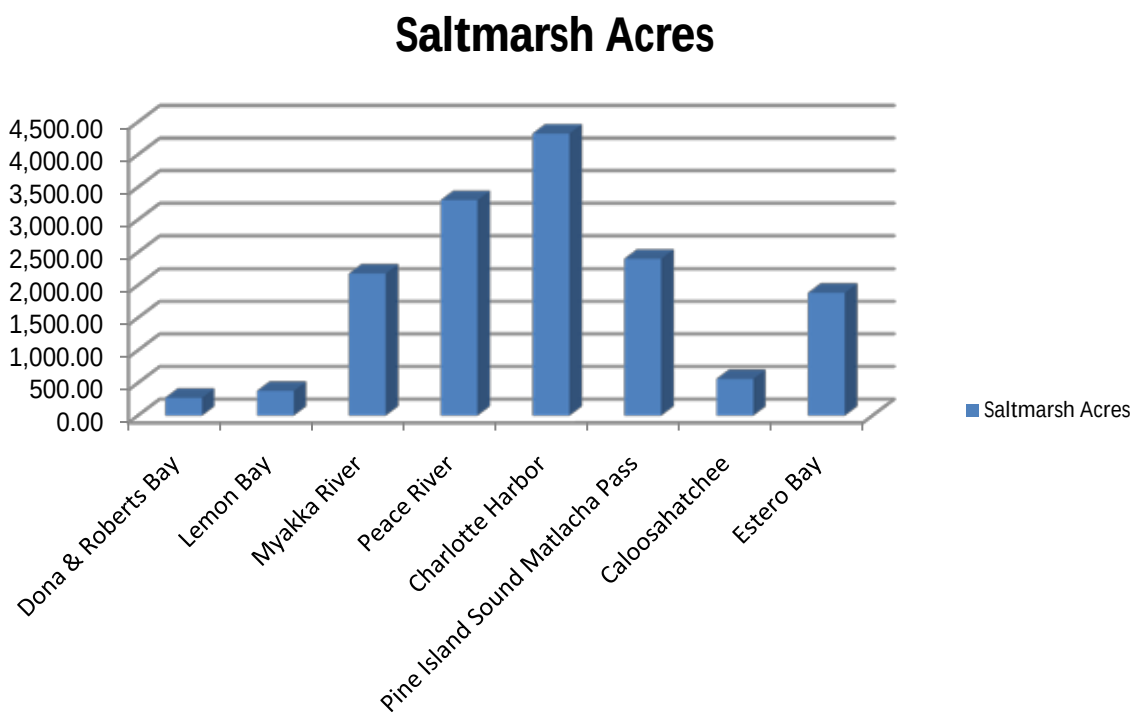


Figure 12: Acres of salt marshes in the CHNEP Study Area

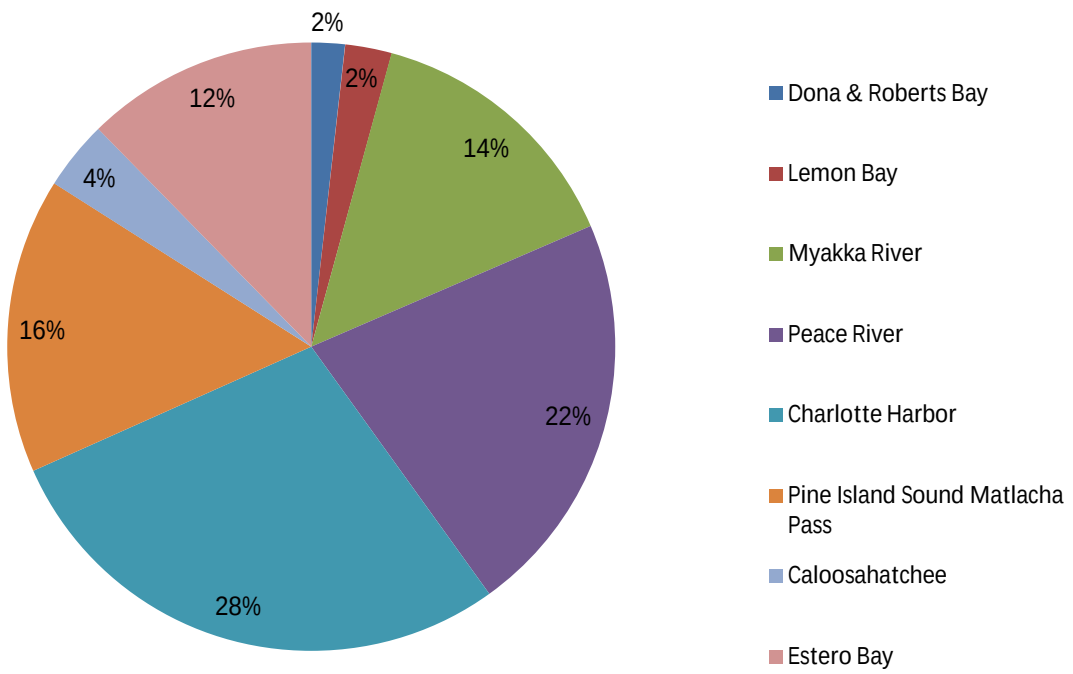


Figure 13: Relative proportion of salt marshes in the CHNEP Study Area

Coastal Strand Habitat

In southwest Florida, little of the original coastal strand ecosystem remains. This plant community can be found in long narrow bands of well-drained sandy soils affected by salt spray along the Gulf and estuaries. Vegetation includes low-growing grasses, sea grape (*Coccoloba uvifera*), prickly pear cactus (*Opuntia humilis*), cabbage palm (*Sabal palmetto*) and live oak (*Quercus virginiana*).

While residential and urban development converted most of the original coastal strand community, large adjacent sections do remain. These include the undeveloped barrier islands in Lee County, particularly Cayo Costa, and also the Stump Pass area of Charlotte County. Coastal strands provide invaluable habitat to sea turtles, shorebirds and amphibians.

Open water commercial and sport fisheries

Charlotte Harbor is highly significant to Florida as a nursery ground for marine and estuarine species. Up to 90 percent of commercial and 70 percent of recreational species landed in Florida spend all or part of their lives in estuaries such as Charlotte Harbor. The main fishery species of commercial and recreational value in the CHNEP study area include black mullet (*Mugil niger*), spotted seatrout (*Cynoscion nebulosus*), red fish (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), kingfish (*Menticirrhus* spp), southern flounder (*Paralichthys lethostigma*), blue crab (*Callinectes sapidus*), pink shrimp (*Farfantepenaeus duorarum*), stone crab (*Menippe mercenaria*), southern hard clam (*Mercenaria campechiensis*), snook (*Centropomus undecimalis*), tarpon (*Megalops atlanticus*), grouper (*Epinephelus* spp. and *Mycteroperca* spp.), black sea bass (*Centropirstis striata*), snapper (*Lutjanus* spp.), Florida pompano (*Trachinotus carolinus*), bluefish (*Pomatomus saltatrix*), sand seatrout (*Cynoscion arenarius*), Spanish and king mackerel (*Scomberomorous maculatus* and *S. cavalla*), sheepshead (*Archosargus probatocephalus*) and several species of sharks.

Recreational fishing in freshwater creeks, rivers and lakes is a popular pastime in inland counties. Snook (*Centropomus undecimalis*) are caught as far upstream as Fort Meade, while freshwater fish such as largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), gar (*Lepisosteus platyrhynchu*s) and the exotic species blue tilapia (*Oreochromis aureus*) are also highly prized game fish throughout the CHNEP study area. The bountiful waters off Charlotte Harbor provide some of the best saltwater sport fishing in the world. Snook (*Centropomus undecimalis*), tarpon (*Megalops atlanticus*), red fish (*Sciaenops ocellatus*) and spotted seatrout (*Cynoscion nebulosus*) are just a few game fish found in the area. One of every three tourists comes to Florida to fish. As a result, the Charlotte Harbor region derives substantial economic benefits from the maintenance of a healthy estuarine and coastal sport fishery. It is difficult to establish a precise monetary value because of the industry's close relationship to tourism facilities and service, but FDEP data indicate that 21 percent of the population engages in recreational fishing, and total angling in the region exceeds $1.1 billion annually.

Shellfish harvesting

More than 275 species of shellfish are found throughout the waters of the Charlotte Harbor estuaries. In the ancient past, the Calusa Indians of southwest Florida gathered enormous amounts of shellfish and constructed immense mounds from the shell. These shell mounds still

dot the coastal landscape of the CHNEP study area and some are protected as state archaeological sites.

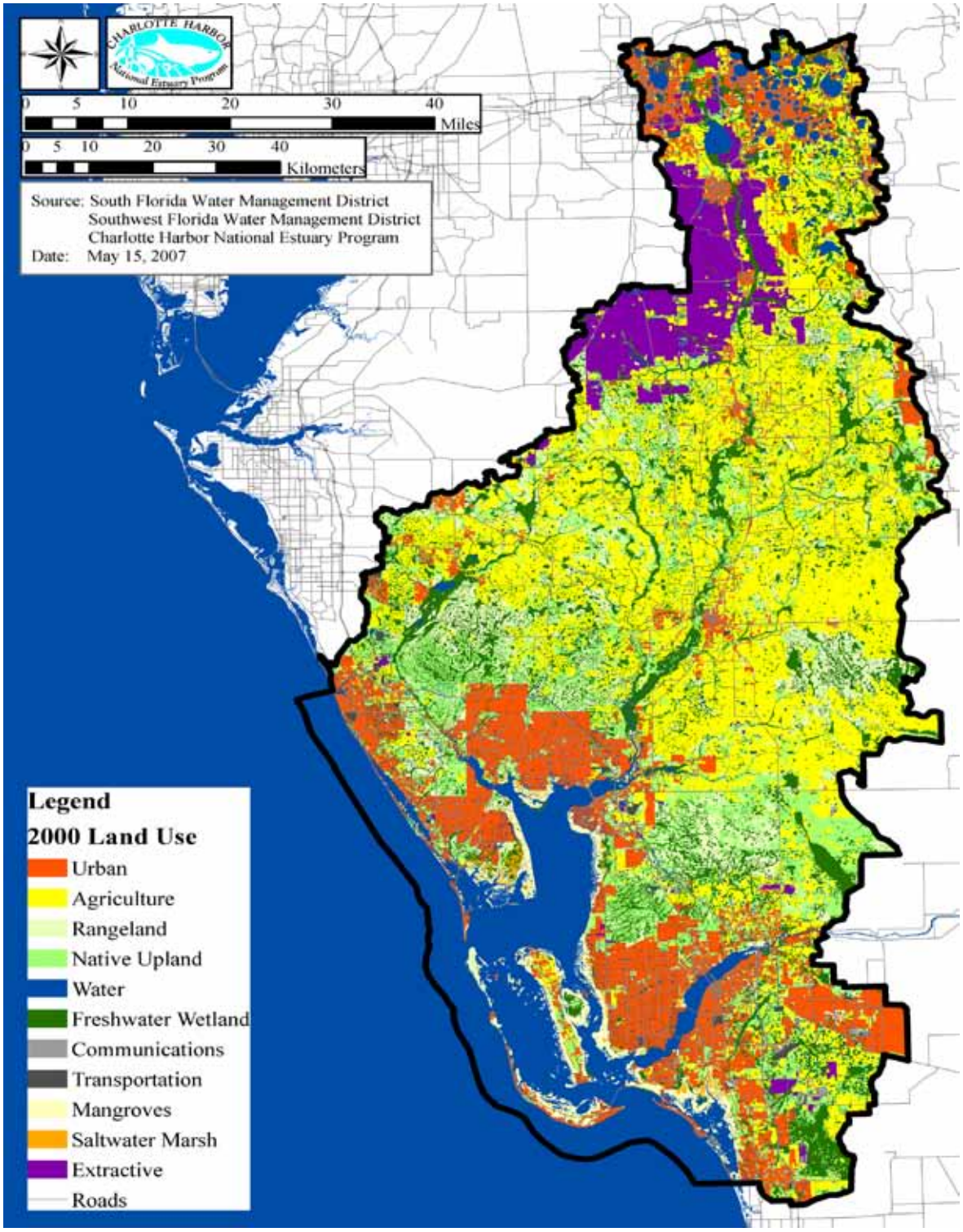
In the more recent past, oysters, clams, and scallops (*Argopecten irradians*) were harvested commercially and recreationally throughout Lemon Bay, Gasparilla Sound, Charlotte Harbor and Pine Island Sound. The height of the shellfish industry in the Charlotte Harbor area occurred during the 1940s. Since then the commercial harvest of shellfish has been declining, including the disappearance of the scallop fishery in Pine Island Sound in the early 1960s.
Shellfish are a reliable measure of the environmental health of an estuary because shellfish feed by filtering estuary water; they assimilate and concentrate materials carried in the water. In clean water free from bacteria, red tide and other pollutants, the shellfish can be safely eaten year round. In areas of the estuaries affected seasonally by red tide or nearby urban areas contaminated by runoff, shellfish may not be safe to consume. Therefore, shellfish must be monitored regularly to protect public health. Currently, about one-third of Pine Island Sound is approved for shellfish harvesting year round. Many areas in Lemon Bay, Gasparilla Sound and the Myakka River are conditionally approved for seasonal harvest when bacteria and red tide concentrations are at safe levels. Pine Island Sound and Estero Bay are closed to shellfish harvesting throughout the year due to measured or probable bacterial contamination.

The importance of healthy waters for safe shellfisheries has taken on a new significance in Charlotte Harbor. A 1995 state constitutional amendment precluded the use of typical nets used in commercial fishing. Many of the commercial fishermen in the Charlotte Harbor area took advantage of training aquaculture programs. Areas of the submerged estuary bottomlands are leased to individuals by the state for shellfish aquaculture. Areas where such leases have been issued include Gasparilla Sound and Pine Island Sound. Marine shellfish aquaculture in Charlotte Harbor is primarily hardshell clams. Clams require proper salinity, oxygen and nutrients to grow at a reasonable rate, as well as good water quality to be safe to eat.

Upland residential land uses

The land-sale development that began in the 1950s dramatically and permanently changed the character and use of the land. Pastures and croplands were drained and cleared and coastal lowlands were dredged and filled to create developable home sites by the tens of thousands. The land was subdivided, canals were dug and streets were paved. Even though some of this land was platted and sold 20 years ago, today a large percentage of it remains sparsely populated. The existing residential centers such as Fort Myers, Fort Myers Beach, Bonita Springs, Sanibel, Cape Coral, Port Charlotte, North Port, Punta Gorda, Englewood and Venice have expanded and grown.

The thousands of acres of land subdivided in the 1950s and 1960s have permanently cast the form of future development. The platting of these extensive tracts of land removed thousands of acres from agricultural and other productive uses years in advance of when the land would actually be needed for housing. Agricultural land is under considerable development pressure near existing urban centers, particularly south and east of Fort Myers. There, flower and vegetable cropland is being rapidly displaced by urban land uses. Since so much land has already been converted, local governments may find it preferable to encourage new development to infill platted areas before covering additional high-quality habitat areas.



Map 11: 2000 Land Use of the CHNEP Study Area

Both the Southwest and South Florida Water Management Districts map land uses using the Florida Land Use Code and Classification System (FLUCCS). The land use map for 2000 illustrates the distribution of urban, extractive, agriculture, wetlands and uplands within the CHNEP study area.

Effects of Climate Change on Coastal Wetlands in Southwest Florida

For the past few thousand years, the sea level around Florida has been rising very slowly, although a persistent upturn in the rate of relative sea level rise may have begun recently (IPCC 2007b). Geological studies show that, in the past, the sea level of Florida, as well as the rest of the globe, changed much more rapidly than it has in more recent times. Distinguishing Florida-specific sea level trends from future global trends is a critical research need.

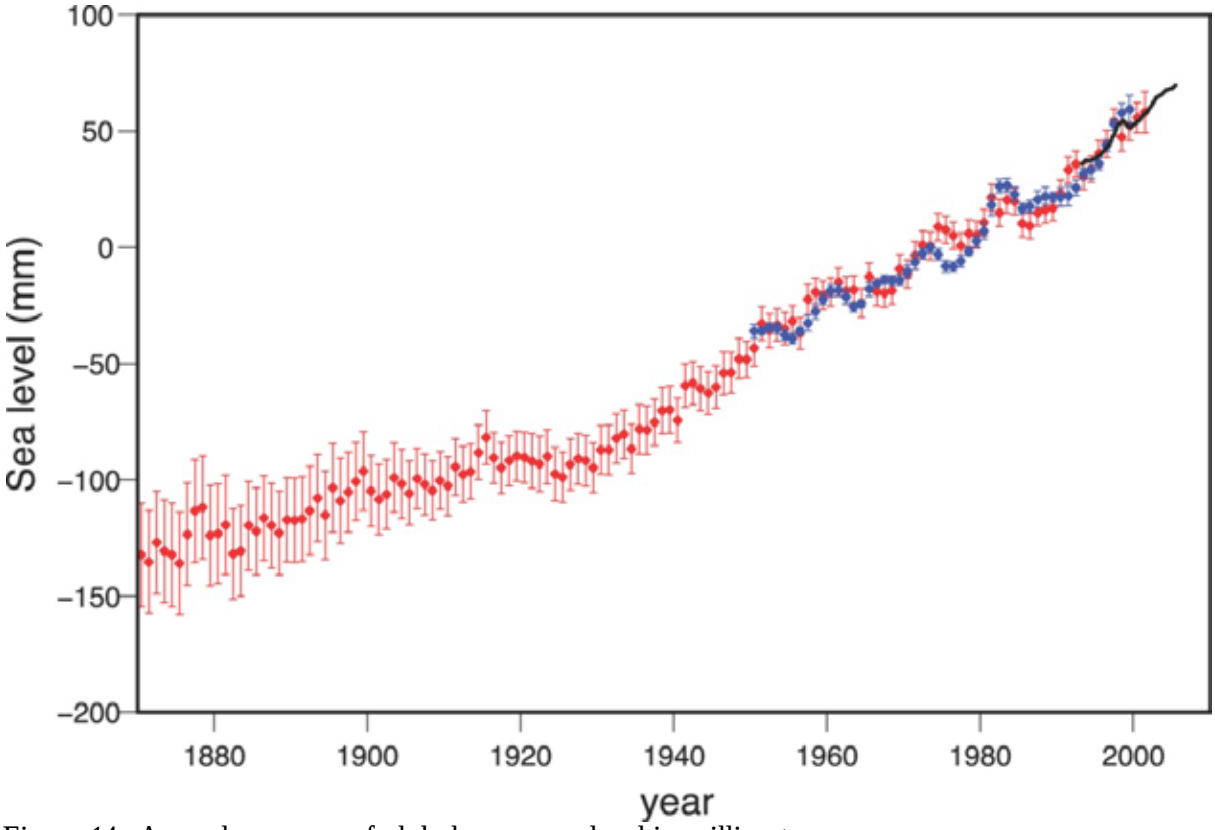


Figure 14: Annual averages of global mean sea level in millimeters

The red curve shows reconstructed sea level fields since 1870 (updated from Church and White, 2006); the blue curve shows coastal tide gauge measurements since 1950 (from Holgate and Woodworth, 2004) and the black curve is based on satellite altimetry (Leuliette et al., 2004). The red and blue curves are deviations from their averages for 1961 to 1990, and the black curve is the deviation from the average of the red curve for the period 1993 to 2001. Error bars show 90% confidence intervals.

Source: Intergovernmental Panel on Climate Change (2007) fig-5-13

The *rate* at which sea level rises is equally as important to coastal resources as how much it rises. The rate of global sea level rise increased from the 19th to the 20th century (IPCC 2007b) and has increased further since 1993 (FOCC 2009), and is now a rate of 2.0-3.0 mm per year per year (0.08-0.12 inches) along most of the U.S. Atlantic and Gulf coasts. The rate of sea level rise

varies from about 10 mm (0.36 inches) per year along the Louisiana Coast (due to land sinking, or subsidence), to a *drop* of a few inches per decade in parts of Alaska (because land is rising).

Around Florida, relative sea level has been rising at a slow but constant rate, about 2.5 cm (1 inch) or less per decade (Maul and Martin 1993; FOCC 2009). The historic (1947-2009) sea level rise in southwest Florida measured at St. Petersburg is 2.3 mm (0.09 in) per year (Walton 2007, FOCC 2009). Figure 15 provides further evidence specific to southwest Florida, measured at Key West, that sea level has been rising at an estimated rate of 3 mm (0.12 in) per year (Maul and Martin 1993; Savarese et al. 2002).

Since 1933, the Permanent Service for Mean Sea Level (PSMSL) has been responsible for the collection, publication, analysis and interpretation of sea level data from the global network of tide gauges. It is based in Liverpool at the Proudman Oceanographic Laboratory (POL) which is a component of the UK Natural Environment Research Council (NERC). The PSMSL is a member of the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) established by the International Council for Science (ICSU). It is supported by FAGS, the Intergovernmental Oceanographic Commission (IOC) and NERC.

As of December 2006, the database of the PSMSL contained over 55,000 station-years of monthly and annual mean values of sea level from almost 2,000 tide gauge stations around the world received from almost 200 national authorities. On average, approximately 2,000 station-years of data are entered into the database each year (Woodworth and Player, R. 2003). Local sea level information from PSMSL is found below.

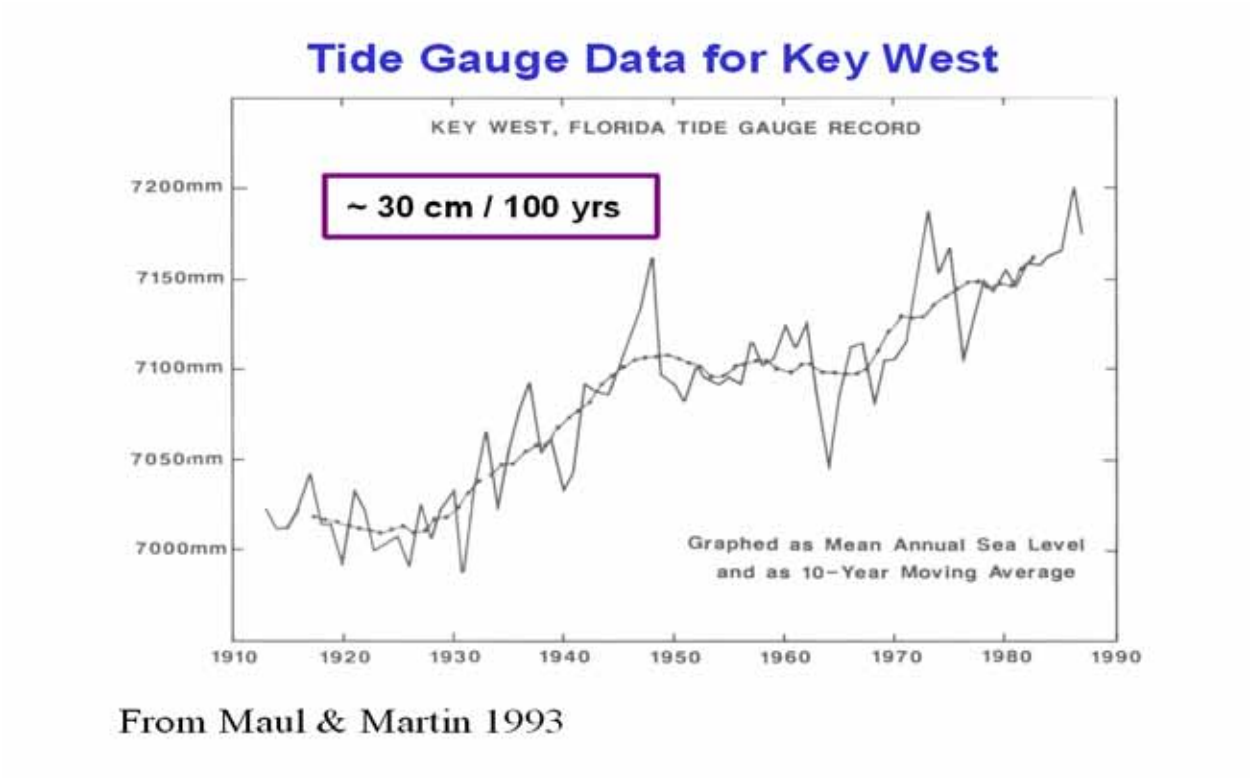


Figure 15: Mean annual sea level at Key West, Florida 1910-1990
Key: 7000 mm is 275.6 inches, 7200 mm is 283.5 inches, and 30 cm is 11.8 inches in 100 years of record

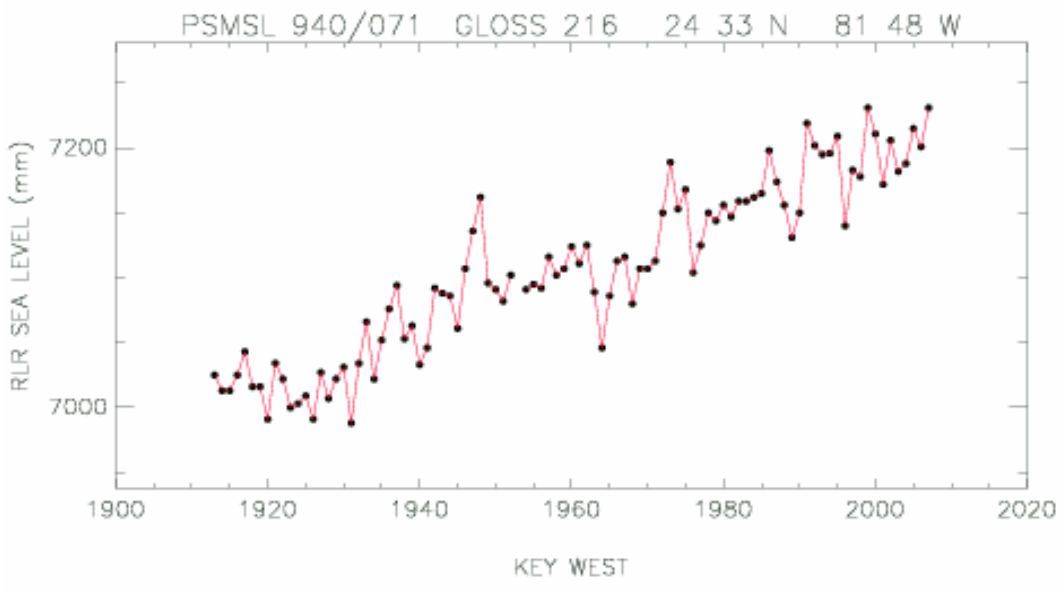


Figure 16: Mean annual sea level at Key West, Florida 1910-2009
Source: Permanent Service for Mean Sea Level (PSMSL), hosted at the Proudman Oceanographic Laboratory (POL)

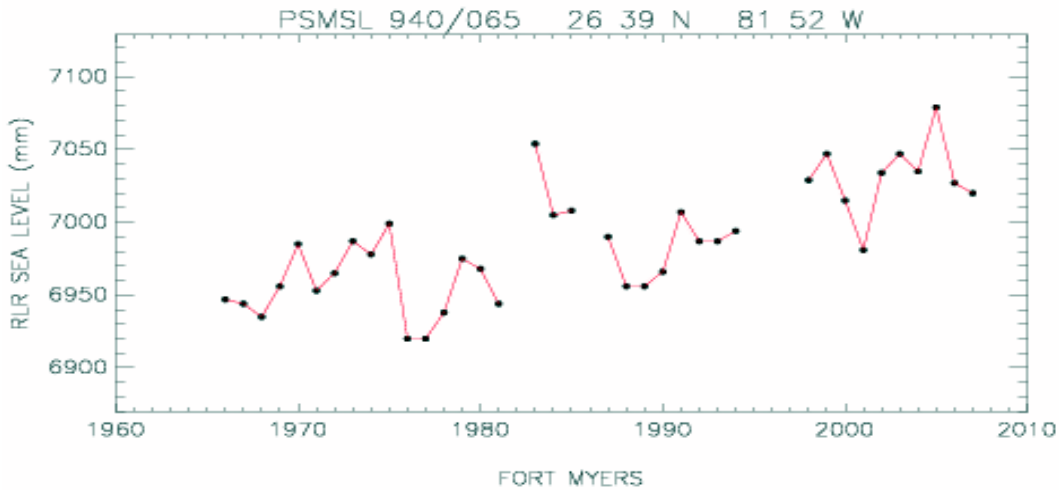


Figure 17: Mean annual sea level at Fort Myers, Florida 1910-2009
Source: Permanent Service for Mean Sea Level (PSMSL), hosted at the Proudman Oceanographic Laboratory (POL)

Probability (%)	2025		2050		2075		2100		2150		2200	
	cm	inches	cm	inches	cm	inches	cm	inches	cm	inches	cm	inches
Rapid Stabilization Case	41	1.8	9	3.5	13	5.3	18	7.1	22	8.8	27	10.5
90 (least)	7	2.8	13	5.0	20	7.7	26	10.4	40	15.7	53	21.0
80	9	3.6	17	6.6	26	10.1	35	13.9	53	20.8	71	28.1
70	11	4.4	20	7.8	30	11.6	41	16.3	63	24.7	85	33.6
60	12	4.7	22	8.6	34	13.2	45	17.8	72	28.3	99	39.1
50 (moderate)	13	5.1	24	9.4	37	14.4	50	19.8	80	31.4	112	44.2
40	14	5.5	27	10.6	41	16.0	55	21.8	90	35.4	126	49.7
30	16	6.3	29	11.3	44	17.1	61	24.1	102	40.1	146	57.6
20	17	6.7	32	12.5	49	19.1	69	27.3	117	46.0	173	68.2
10	20	7.9	37	14.5	57	22.3	80	31.6	143	56.2	222	87.5
5 (worst)	22	8.7	41	16.1	63	24.6	91	35.9	171	67.2	279	110.0
2.5	25	9.9	45	17.6	70	27.4	103	40.7	204	80.2	344	135.6
1	27	10.6	49	19.2	77	30.1	117	46.2	247	97.2	450	177.3
Business as Usual	29	11.3	57	22.6	86	34	115	45.3	247	97	450	177

***The results of this table are based on using Tables 9-1 and 9-2 of the USEPA Report "The Probability of Sea Level Rise". Basically, the formula is multiplying the historic sea level rise (2.3 mm/yr) in Southwest Florida (closest point used is St. Petersburg, Fl., Table 9-2) by the future number of years from 1990 plus the Normalized Sea Level Projections in Table 9-1 and Table ES-2. Two Future Climate Scenarios for Florida Stanton and Ackerman 2007**

Table 2: Combined sea level projections by year for southwest Florida

One cause of sea level rise is increased temperature and the subsequent expansion of the warmer water volume (Titus 1998; USEPA CRE 2008). The rate of global average sea level rise has increased during the late 20th century (Church and White 2006) and will accelerate further because of ocean warming and contributions from land-based ice melt from glaciers and the ice sheets of Greenland and Antarctica (IPCC 2007b). Sea level rise will continue well after 2100 even if greenhouse gas concentrations are stabilized by then (IPCC 2007b). Major inputs of water from the melting of high latitude and high altitude ice reservoirs could cause several meters of sea level rise over the centuries to come (Hansen 2007).

As a result of these increasing sea levels, Florida will probably become more vulnerable to coastal flooding and storm surges. Sea levels around the state will probably continue to rise at historical or accelerated rates in upcoming decades.

Increases in sea level will probably increase shoreline erosion. Barrier islands will likely continue to erode and migrate towards the mainland or along prevailing lateral pathways, which could eventually threaten the ecological integrity of natural communities in estuaries, tidal wetlands, and tidal rivers. As sea levels rise, shallow coastal aquifers and associated public drinking water supplies are at risk from saltwater intrusion (FOCC 2009).
Sea level rise will also exacerbate many other effects of climate change on coastal wetland habitats. For example, coastal shorelines, beaches, mangroves, low marsh, river and creek shorelines will experience higher tides including higher high tides, higher normal tides, and higher low tides (Titus 1998; USEPA CRE 2008; Folland & Karl 2001; IPCC 2001c).

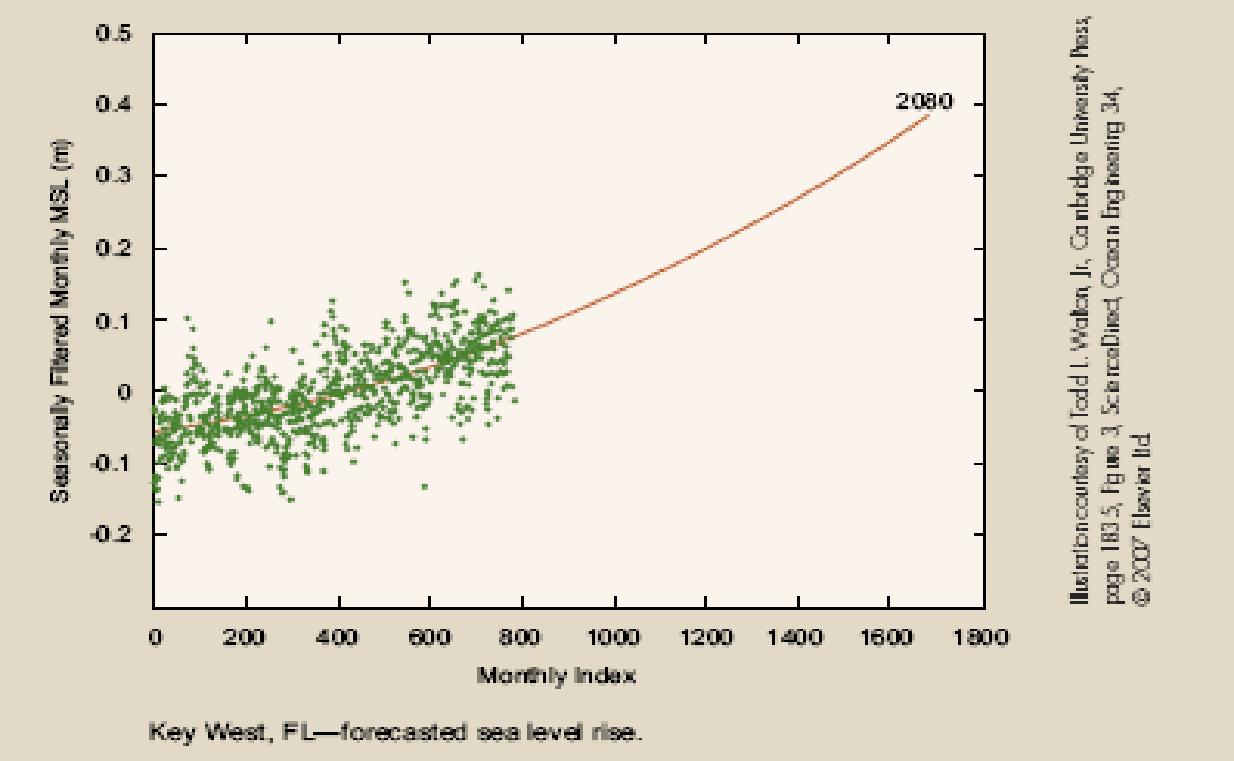


Figure 18: Forecasted sea level rise at Key West, Florida

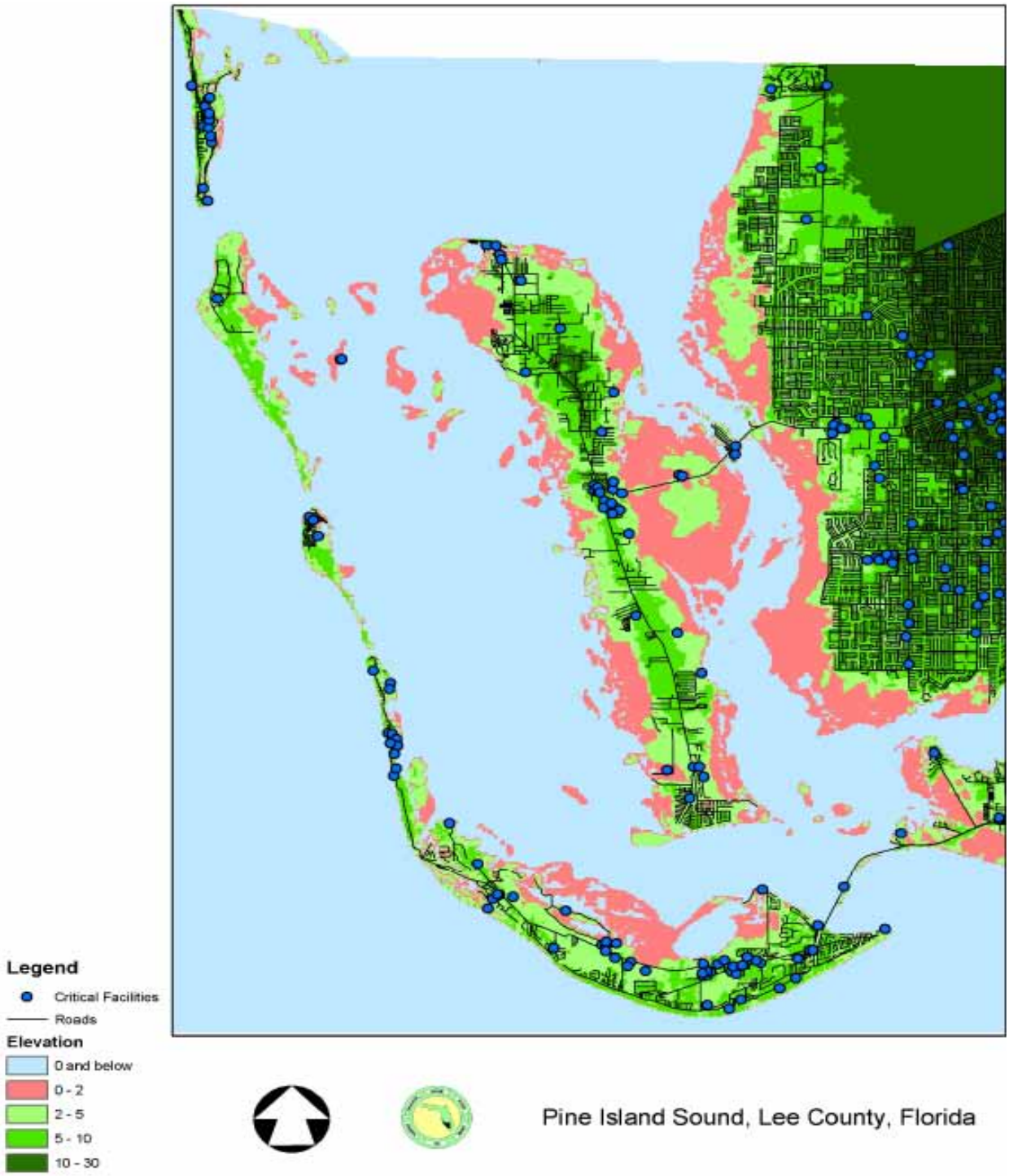


Figure 19: Two-foot contour sea level rise for the Pine Island Sound, Matlacha Pass and SanCarlos Bay area

This is the prediction of Karl et al. (2007) for the year 2100; approximately equivalent to a 90% probability 2200 prediction (IPCC 2007); a 5% Probability 2075 prediction (IPCC 2007); or the 2050 Business as Usual Worst Case scenario.

Source: Stanton and Ackerman 2007

Some scientists expect more rapid sea level rise than previously predicted by IPCC 2007 (USEPA CRE 2008). One team of researchers has suggested that global sea level could rise far

higher than previously forecast because of changes in the polar ice sheets, a meter or more by 2100. They assert that the IPCC projections did not include the potential impact of polar melting and ice breaking off. The IPCC, in its 2007 Fourth Assessment Report, had said that the maximum rise in sea level would be about 59 centimeters (23 inches).

Local topography and land use will greatly affect the scope and reach of whatever sea level rise occurs in Florida. The area included in this study is divided into uplands (112,118 hectares/277,050 acres) and wetlands (237,052 hectares/ 585,766 acres) below 3 meters (10 feet) in elevation. The areas below this elevation, (equivalent to 2.8 meters or 9.2 feet above mean sea level or subject to daily tidal inundation with 2.5 meters or 8.2 feet of sea level rise), which are subject to sea level rise impacts, comprise 22.4 percent of the region's total land area. A current population of approximately 607,000 people lives in 357,000 dwelling units (SWFRPC 2001). Millions of square feet of commercial, office and other uses exist within the study area. This area is expected to be essentially built-out in the next 50 years with a population of more than one million people.

Lee County	Half Ft	1 Ft	1.5 Ft	2 Ft	3 Ft	4 Ft	9 Ft
	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Coastal Strand	0.84	2.02	4.76	12.28	29.44	88.74	710.84
Sand/Beach	37.08	72.98	117.21	159.05	219.20	278.08	382.11
Dry Prairie	22.72	58.54	128.26	237.38	648.88	1,230.19	4,452.41
Mixed Pine-Hardwood Forest	12.25	40.49	105.17	193.05	368.66	612.90	1,245.02
Hardwood Hammock/Forest	52.31	143.99	321.41	538.80	1,126.95	1,894.64	4,474.55
Pinelands	112.08	437.05	1,068.55	2,069.10	4,829.68	7,721.16	16,668.56
Tropical Hardwood Hammock	3.43	11.07	23.66	45.24	87.68	127.68	183.69
Freshwater Marsh and Wet Prairie	20.59	43.32	103.57	175.51	339.80	526.93	1,202.70
Shrub Swamp	18.39	65.29	149.60	248.54	444.25	581.05	970.77
Cypress Swamp	16.70	50.78	111.78	181.62	370.59	513.06	1,091.35
Cypress/Pine/Cabbage Palm	11.44	38.73	84.34	142.28	275.83	361.32	659.74
Mixed Wetland Forest	15.33	64.61	153.84	248.51	440.99	638.06	1,317.61
Hardwood Swamp	30.04	124.97	271.97	419.42	686.73	939.40	1,617.57
Salt Marsh	167.33	576.17	1,516.82	2,403.36	3,921.61	4,332.12	4,679.41
Mangrove Swamp	6,029.4	14,497.2	22,240.8	26,928.5	31,824.2	33,254.7	33,999.58
Open Water	1,788.4	3,605.52	5,421.89	6,741.97	8,557.92	9,972.52	13,660.87
Shrub and Brushland	2.37	6.78	11.71	20.45	51.57	102.02	475.10
Grassland	0.01	0.01	0.12	0.63	1.59	3.43	6.99
Bare Soil/Clear-cut	11.77	25.84	60.24	110.27	222.22	408.39	1,655.42
Improved Pasture	4.35	18.78	25.99	36.02	99.23	226.55	2,132.31
Unimproved Pasture	0.05	0.61	1.29	30.00	101.84	159.12	515.34
Citrus	0.00	2.90	8.73	21.82	77.64	228.40	1,521.45
Row/Field Crops	0.00	0.16	3.78	23.53	93.88	286.54	760.24
Other Agriculture	0.00	0.00	0.39	4.85	18.93	80.62	413.62
Exotic Plants	0.00	0.00	0.00	0.19	1.23	2.35	35.75
High Impact Urban	237.27	681.44	1,437.77	2,543.28	5,938.12	11,800.7	53,005.86
Low Impact Urban	22.07	80.90	183.50	326.60	828.72	1,758.87	7,840.63
Extractive	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8,616.3	20,650.1	33,557.1	43,862.2	61,607.4	78,129.5	155,679.4

Table 3: Acres of habitat or land use at and below various elevations in Lee County 2009

Note: number includes the prior acreage.

Utilizing the most recent available land cover data from the Florida Fish and Wildlife Conservation Commission (FWC) (2003) and currently available Lidar elevations, it is possible to project the amount of habitat that would be subject to future inundation from various levels of sea level rise. The following tables and graphs display the results for Lee and Collier Counties, which are the two counties with complete Lidar data at this time. There are currently gaps in the Lidar data for Charlotte and Sarasota Counties.

Charlotte	Tropical Storm	Cat 1	Cat 2	Cat 3	Cat 4+

Elevation range (in feet)	(3.1' to 5.7')	(4.3' to 6.6')	(8.3' to 12.3')	(11.3'-20.0')	(17.2'-31.7')
Coastal Strand	29.7	46.3	46.3	46.3	46.3
Sand/Beach	147.1	189.7	189.7	189.7	189.7
Xeric Oak Scrub	14.5	40.0	66.2	153.7	221.3
Sand Pine Scrub	0.0	0.0	16.0	18.9	46.0
Dry Prairie	2,163.5	2,729.8	8,531.7	12,463.4	24,453.7
Mixed Pine-Hardwood Forest	539.8	805.6	2,072.8	2,984.1	3,719.6
Hardwood Hammocks and Forest	873.3	1,233.4	3,039.1	4,213.1	5,545.8
Pinelands	3,915.5	4,845.7	9,119.9	11,496.4	28,254.6
Freshwater Marsh and Wet Prairie	1,650.0	1,731.7	2,384.2	2,712.7	13,771.6
Shrub Swamp	647.1	697.0	934.4	1,017.0	2,463.8
Cypress Swamp	432.8	473.0	725.5	792.5	2,279.6
Cypress/Pine/Cabbage Palm	66.5	66.5	72.6	80.7	2,341.2
Mixed Wetland Forest	723.6	761.9	977.8	1,023.0	1,487.6
Hardwood Swamp	948.5	999.8	1,465.6	1,648.2	2,104.3
Salt Marsh	8,171.7	8,303.9	8,891.6	8,894.8	8,894.8
Mangrove Swamp	15,662.0	15,733.4	15,782.7	15,782.7	15,782.7
Tidal Flat	412.2	412.2	412.2	412.2	412.2
Open Water	5,447.9	6,297.0	10,120.0	11,079.0	16,639.5
Shrub and Brushland	145.8	241.5	778.0	1,364.8	2,388.4
Grassland	7.5	16.2	32.1	48.0	125.1
Bare Soil/Clear-cut	101.2	155.5	328.6	640.2	1,563.3
Improved Pasture	171.1	200.7	928.2	2,596.0	15,394.3
Unimproved Pasture	0.0	0.0	0.0	0.0	468.4
Sugar cane	0.0	0.0	0.0	0.0	0.0
Citrus	4.6	20.6	445.7	1,079.4	4,054.3
Row/Field Crops	0.0	0.0	0.0	242.5	2,018.7
Other Agriculture	4.3	6.4	47.7	82.4	1,414.6
Exotic Plants	11.1	11.1	11.1	11.1	11.1
Melaleuca	0.0	0.0	0.0	0.0	1.0
Brazilian Pepper	0.0	0.0	0.0	0.0	176.8
High Impact Urban	4,529.9	8,145.4	26,698.2	37,863.8	48,820.3
Low Impact Urban	1,090.4	1,905.0	10,245.9	15,853.2	20,760.4
Extractive	0.0	0.2	110.6	180.9	543.2
Total	**47,911.8**	**56,069.6**	**104,474.5**	**134,971.0**	**226,394.6**

Table 4: Acres of habitat or land use at and below various elevations in Collier County 2009

Note: number includes the prior acreage.

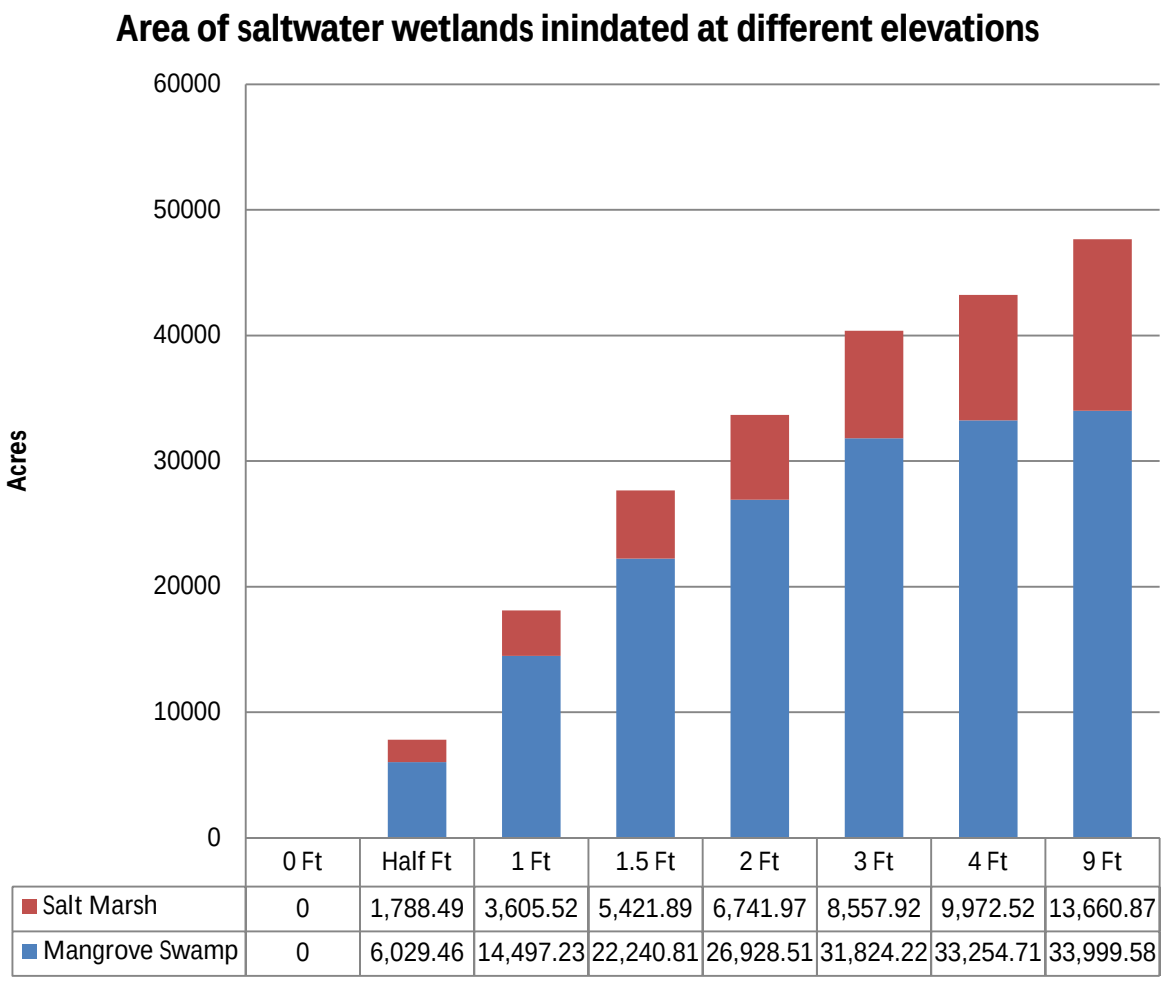
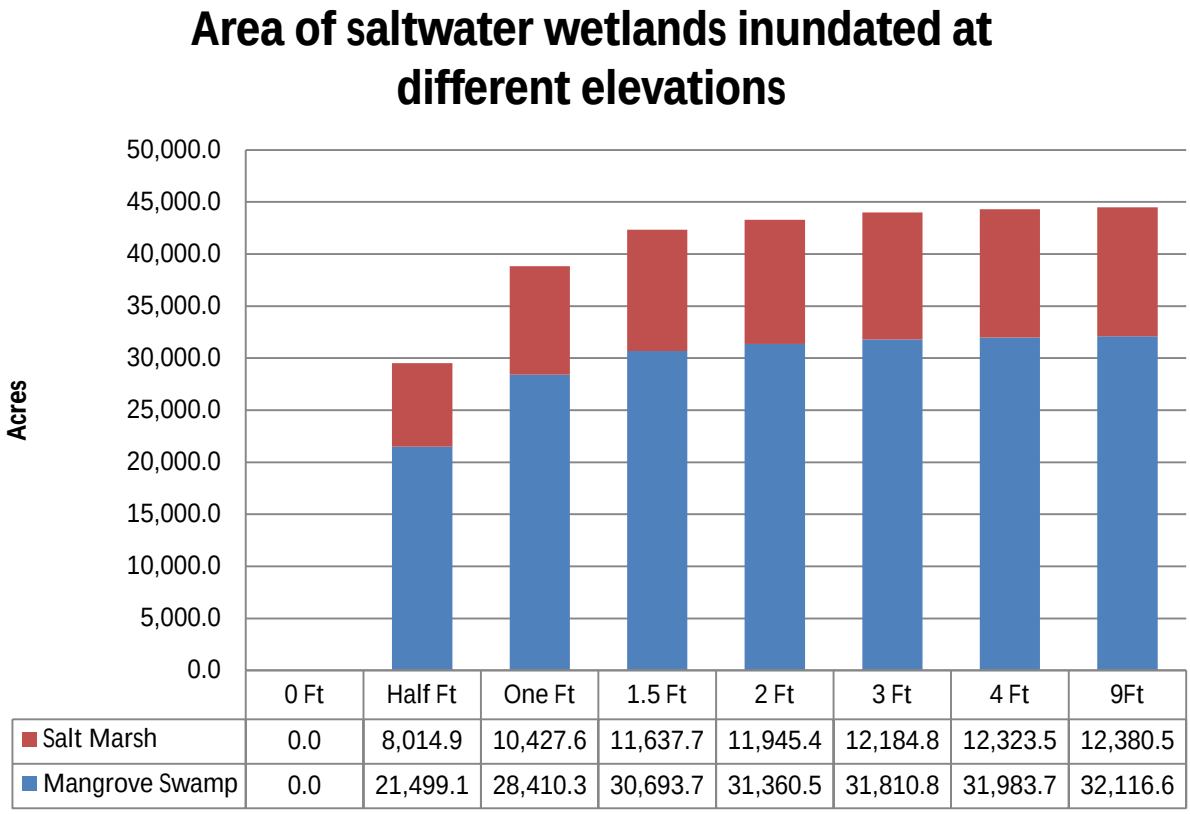


Figure 20: 2009 acres of mangrove and salt marsh habitat at and below different elevations in Lee County



	0 Ft	Half Ft	One Ft	1.5 Ft	2 Ft	3 Ft	4 Ft	9Ft
Salt Marsh	0.0	8,014.9	10,427.6	11,637.7	11,945.4	12,184.8	12,323.5	12,380.5
Mangrove Swamp	0.0	21,499.1	28,410.3	30,693.7	31,360.5	31,810.8	31,983.7	32,116.6

Figure 21: Area of saltwater wetlands inundated at different elevations

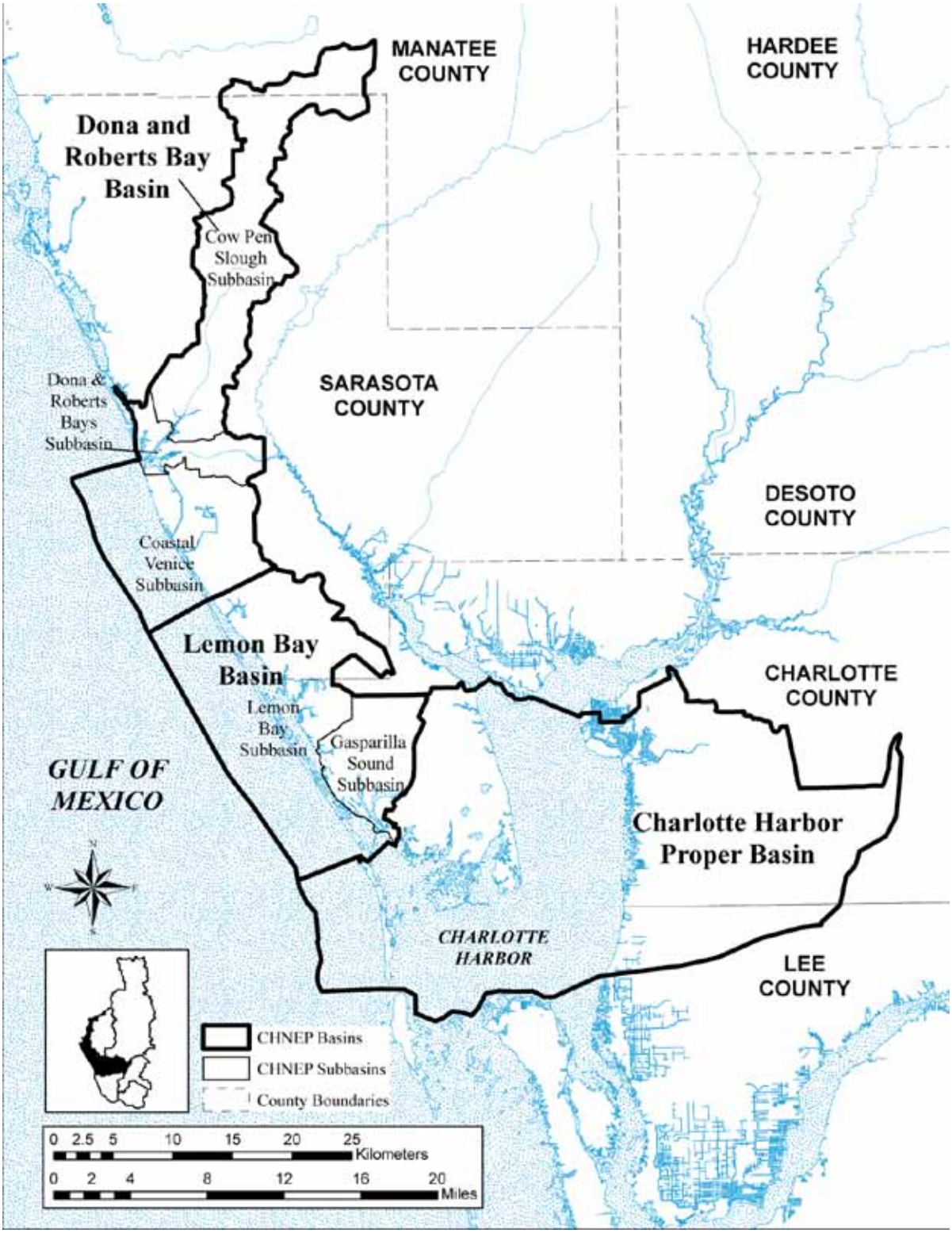
Shoreline retreat due to erosion and overwash is already occurring (Sallenger et al. 2006, FOCC 2009). There has been an increase in the formation of barrier island inlets and in island dissection events, in which islands are eroded by wind and waves (Sallenger et al. 2006; Sallenger et al. 2005). Normal mangrove accretion in stable estuaries occurs at a rate of 7 mm/year (0.28 inches/year) (Cahoon et al. 1999), effectively increasing elevations. Under equilibrium conditions, the processes of erosion and deposition balance, and wetlands are not lost. However, even historic sea level rise coupled with local subsidence has upset coastal equilibrium in many parts of the world (Bird 1985; Bruun 1986).

Sea level rise will change coastlines in many ways (USEPA CRE 2008; Volk 2008; Bollman 2007; Titus 1998). There will be erosion with landward migration of coastlines, barrier island disintegration, saltwater intrusion into surface and subsurface waters, rising surface and groundwater tables. Where retreat is possible, there will be a migration of mangrove and marsh species, altered plant community structural diversity with potential changes in dominant or foundation species, and structural and functional habitat changes. As waters deepen, there will be less sunlight available to submerged aquatic vegetation (SAV) in current locations and light attenuation coefficients will be exceeded (USEPA CRE 2008).

Continued sea level rise will exacerbate erosion, reducing the elevation of barrier islands and affecting coastal transportation infrastructure. Increased overwash and breaching of coastal roads

will occur. Low barrier islands will vanish, exposing marshes and estuaries to open-coast; high fetch conditions (Sallenger et al. 2006, 2009).

Sea level rise will add to the effects of relative surface elevation subsidence caused by changes in sediment transport from watersheds to the estuaries and coast. Dams, diversions, reservoirs, shoreline hardening, dredging of channels and passes with deep water or landward spoil disposal can starve the bed load sediment budget preventing the relative elevation of shallow subtidal and intertidal zones to retain a relative position to sea level to allow wetlands to retreat and re-zone . Some structural adaptations to sea level rise, such as vertical sea walls, tidal barriers, fetch barriers, channelization, etc., will restrict sediment transport and reduce the ability of wetlands to migrate inland with sea level rise. The balance between rainfall and evaporation modified by increased human consumption/drawdown of groundwater will reduce supplies for wetlands and estuaries. When wetlands are "squeezed" and can't migrate, they do not create land fast enough to avoid drowning (Ebi et al. 2007; Titus 1998).



Map 12: Northern Estuarine Watersheds of the CHNEP

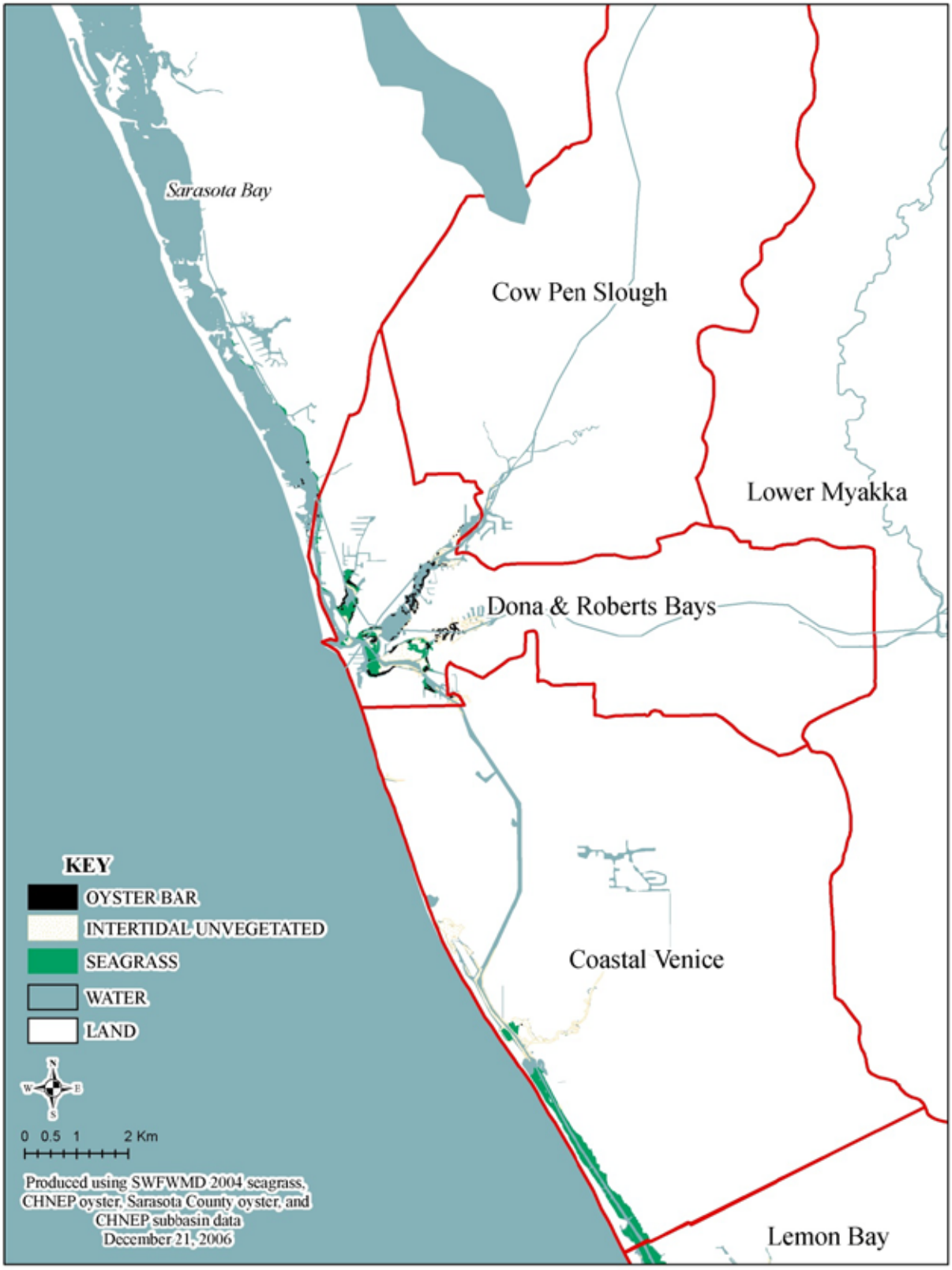
The Coastal Watersheds of the Charlotte Harbor National Estuary Program

Bays, beaches, barrier islands and mangroves dominate the region from Dona and Roberts Bays to Fishtrap Bay at South Estero Bay. Barrier islands separate the waterway running from Venice Inlet through Lemon Bay from the open waters of the Gulf of Mexico and Charlotte Harbor. Gasparilla Sound's broad open water body forms the exception to this pattern of Sarasota and Charlotte County lagoons. Southward, Gasparilla Sound merges into Charlotte Harbor proper. The Harbor waters split around Pine Island, forming Pine Island Sound to the west and Matlacha Pass to the east. The barrier island pattern picks up again, with Cayo Costa, Upper Captiva, and Captiva/Sanibel Islands standing between the Gulf and Pine Island. Estero Bay then lies between Estero Island and the Lee County mainland.

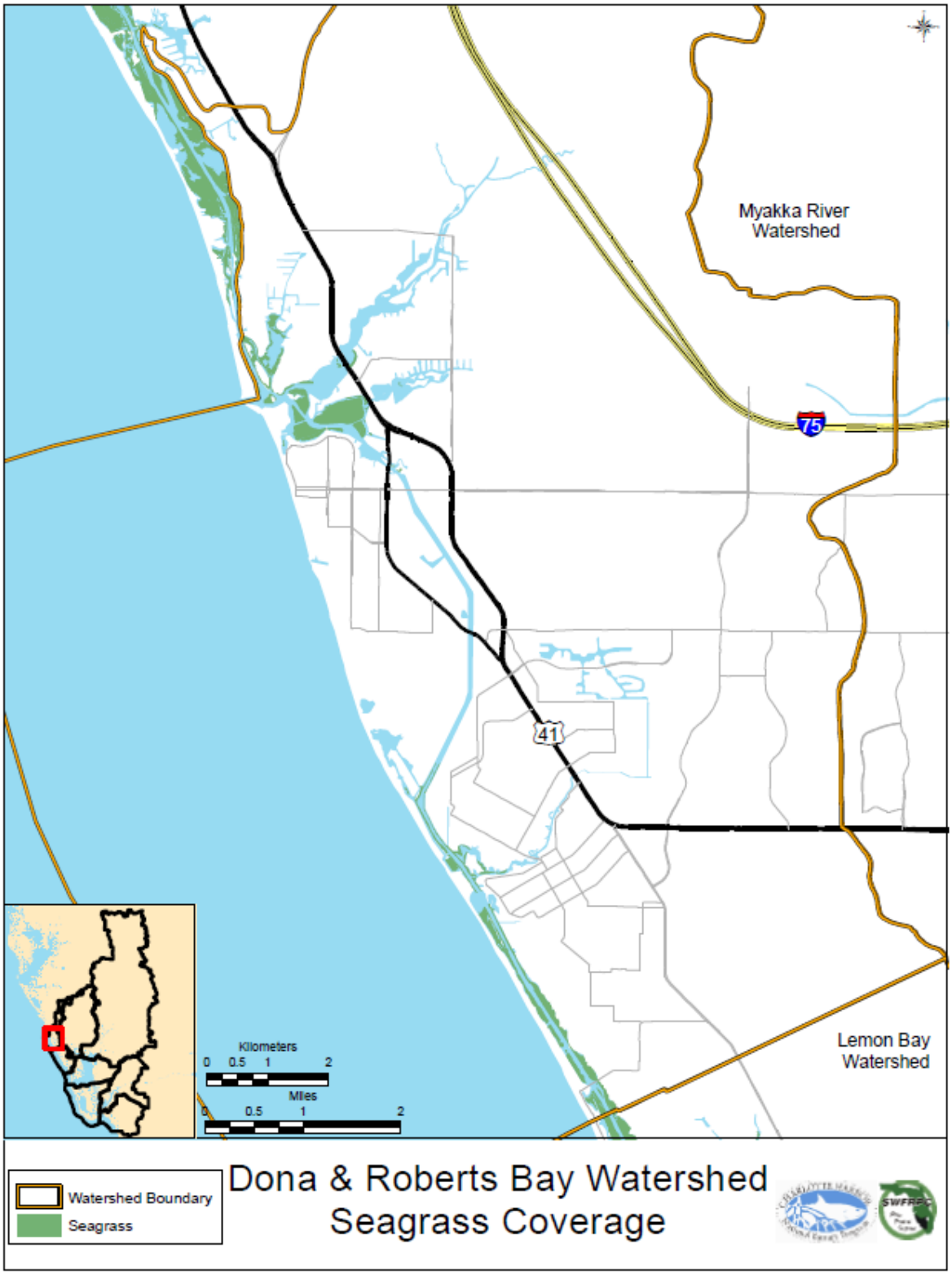
Dona and Roberts Bays

The Dona and Roberts Bay Watershed currently spans a total of 25,227 hectares (97.4 square miles), 90% of which lies within Sarasota County. Dona Bay, in Nokomis, is downstream of Shakett Creek, Fox Creek, Salt Creek, and Cowpen Slough. Before about 1916, the watershed for Dona Bay was approximately 4,144 hectares (16 square miles). Decades of drainage projects constructed to reduce the numbers of mosquitoes, drain wetlands, and reduce flooding (on infrastructure that had been built in floodplains) dramatically changed the flow of runoff to both bays. The most significant of these projects are Cow Pen Slough, constructed in the 1960's, which empties into Dona Bay, and the Blackburn Canal, constructed in 1959, which empties into Roberts Bay. The result is a watershed for Dona Bay that is more than five times its original size. Scientists estimate that 7 percent of the Myakka River's flow is diverted to Roberts Bay by the Blackburn Canal.

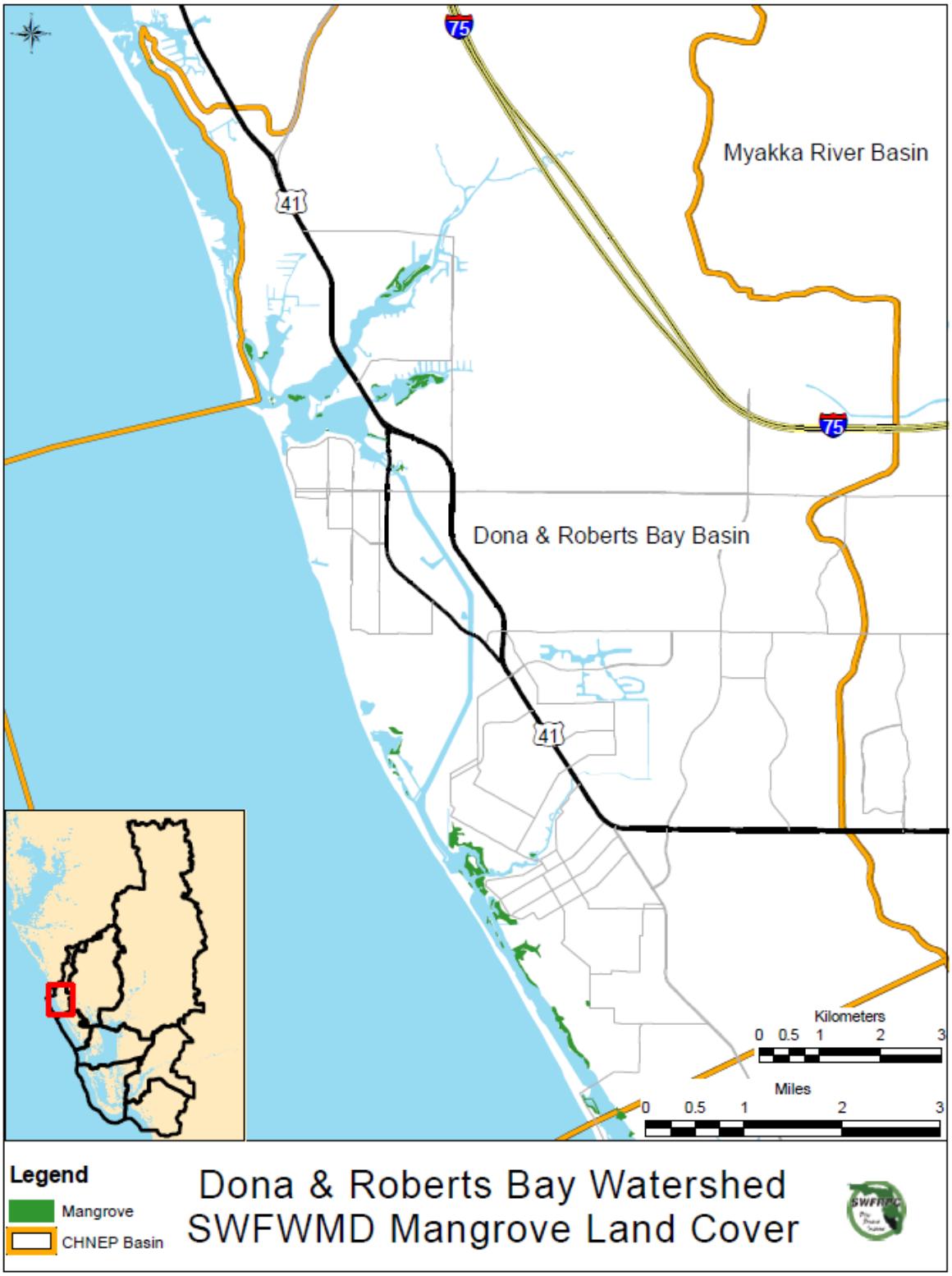
Runoff from rainfall has been diverted by these canals into the tidal creeks and bays, altering the mix of fresh and salt water, and changing the habitat for shellfish and young finfish. The drainage system also carries soil and anything else that can float or be carried by flowing waters from the watershed to the bays, changing bottom habitats in creeks and bays. Resultant increases in freshwater have changed the estuarine ecosystem and have even been known to prevent tides from entering the Venice Inlet during summer rainy season. These small bays are protected as designated Outstanding Florida Waters (OFW).



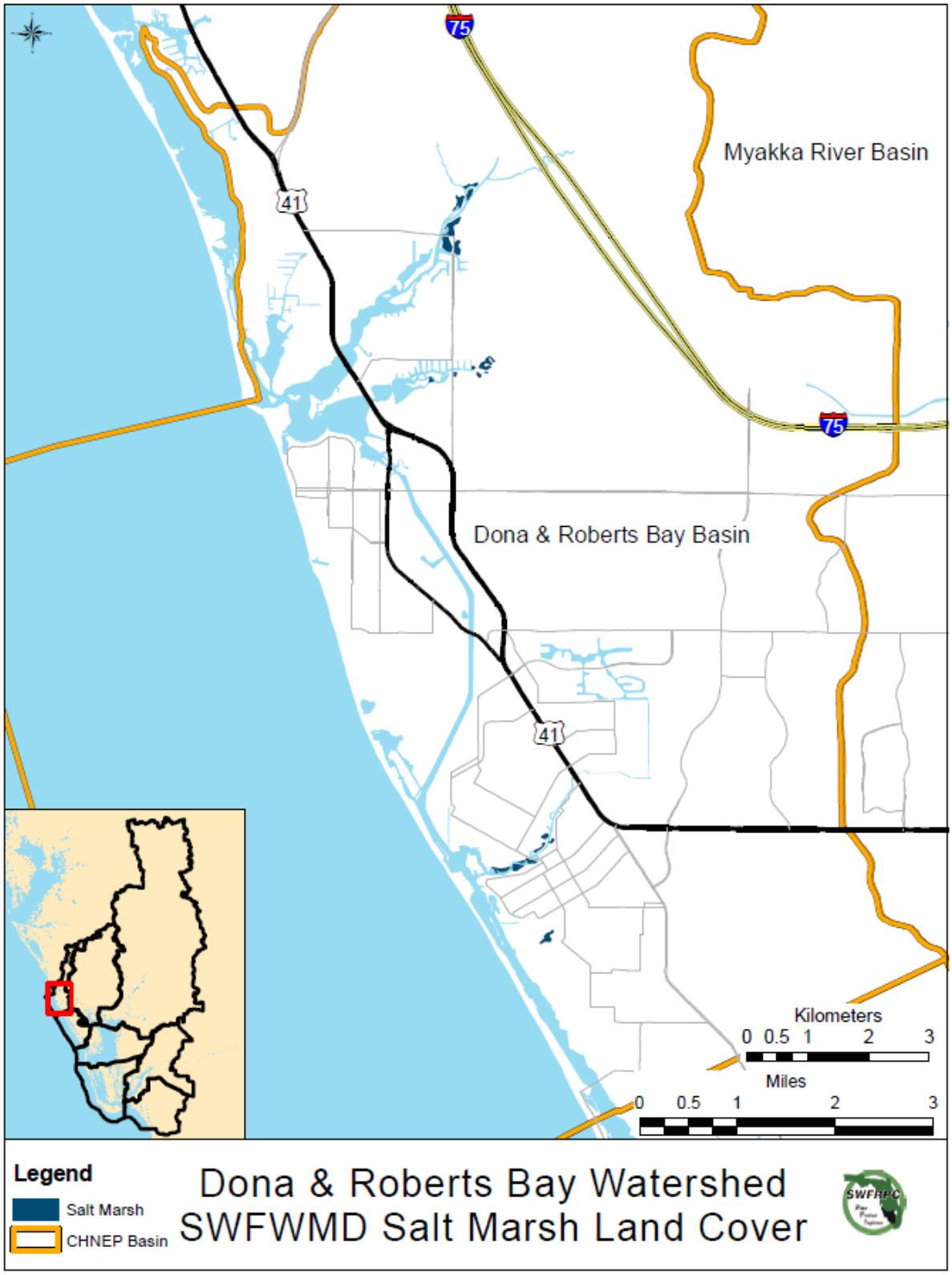
Map 13: 2009 Habitat Distribution in Dona and Roberts Bays and Coastal Venice Watersheds



Map 14: 2009 Seagrass and Oyster Bar Distribution in Dona and Roberts Bays and Coastal Venice Watersheds



Map 15: 2007 Mangrove Distribution in Dona and Roberts Bays and Coastal Venice Watersheds



Map 16: 2007 Salt Marsh Distribution in Dona and Roberts Bays and Coastal Venice Watersheds

Lemon Bay

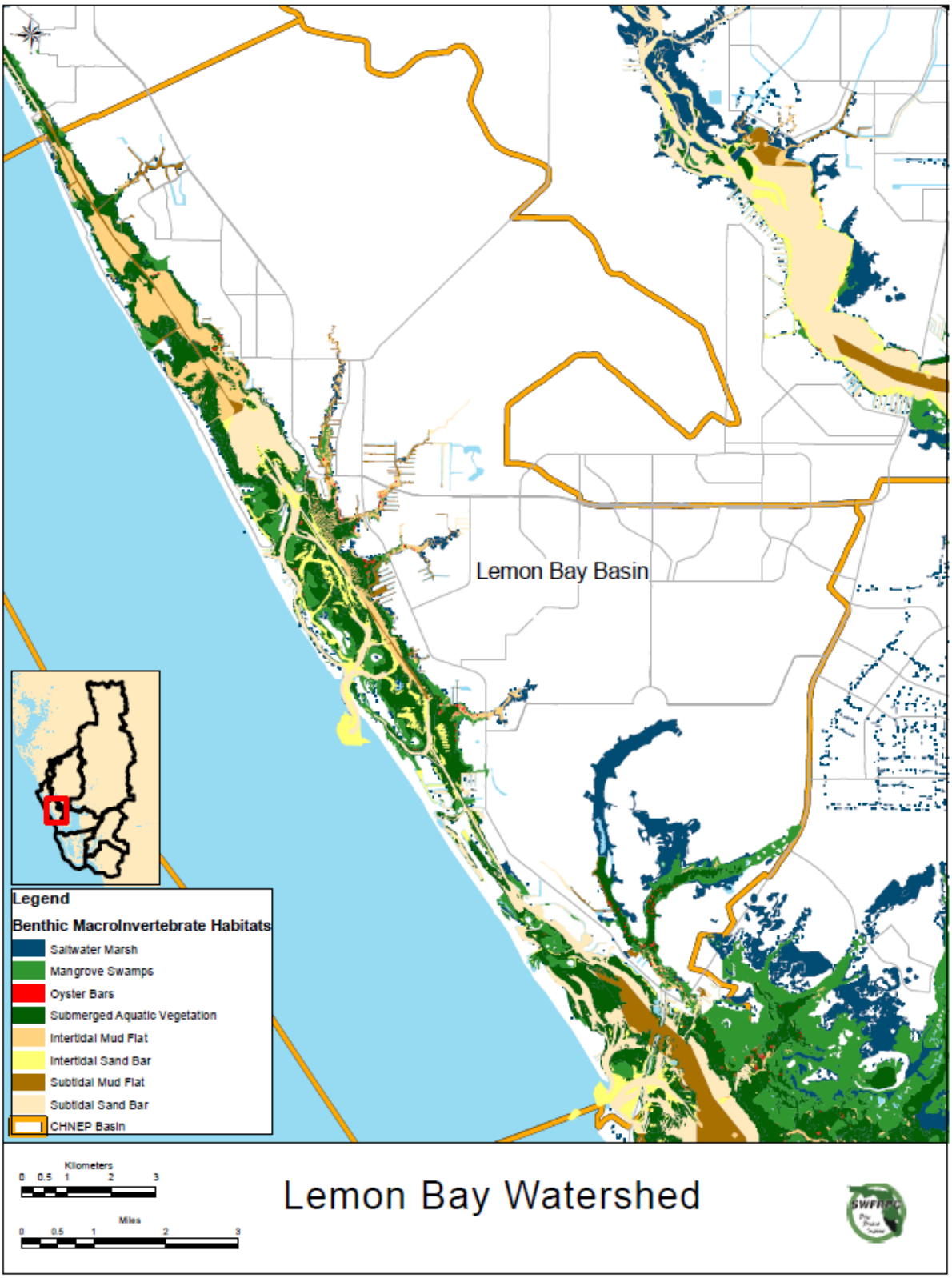
Lemon Bay was designated an Aquatic Preserve by the Florida Legislature in 1986, and, like all Aquatic Preserves, is an Outstanding Florida Water. The Lemon Bay Watershed, identified on Map 17, occupies approximately 18,907 hectares (73 square miles) and is located within Charlotte and Sarasota counties. A relatively long, narrow body of water, Lemon Bay's average width along its 21 km (13 mile) length is 1.2 km or three quarters of a mile, though it ranges from 1.3 to 2 kilometers (one-eighth of a mile to 1.2 miles). Lemon Bay has an average depth of approximately 1.8 meters (6 feet) at mean high water (FDNR1991).

Lemon Bay is separated from the Gulf of Mexico by a chain of barrier islands, and connected to it through Gasparilla Pass, Stump Pass and Gasparilla Sound. Seven shallow, tidal creeks—Lemon, Buck, Oyster, Ainger, Godfried, Forked, and Alligator—drain into Lemon Bay; the latter two, Forked and Alligator, occur in Sarasota County. Waterward of the bridges over County Road 775, these tributary creeks are considered part of the Aquatic Preserve.

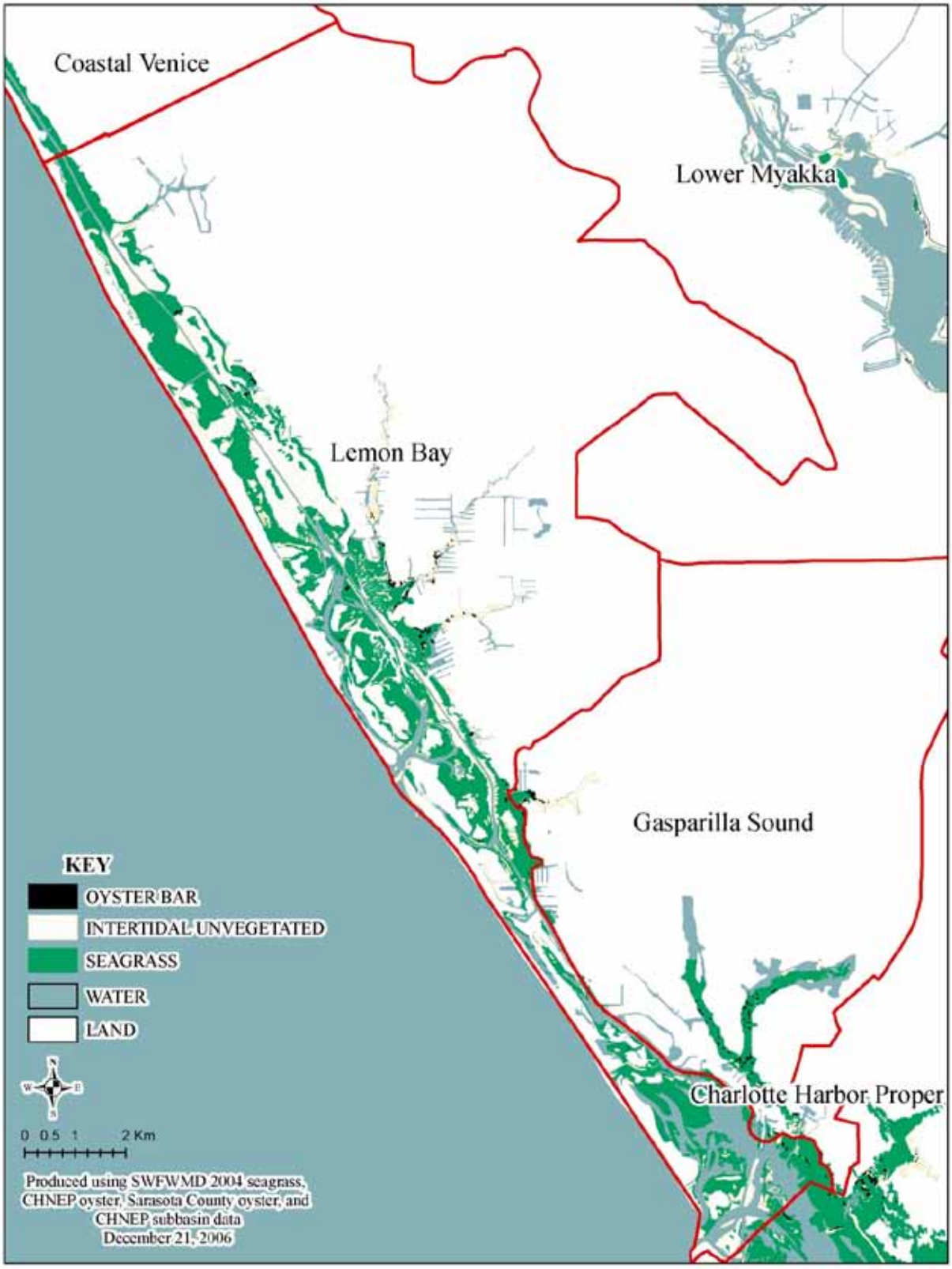
This part of the CHNEP study area has some important resource management challenges including the effects of boat traffic and dredging on the Intracoastal Waterway and other channels; retaining mangrove areas and protecting seagrass beds; large areas of undeveloped platted lots; effects of septic systems and stormwater runoff from development on water quality; dynamically unstable tidal inlets; and removal of nuisance exotic vegetation. All these factors influence the neighborhoods and habitats in this coastal area.

The distribution of seagrass in Lemon Bay as compiled by the SWFWMD is presented in Maps 17 and 18. North of Lemon Bay, the Intracoastal Waterway connects to Roberts Bay in Venice. Because of the relatively small area of protected estuary behind the barrier islands, the total area of seagrass is small. However, the proportion of the coverage of bay bottom in this region is relatively high. Seagrasses are most abundant south of the Tom Adams Bridge in Lemon Bay, covering more than70% of the bay bottom in that area. North of the bridge, most of the seagrass can be found on the western side of the bay. The oyster reef/hard bottom communities (Map 18) within this system are primarily limited to four concentrations at the mouths of the tributaries Coral Creek, Ainger Creek, Oyster Creek, and Buck Creek. Important fringing oyster reef habitat exists throughout the estuary.

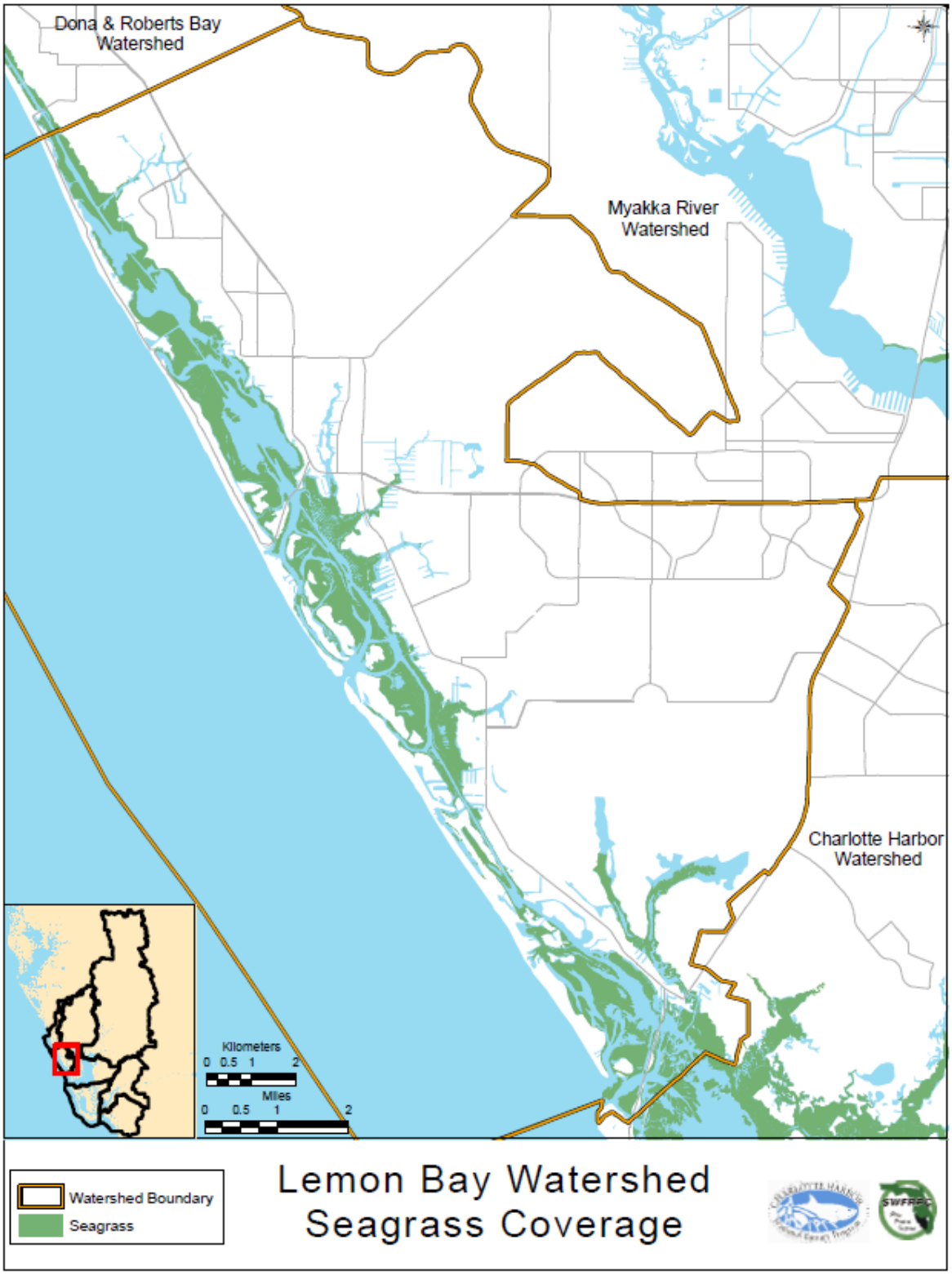
The tidal flats adjacent to the shorelines of this region are associated with mangrove fringes, and some accretion areas from erosion off hardened seawalls. In addition, several tidal flats near the center of the bay are associated with the discard of maintenance dredging spoil from the creation of navigational channels.



Map 17: 2009 Benthic Habitats in the Lemon Bay Watershed



Map 18: 2006 Seagrass and Oyster Bar Distribution in the Lemon Bay Watershed



Map 19: 2009 Seagrasses in the Lemon Bay Watershed

Map 20 presents the mangrove habitat of the Lemon Bay coastal region. The total reported mangrove area for this subbasin in 2000 was 306 hectares (757 acres). These mangroves fringe the protected shorelines of the barrier islands. The mangrove overwash islands isolated by water in Lemon Bay provide very important roosting habitats for wading birds in this urban area.

Map 20: Mangrove Distribution in the Lemon Bay Watershed

The salt marsh habitat of the Lemon Bay coastal region is presented in Map 21. The total reported salt marsh area for this subbasin is 139 hectares (344 acres). Lemon Bay also has a very limited distribution of salt marshes on the mainland.

Map 21: Salt Marsh Distribution in the Lemon Bay Watershed

Charlotte Harbor, Tidal Myakka and Tidal Peace Estuaries

Charlotte Harbor proper lies primarily in Charlotte County and is formed by the convergence of two natural rivers, the Peace River and the Myakka River, with a connection to the Gulf of Mexico through Boca Grande Pass. The Harbor is approximately 27.4 kilometers (17 miles) long by 8 kilometers (5 miles) wide. The depth of the Harbor ranges from 3 to 3.7 meters (10 to 12) feet, with most of the man-made channels excavated to a depth between 0.9 to 1.8 meters (3 to 6 feet). Tide range is an average of 0.6 meters (2 feet). The winter months bring in lower than normal tides. The October and November tides are the highest.

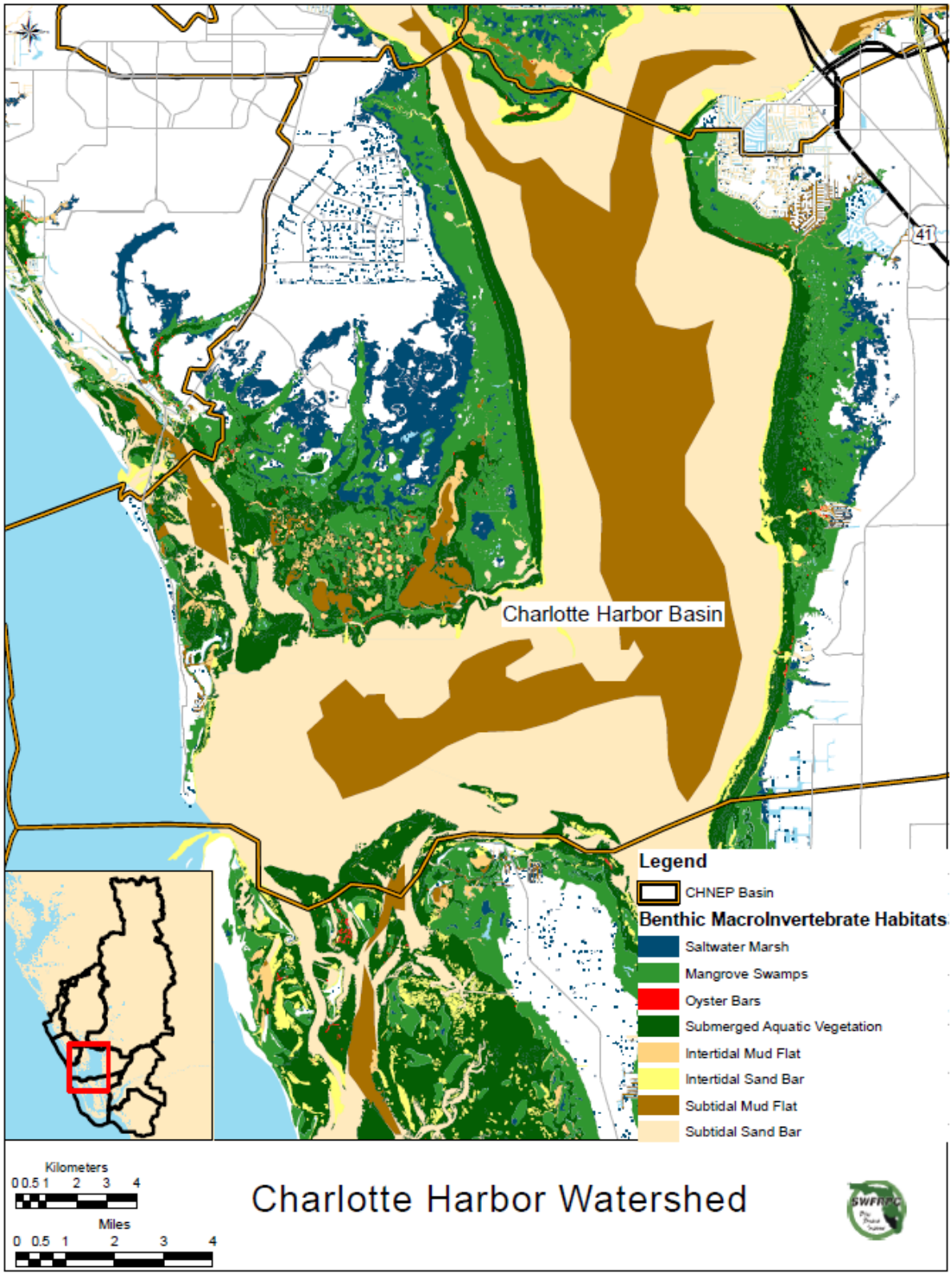
Although the Harbor has an area of about 33,670 hectares (130 square miles), much of it is very shallow. Areas of deep Harbor water extend up into the lower Myakka and Peace rivers. Sandy shelves make up the Harbor "walls," including Cape Haze on the west and Punta Gorda/Cape Coral on the east. The bottom here is covered by seagrass beds — essential habitat for young fish and other wildlife**.**

Perimeter sand bars extend along both the east and west shores of the upper bay, separated from the mangrove shores by slightly deeper seagrass-filled troughs. Yet other sandbars, or shoals, extend outward into the bay like those at Cape Haze and from the south end of Hog Island. Elsewhere, large areas of shallow, grass flats can be found, such as those that extend southward into Matlacha Pass and Pine Island Sound and northward into Turtle Bay and Bull Bay.

The topography of the bay bottom is quite diverse, despite the fact that it is relatively shallow. The diversity of sand and grass bottoms, shoals and troughs, mangrove islands and passes, and the mixture of salt and fresh water, creates conditions and environments that are very attractive to an equally diverse fish community (Benuzzi 2004).

The tides from the Gulf of Mexico affect water levels far up the Myakka and Peace Rivers. Although salt water migrates up the rivers during low river flow periods, typical high freshwater flows coming down the rivers in the summer lower salinity in the rivers and the Harbor. Thus, the Harbor changes dramatically with the seasons.

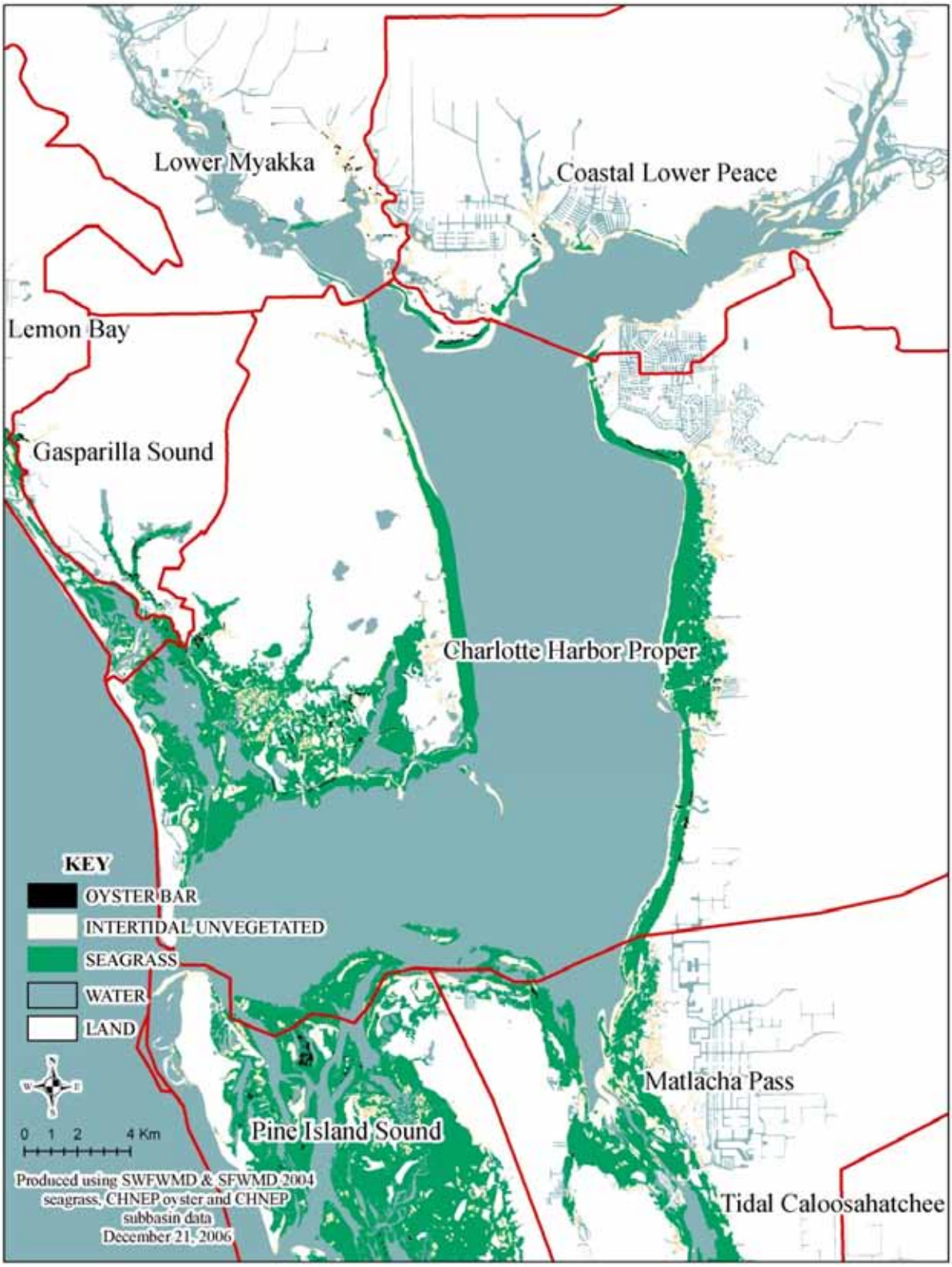
The Charlotte Harbor Aquatic Preserves (CHAP) is five contiguous aquatic preserves within the greater Charlotte Harbor estuary complex designated by the state Legislature under the Florida Aquatic Preserve Act of 1975. The preserves are (from north to south): Lemon Bay Aquatic Preserve (Lemon Bay AP), Cape Haze AP, Gasparilla Sound–Charlotte Harbor AP, Matlacha Pass AP and Pine Island Sound AP. All of these areas are included in the Charlotte Harbor Aquatic Preserves Plan.



Map 22: Benthic Habitats of the Charlotte Harbor Proper Watershed

The public owns many of the wetlands, mangrove forests and salt marshes surrounding the Harbor. Very large buffer areas, including the Charlotte Harbor Buffer Preserve State Park and mangrove islands are also publicly owned. However, much of the former ranch land and natural habitat have been displaced by platted lots and suburban development. As people continue to move to the communities around Charlotte Harbor, the impacts of man-made canals, septic systems, mangrove trimming and loss of upland habitats require more careful management. One excellent example is the recent decision by Charlotte County to provide central sewers to the South Gulf Cove development.

The SWFWMD 2004 seagrass distribution data for the Charlotte Harbor Proper portion of the Charlotte Harbor complex are presented in Map 23. All seagrasses are confined to the fringes of the Harbor in shallow water and the mapped areas represent three species (*Thalassia*, *Halodule*, and *Ruppia*). The most extensive areas are the harbor-fringing shoal meadows along the eastern shore of the upper Harbor. These occur from about Burnt Store Marina to Alligator Creek and in the shallow areas among the mangrove keys in the lower Harbor in Gasparilla Sound and north of Bull Bay to Whidden Creek. In Gasparilla Sound north of the bridges, the largest seagrass beds are west of the Intracoastal Waterway. South of the bridges, the largest seagrass beds extend from the mouth of Coral Creek south to Charlotte Harbor. One extensive area occurs west of the Intracoastal Waterway about midway down Gasparilla Island. A narrower fringe occurs south of Hog Island and along the western shore of the upper Harbor. This distribution reflects the bathymetry of the Harbor: broader shoal areas on the east shore; shallower on the west shore, similar to Tampa Bay to the north. High salinities greater than about 37 ppt. have never been recorded in Charlotte Harbor and seagrass distributions of three species should not be influenced by high salinity. Low salinities toward the head of the Harbor may be very important. Known lower salinity limits for seagrasses are approximately 20 ppt. for *Thalassia* and *Syringodium.* Morrison *et al.* (1989) observed localized declines in seagrass abundance in Matlacha Pass and attributed the changes to declining summer salinities. *Ruppia* prefers lower salinities from about 10 ppt. to 25 ppt. *Halophila* may occur when salinities are generally greater than 28 ppt. The shallow bar on the south side of Hog Island marks the approximate northern limit of *Thalassia.* Only *Halodule* and *Ruppia* extend further up the Harbor.



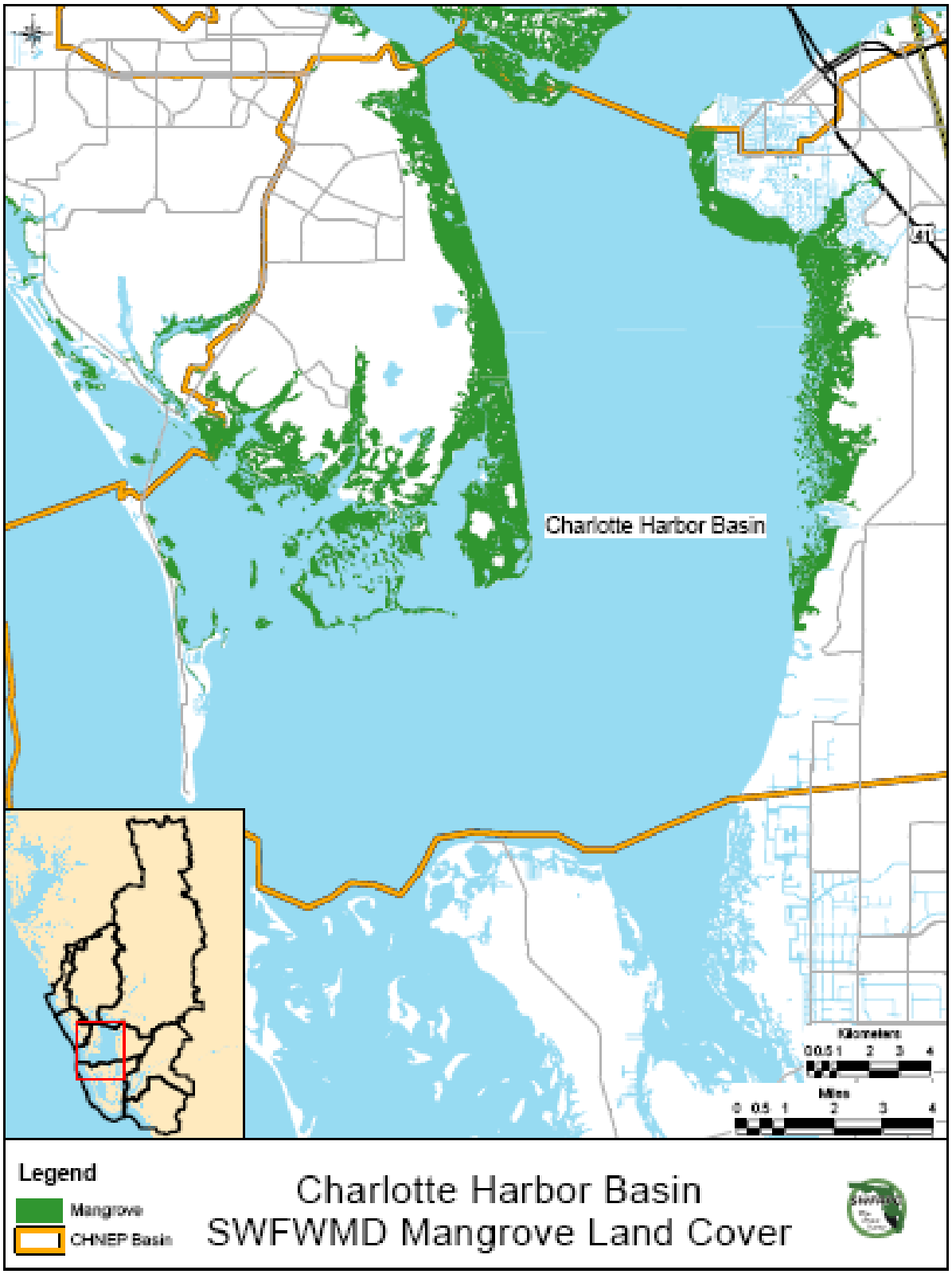
Map 23: Coastal Habitat Distribution in the Charlotte Harbor Watershed

Map 24: 2009 Seagrass Distribution in the Charlotte Harbor Proper Watershed

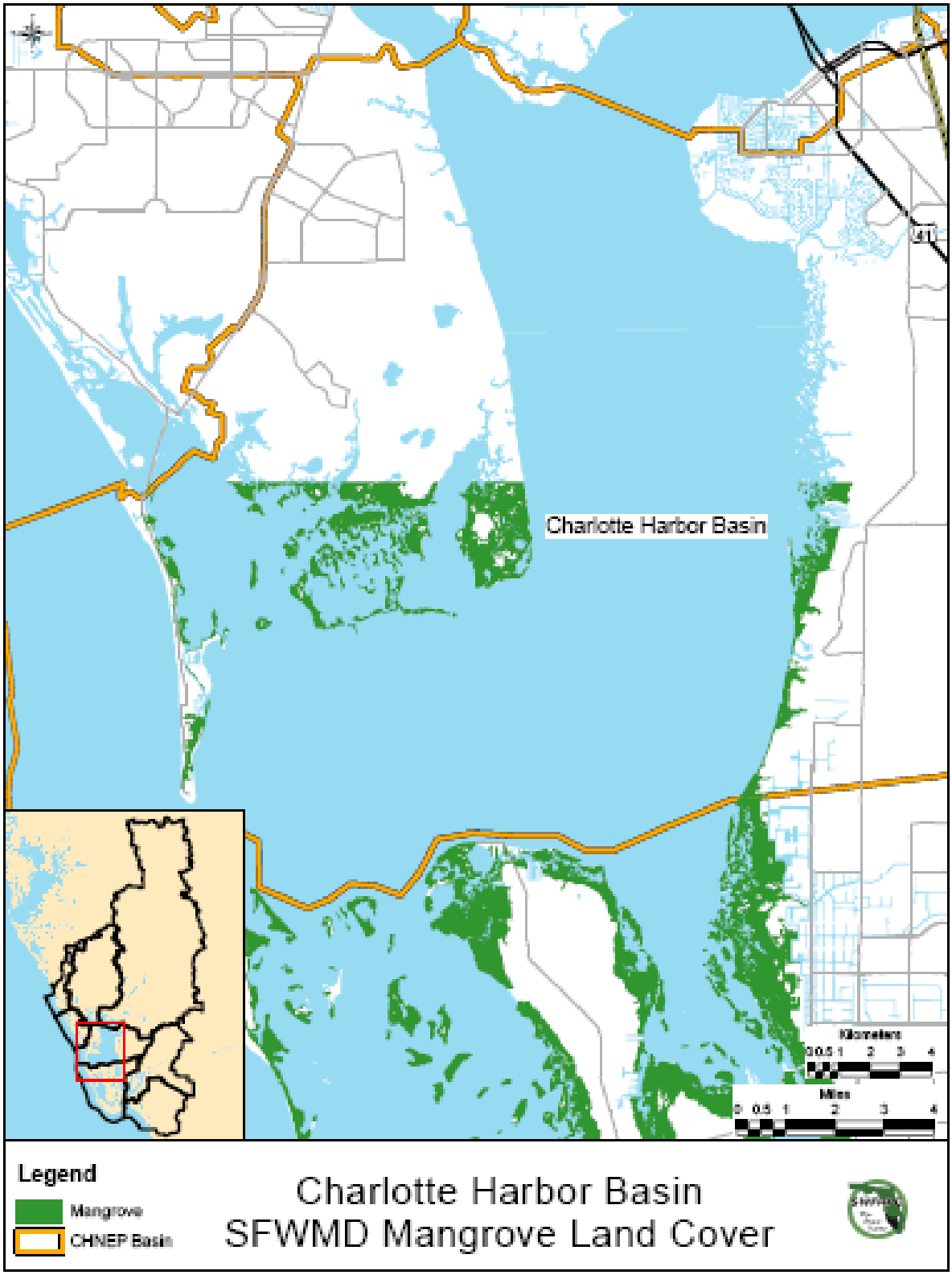
Important fringing oyster reefs are associated with the mangrove forests, shorelines, and seawalls throughout Charlotte Harbor; however, they are too small to be represented in this series of maps. Notably, large oyster reef-hard bottom communities are located at the southeastern tip of Hog Island in the northernmost portion of the Harbor, and to the southwest of the Punta Gorda peninsula in the northeast portion of the Harbor. Larger oyster reef-hard bottom communities are also associated with the complex system of mangrove keys in the southwest.

The tidal /mud flats of this region comprise the largest extent of this habitat within the study area. In particular, very large flats are located south of the Punta Gorda peninsula in the northeast portion of the Harbor. From these large expanses, a series of fringing flats exists east of and adjacent to the seagrass meadows along the eastern shoreline of the Harbor. Similar fringing flats exist to the south of the seagrass meadows in the Gasparilla Sound Region. Flats are also located in the southern portion of the Harbor in an area that is likely to experience a higher energy wave environment.

Map 25 presents the distribution of mangrove habitats in the Charlotte Harbor proper region of the study area. These compiled data report a total of 5,754 hectares (14,219 acres) of mangroves in the Coastal Charlotte Harbor Proper Subbasin, a total of 1,157 hectares (2,858 acres) of mangroves in the Coastal Lower Peace River Subbasin, and 338 hectares (835 acres) of mangroves in the Coastal Lower Myakka River Subbasin. These mangroves occur along most of the inland shores of the Harbor, form groups of isolated keys away from the shoreline and vast stretches of dense mangrove habitat along the shoreline, penetrating inland along most of the tidal creeks and coves. They are particularly concentrated in the northern portions of the Harbor.

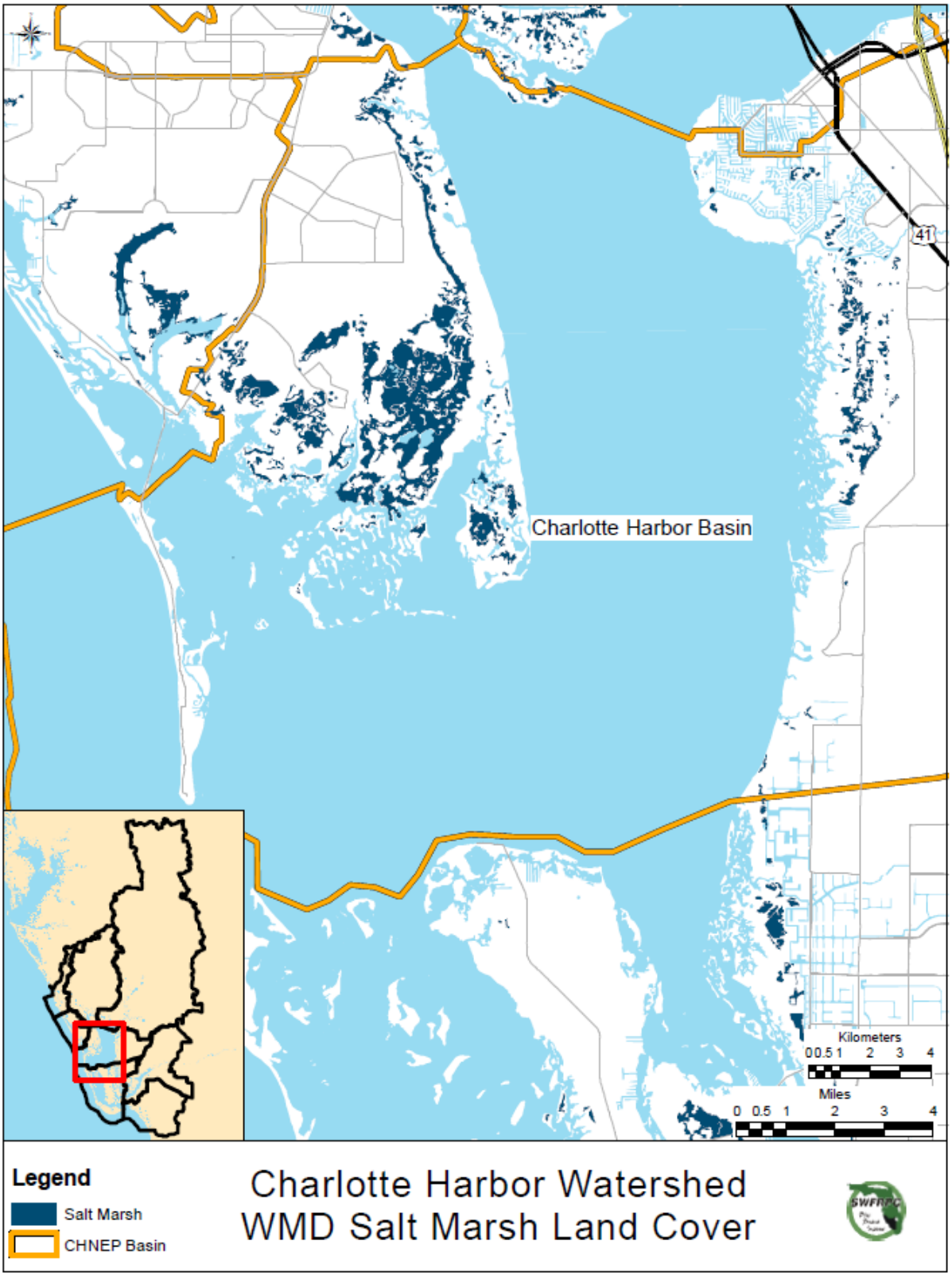


Map 25: SWFWMD Mangrove Distribution in the Charlotte Harbor Proper Watershed

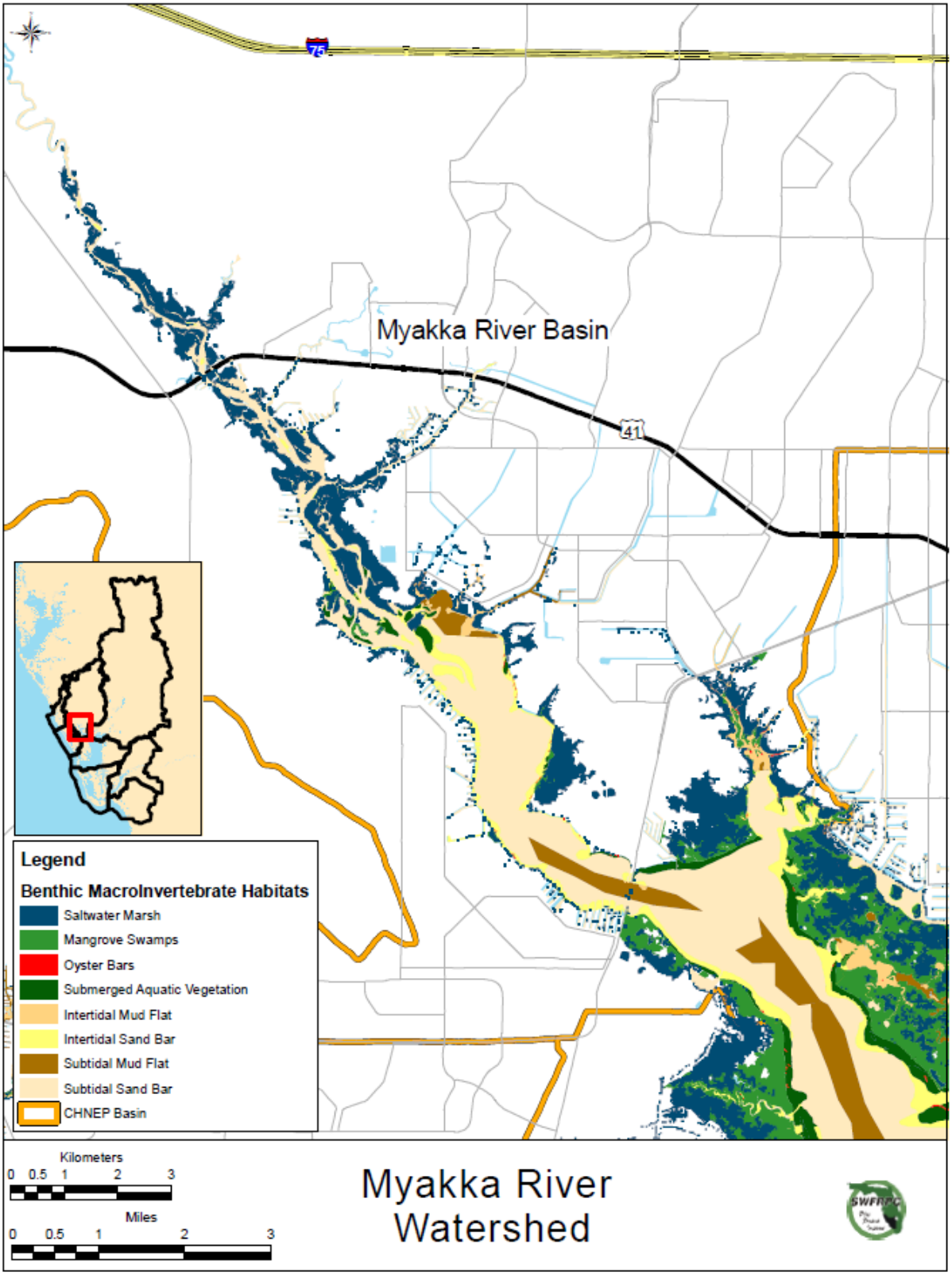


Map 26: SFWMD Mangrove Distribution in the Charlotte Harbor Watershed

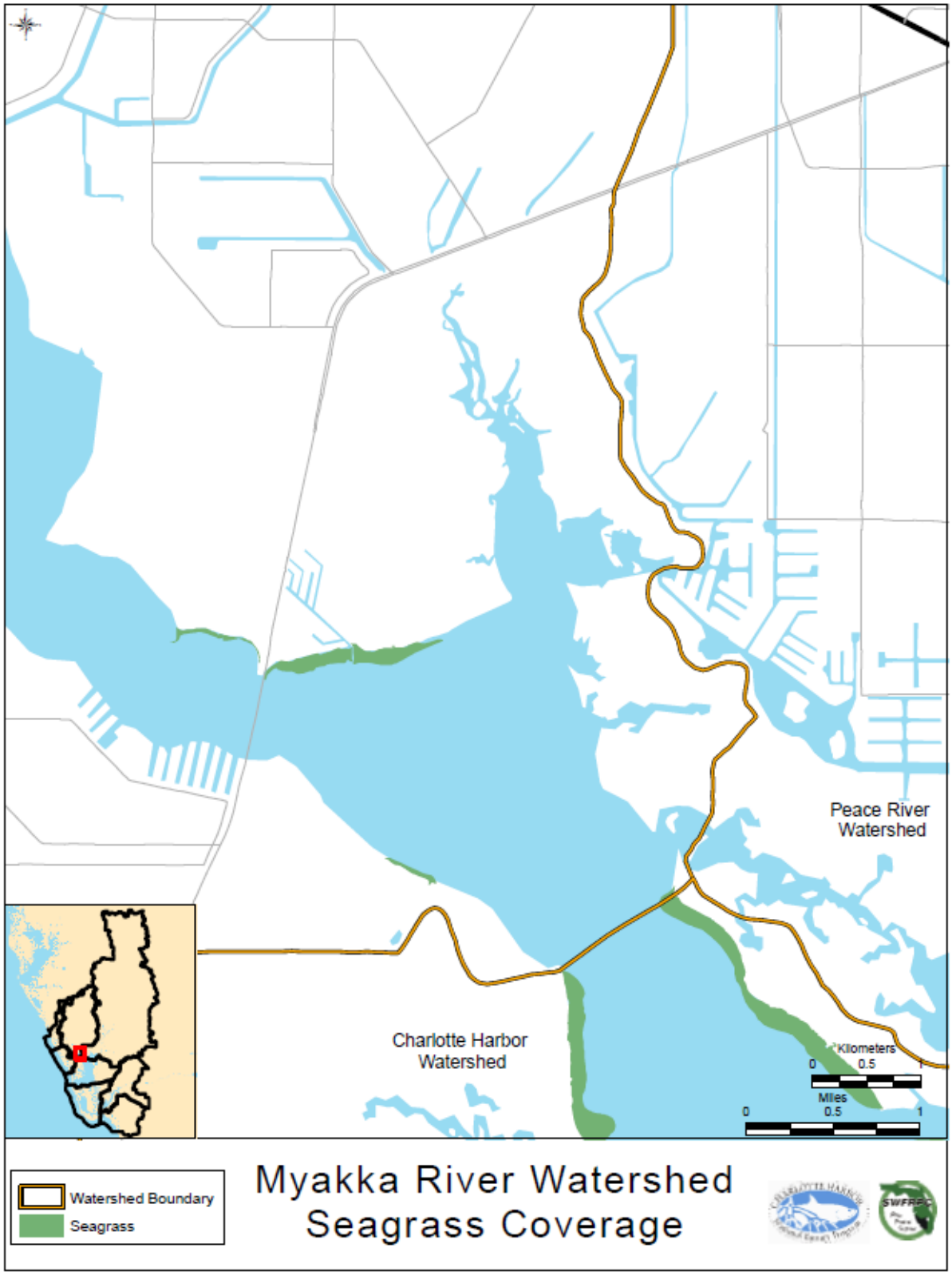
Map 27 presents the distribution of salt marsh habitats in the Charlotte Harbor proper region of the study area. These compiled data report a total of 1,560 hectares (3,855 acres) of salt marshes in the Coastal Charlotte Harbor Proper Subbasin, a total of 680 hectares (1,681 acres) of salt marshes in the Coastal Lower Peace River Subbasin, and 554 hectares (1,369 acres) of salt marshes in the Coastal Lower Myakka River Subbasin. There are seven varieties within two primary types of salt marsh located in the CHNEP study area, and both are represented well in this map. The first type is comprised of the meandering riverine salt marshes depicted in both the Myakka and Peace Rivers. These riverine salt marshes often are located apart from extensive mangrove forests due to the relatively steeper slopes of the upland riverbanks and the fact that the rivers are generally located in the more developed regions of the study area. The second type is located in pockets between the uplands and mangroves. These areas often have higher salinities associated with evaporative sandy depressions that are inundated only on higher high tides. The salt marshes and low growing, stunted mangroves in these areas are often surrounding sandy areas devoid of vegetation (salt barrens).These pocket salt marshes are visible along the western upland fringes of the Charlotte Harbor region.



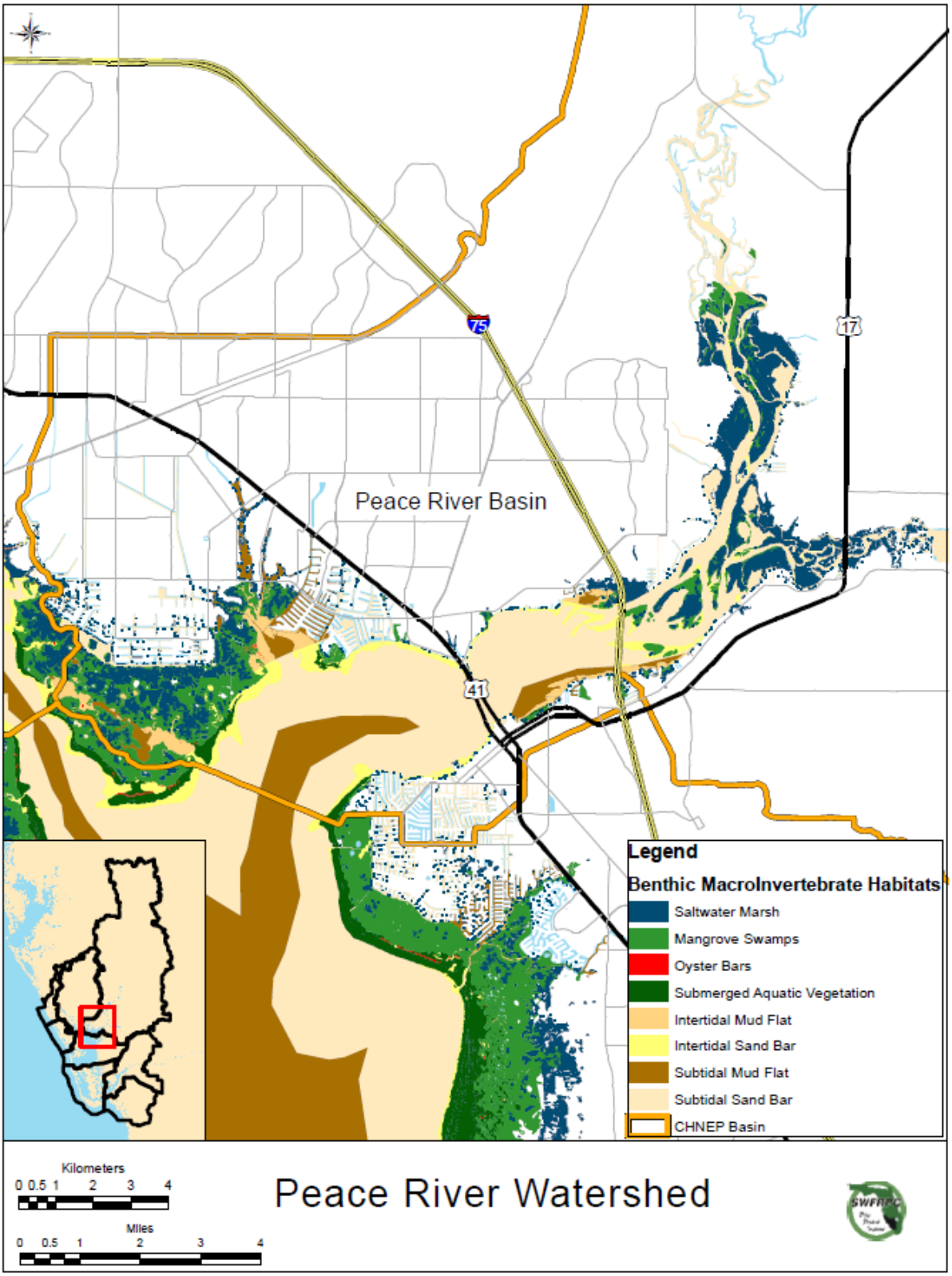
Map 27: Salt Marsh Landcover in the Charlotte Harbor Proper Watershed



Map 28: Benthic and Tidal Habitats of the Tidal Myakka River Watershed

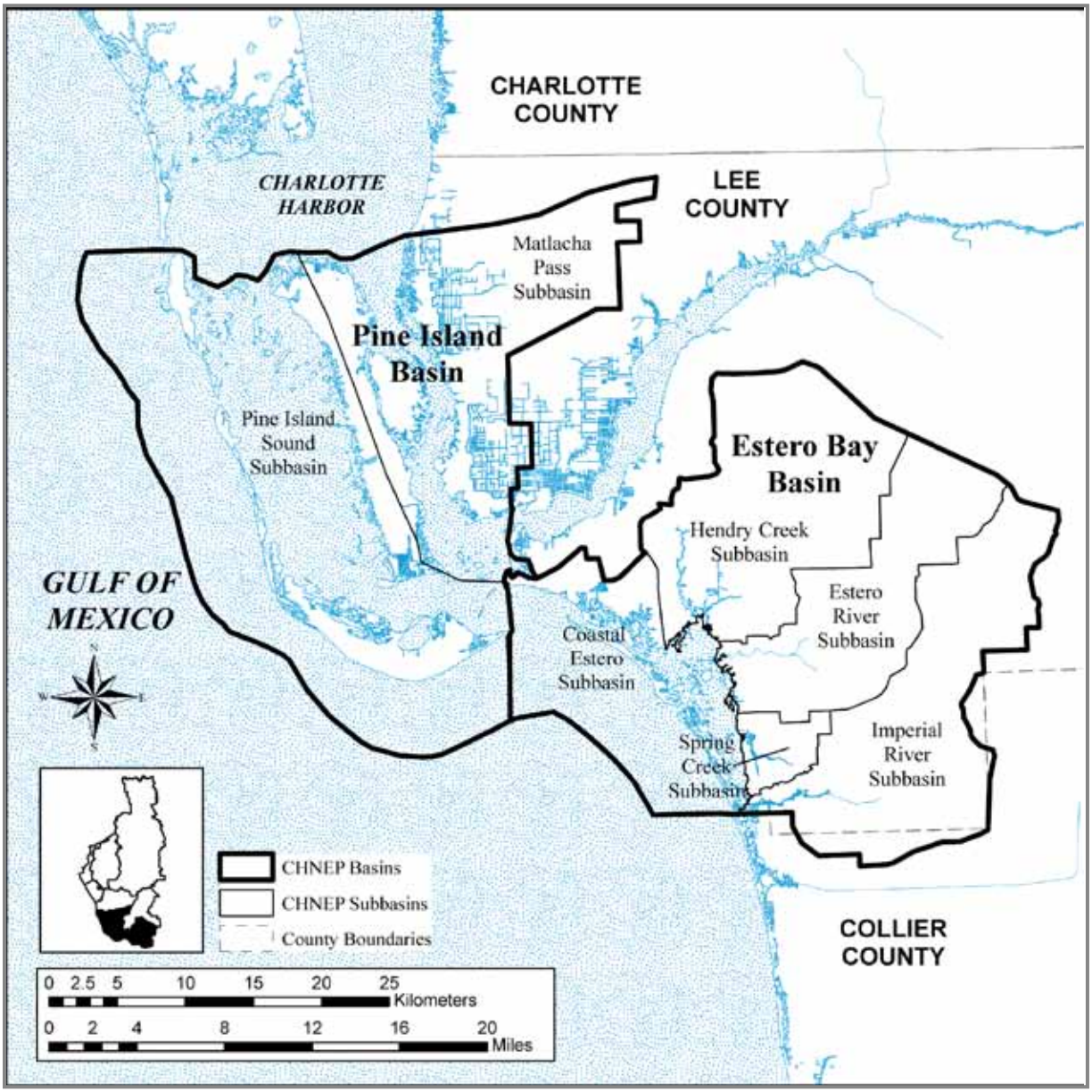


Map 29: Seagrass Habitats of the Tidal Myakka River Watershed



Map 30: Benthic Habitats of the Tidal Peace River Watershed

Map 31: Seagrasses of the Tidal Peace River Watershed

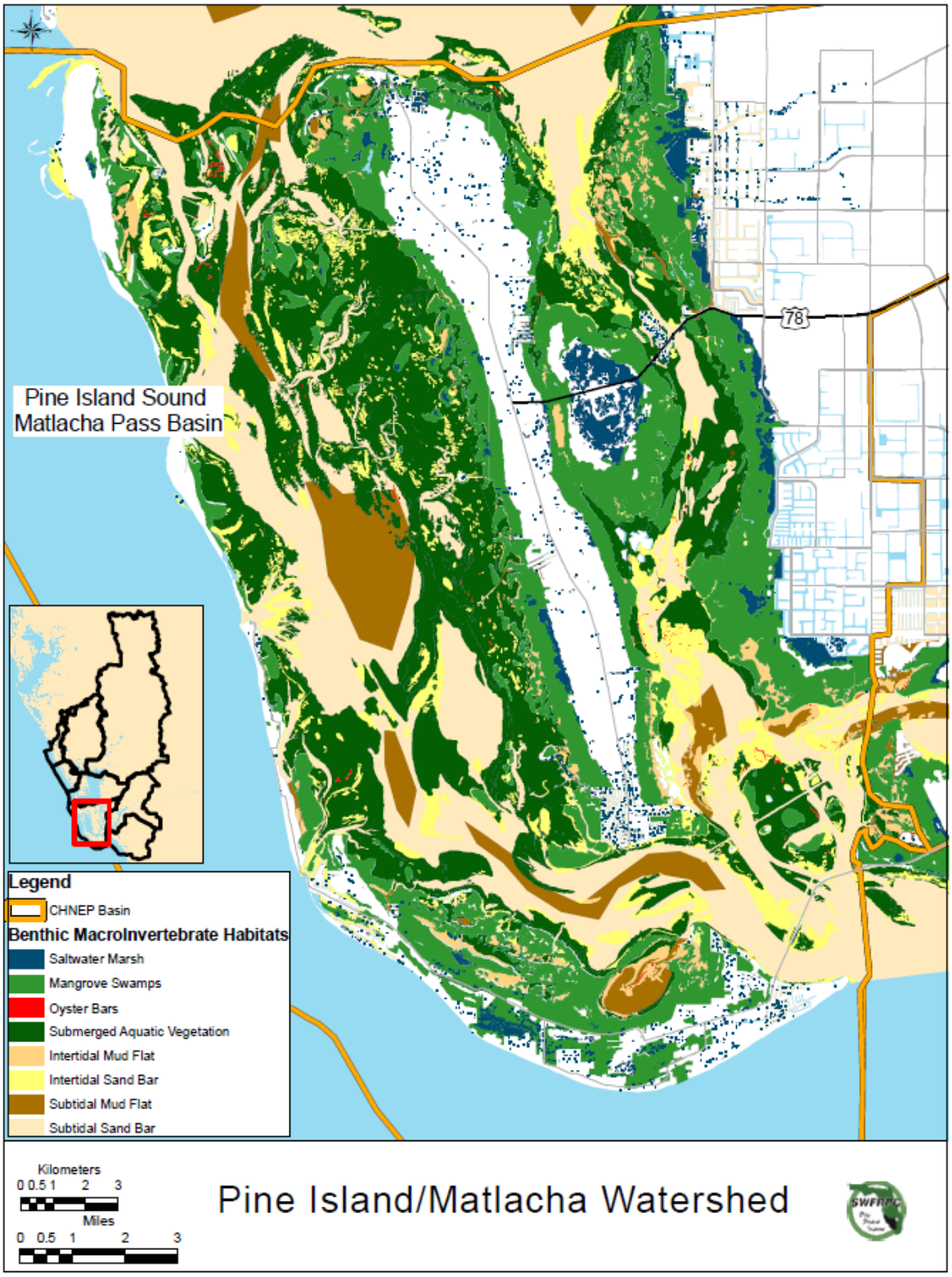


Map 32: Southern Estuarine Watersheds of the CHNEP

Pine Island Sound and Matlacha Pass

Pine Island Sound and Matlacha Pass are two large estuaries that lie immediately south of Charlotte Harbor. Pine Island separates the two estuaries and provides them with limited fresh water from numerous small creeks and wetland areas flowing from the island's interior. Direct rainfall and runoff from western Cape Coral provides the major portion of fresh water. The Cape Coral interceptor waterways directly influence the quantity and quality of the freshwater inflow.

Both estuaries have extensive seagrass beds that provide essential habitat for young fish. Periodically, during large releases from the Caloosahatchee River, outflow can discharge fresh water through San Carlos Bay into southern Pine Island Sound. Dredging, altered timing and volumes of freshwater discharges from the Caloosahatchee River system have harmed these estuaries. Seagrasses, oyster beds and other plants and animals in the system are vulnerable to salinity changes, sediments and pollutants that occur during dramatic changes in freshwater inflows. A better understanding of these impacts and improved management of freshwater releases is necessary to protect these coastal habitats.



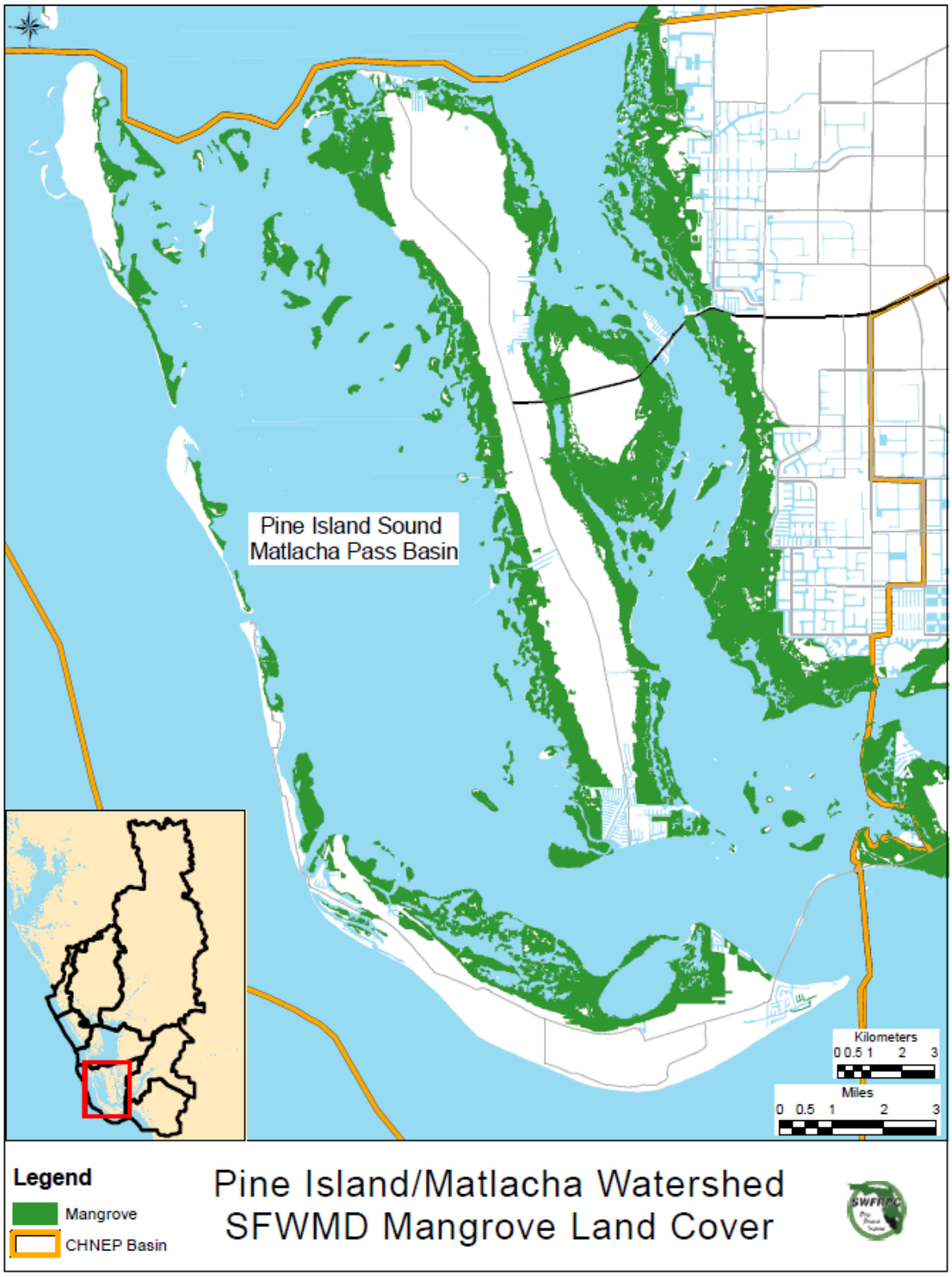
Map 33: Benthic Habitats of Pine Island Sound, Matlacha Pass, and San Carlos Bay

The distribution of seagrass in Pine Island Sound and Matlacha Pass as compiled by the FMRI is presented in Map 34. Pine Island Sound has the most extensive seagrass beds in the greater Charlotte Harbor complex. On the western side of Pine Island, a nearly continuous broad band of seagrass about 27.3 kilometers (17 miles) long extends from north to south. Areas of Pine Island Sound deeper than 1.8 meters (6 feet), generally do not have any of the three common species, but can have *Halophila* appearing in some years. Seagrasses are abundant on the eastern, sides of the barrier islands and on the eastern depositional fan areas of Captiva, Redfish and Blind Passes. In Matlacha Pass, seagrass distribution is generally restricted to water depths of less than a meter (three feet) because of the high water color in the summer months. Seagrasses occur throughout the pass on both west and east sides.

Map 34: 2009 Seagrass Distribution in the Pine Island Sound/Matlacha Pass Watershed

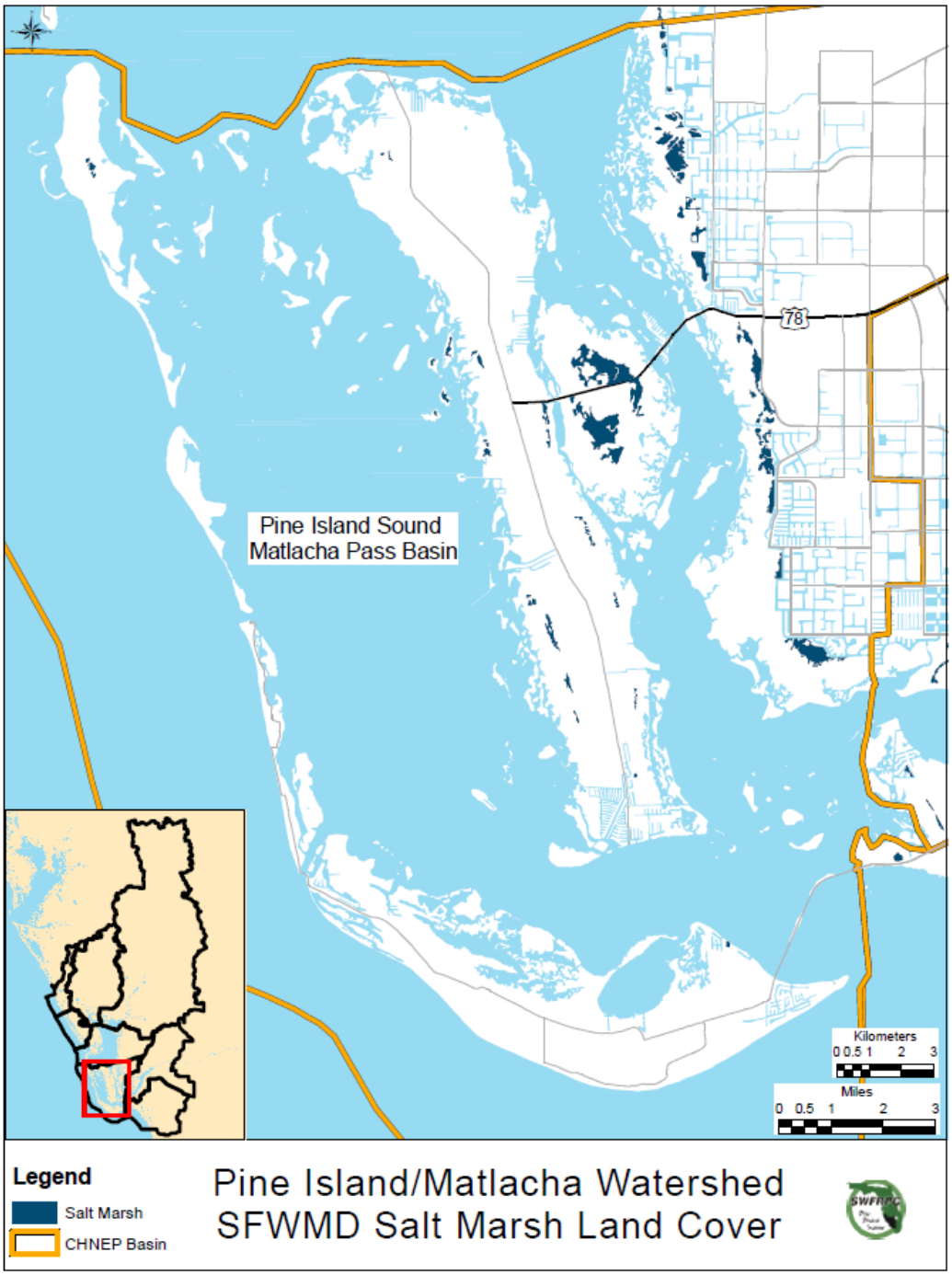
Larger areas of oyster reef-hard bottom communities are relatively rare in the estuary, and are often found associated with the shoreline, yet at a distance from it. Because of their relative rarity in the estuary, these habitats are particularly well-suited to be targeted for protection as part of the Quantifiable Objectives of the CHNEP CCMP.

The distribution of mangroves in the Pine Island Sound and Matlacha Pass region is presented in Map 35. The total reported mangrove acreage for the Pine Island Sound/Matlacha Subbasin is 7,732 hectares (19,107 acres). The mangroves in this region are extensive and fringe all of the protected shorelines of the barrier islands. Little Pine Island in the center of Matlacha Pass was delineated as a particularly large mangrove forest. The mosaics of mangroves in the southern portion of this region, on the northern coast of Sanibel Island, are particularly noted for the living resources they support, such as large populations of roseate spoonbills. These mangroves are currently protected as part of the J.N. "Ding" Darling National Wildlife Refuge.



Map 35: Mangrove Distribution in the Pine Island Sound / Matlacha Pass Watershed

The distribution of salt marsh habitat in the Pine Island Sound and Matlacha Pass region is presented in Map 36. The total reported salt marsh area for the Pine Island Sound/Matlacha Subbasin is 10 hectares (25 acres). Pine Island Sound and Matlacha Pass have very few salt marshes. Most of the emergent saltwater wetlands of this region are mangroves.

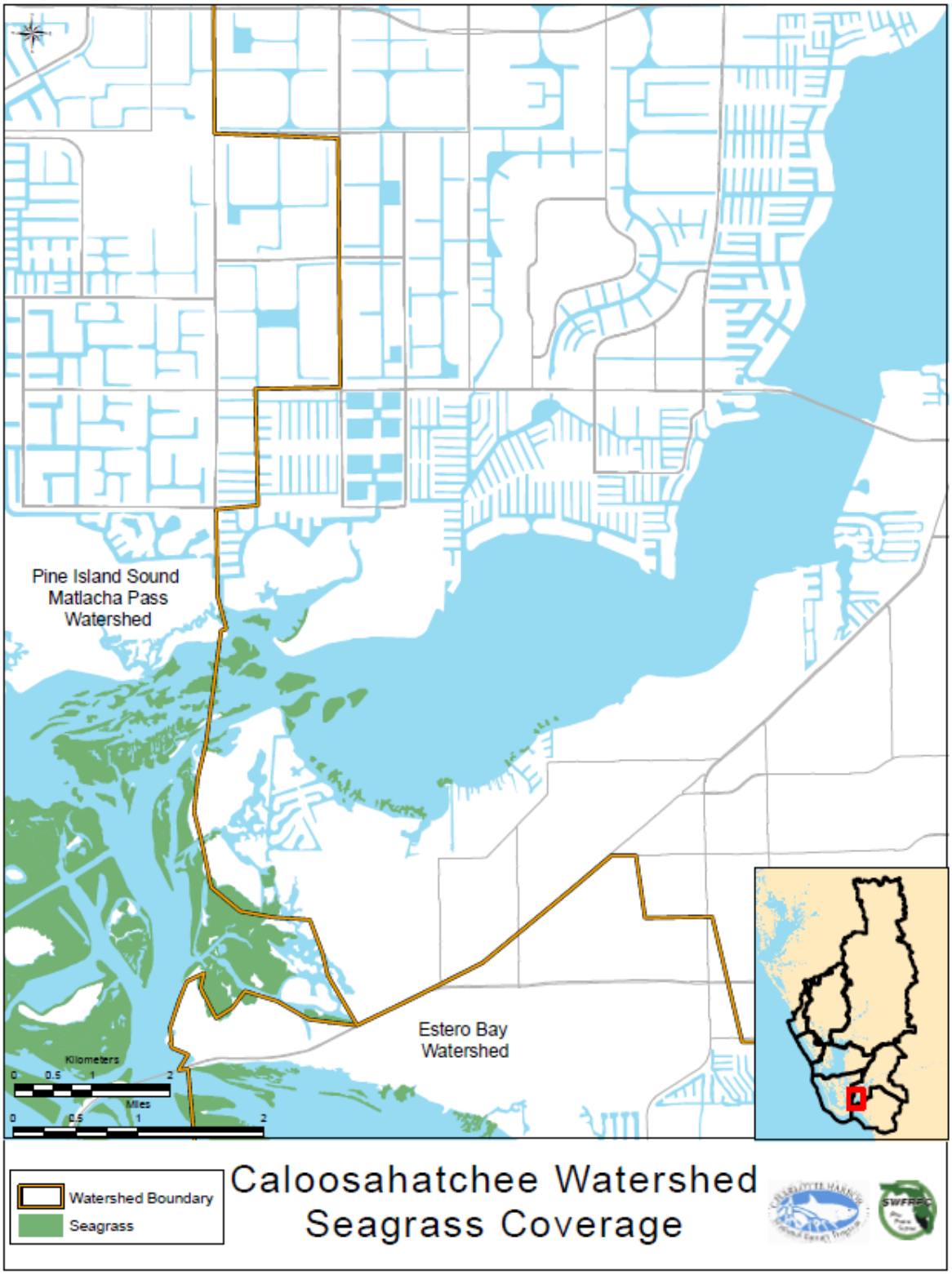


Map 36: Salt Marsh Distribution in the Pine Island Sound / Matlacha Pass Watershed

Relatively few large tidal mud flats are associated with mangrove keys in this region. In the southern portion of Pine Island Sound, a large flat exists in proximity to the mangrove fringed key, Chino Island. A series of small isolated tidal/mud flats is visible in Pine Island Sound running from northwest to southeast. These flats are associated with dredge spoil areas on either side of the heavily traveled Intracoastal Waterway. The expansive tidal flats located inside the barrier islands to the south of Pine Island Sound are protected areas inside the J.N. "Ding" Darling National Wildlife Refuge.

Caloosahatchee River and San Carlos Bay

The distribution of seagrass in the Caloosahatchee River as compiled by the FMRI is presented in Map 37. Small patches of *Thalassia* can be found mixed in with *Halodule* at the mouth of the river. *Halodule* extends up the river mostly along the southern shore to just above Whiskey Creek. A few patches of *Halodule* exist along the northern shore below the Cape Coral Bridge. *Ruppia* appears in geographically variable areas from year to year from the Iona Cove area to just east of Beautiful Island (Railroad Trestle). *Vallisnaria* extends from Beautiful Island to just below Whiskey Creek depending on the salinity. This species distribution appears stable above the Edison Bridge.

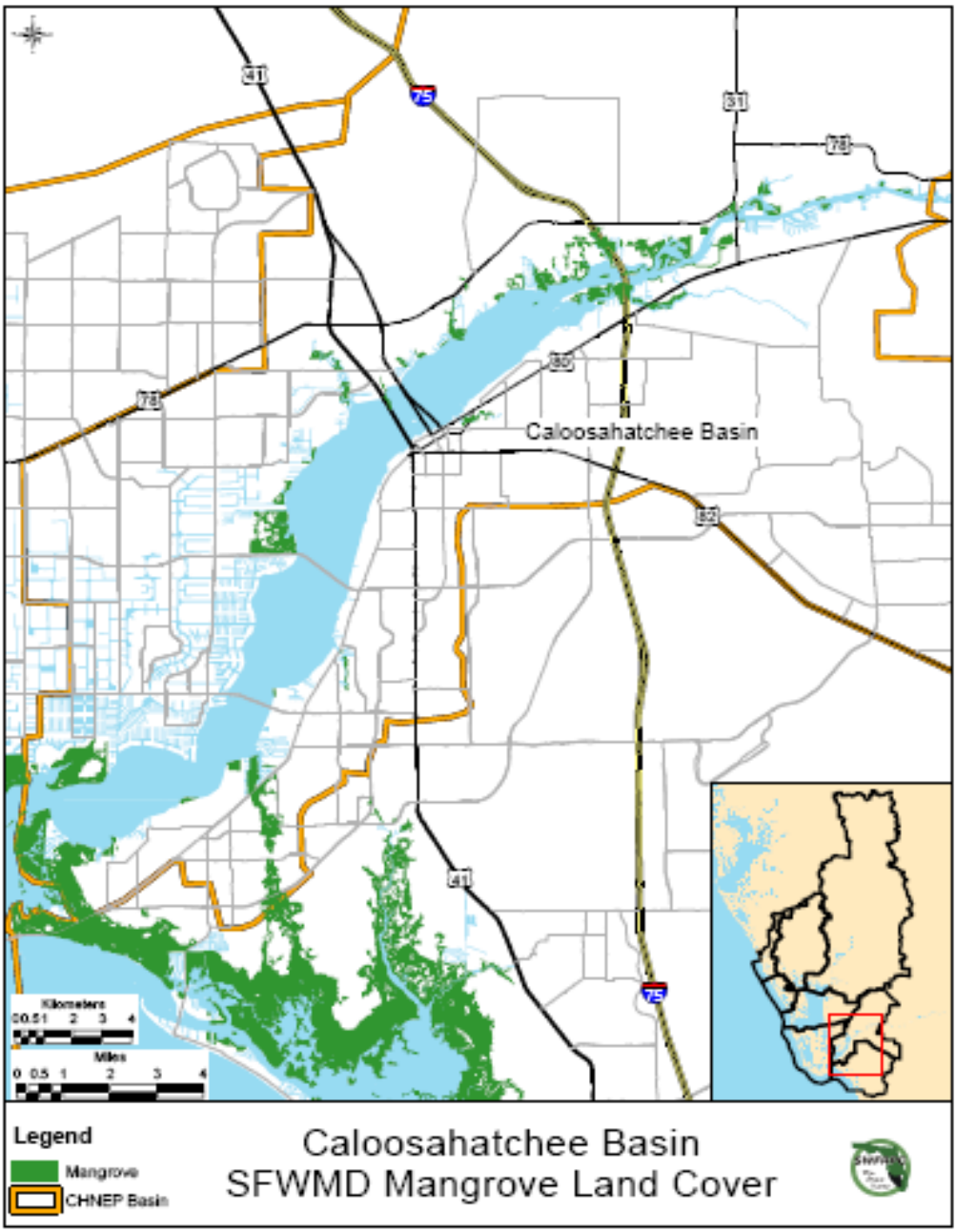


Map 37: 2009 Seagrass Distribution in the Caloosahatchee River Watershed

A notably large oyster reef exists at the mouth of the Caloosahatchee River, and is likely to be the most expansive type of this habitat within the Charlotte Harbor NEP study area. This area is aptly named Big Shell Island, and the mangrove-covered point to the northeast of it is named Shell Point.

Figure 22: Oyster reefs at the confluence of the Caloosahatchee River and, Matlacha Pass, San Carlos Bay and Pine Island Sound

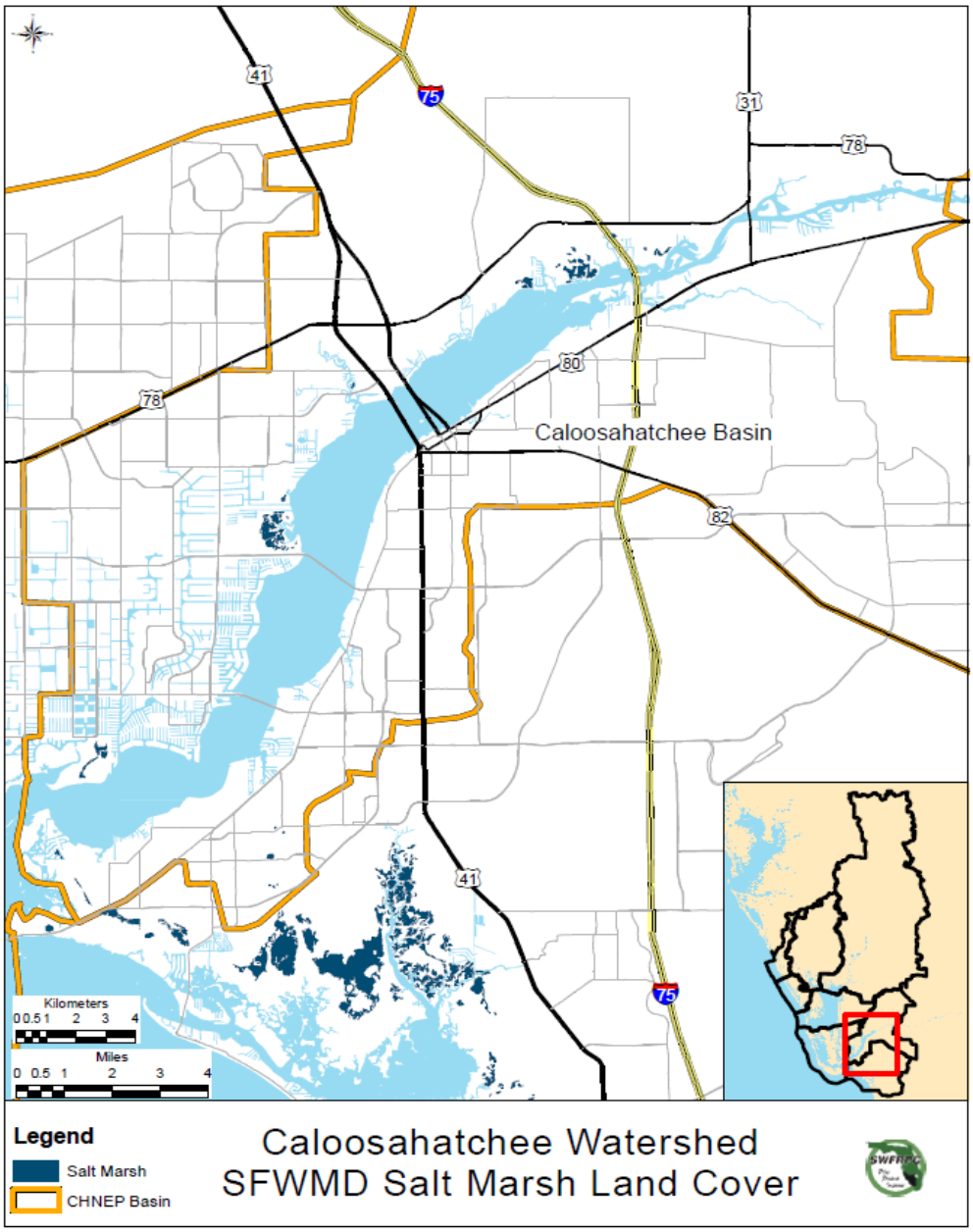
The mangrove forests in the Caloosahatchee River are presented in Map 38. These mapped data report a total of 1,212 hectares (2,995 acres) of mangroves in the Lower Caloosahatchee River Subbasin. These habitats have been almost entirely lost along the shores of the river. Two large isolated mangroves areas exist. One of these is located at North Fort Myers midway up the river at a location named Marsh Point. The second of these is located in the northern portion of the broad area of the river. This latter area is currently protected as the Caloosahatchee National Wildlife Refuge. More extensive coastal mangroves exist at the mouth of the river along Piney Point on the north side of the mouth and Shell point on the south side of the mouth.



Map 38: Mangrove Distribution in the Tidal Caloosahatchee River Watershed

Notably expansive tidal/mud flats in this region include an area in the center of the river in the north. This area is associated with the aptly named Midway Island, and a large flat near the mouth of the river. Several large designated dredge spoil disposal areas are also located near the mouth of the river adjacent to the maintained channel.

The salt marshes in the Caloosahatchee River are presented in Map 39. These mapped data report a total of 96 hectares (238 acres) of salt marshes in the Lower Caloosahatchee River Subbasin. The salt marshes are associated with the meandering portions of the river, and a mangrove-fringed marsh near the mouth at Shell Point.



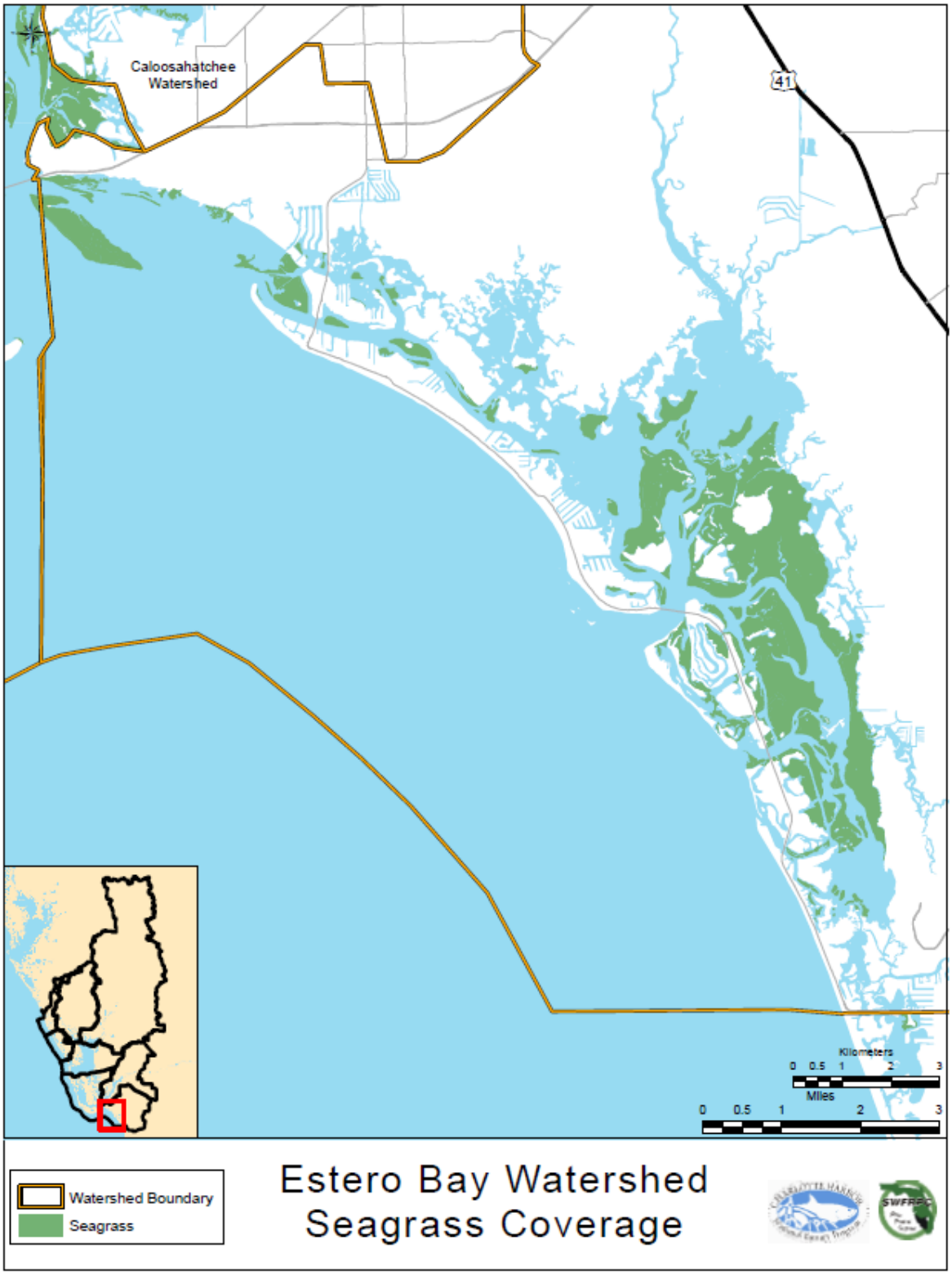
Map 39: Salt Marsh Distribution in the Tidal Caloosahatchee River Watershed

Estero Bay

Estero Bay is protected on the west by a barrier island chain including the Town of Fort Myers Beach and Bonita Beach. The estuary stretches southeast to the mouth of the Imperial River. Extensive seagrass beds support young fish and crabs in the shallow bays, and mangroves support large bird rookeries on the numerous islands. As with Charlotte Harbor, the public owns many of the wetlands, mangrove forests and salt marshes surrounding the bay.

The Estero Bay Aquatic Preserve was dedicated in December 1966—Florida's first aquatic preserve. The state also protects the tributaries to the Estero Bay watershed with the Outstanding Florida Waters designation. The Estero Bay watershed is currently subject to significant growth and development, including the construction of Florida Gulf Coast University, which was completed in 1997, but continues to expand.

Most of the seagrass in Estero Bay is found along the northern part on the landward side. Although seagrasses are shown in the FDEP GIS system for a large area south of Hendry and Mullock Creeks, few areas were actually proven to be seagrass beds. No verification of the aerial interpretations was done in Estero Bay (per. comm., Ken Haddad) for the 1982 study. Examination of the 1974-75 Lee County aerials and the Soil Conservation aerials from the 1940s and 1950s indicates a general lack of seagrasses in this area. A recent aquatic survey completed by Lee County (1991) did not record seagrasses in this area. The abundance of oyster bars suggests salinities are frequently less than 20 ppt. The central part of the bay between Big Carlos and Big Hickory Passes also has relatively large areas of seagrasses. Few seagrass beds occur in the southern part of the bay. This bay tends to be much more turbid than the other bay systems.



Map 40: 2008 Seagrass Distribution in the Estero Bay Watershed

Several large oyster reefs exist in Estero Bay, and are associated primarily with the mouth of Hendry Creek in the northern portion of the bay. Historically these oyster reefs have influenced anthropogenic impacts to Estero Bay as evidenced by the presence of the very large shell midden named Mound Key. This mound was constructed by Native Americans who lived in the region and used the abundant food supply provided by the oyster reefs. Ironically, later inhabitants may not have been as fortunate as evidenced by the adjacent mangrove island named Starvation Key.

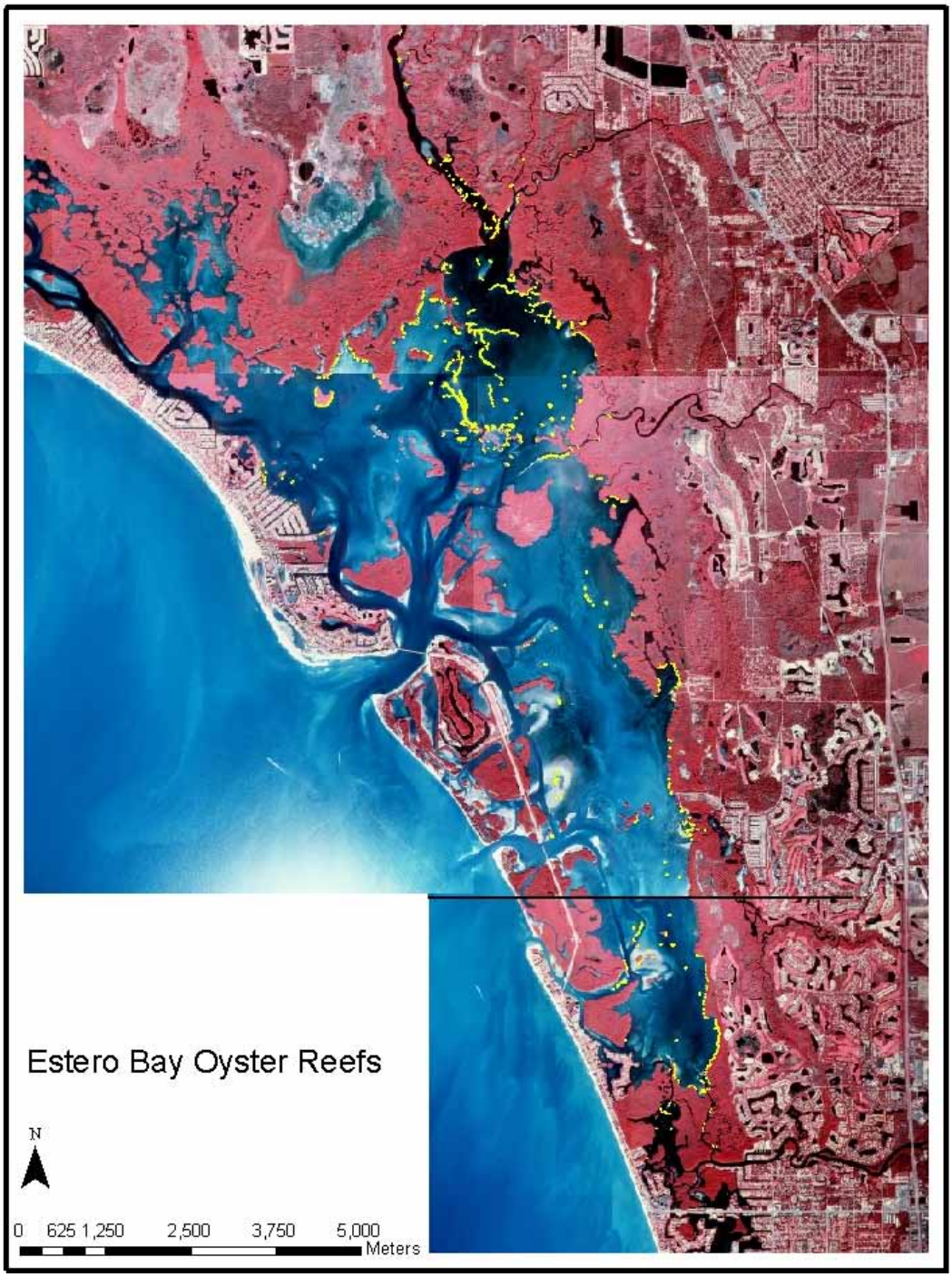
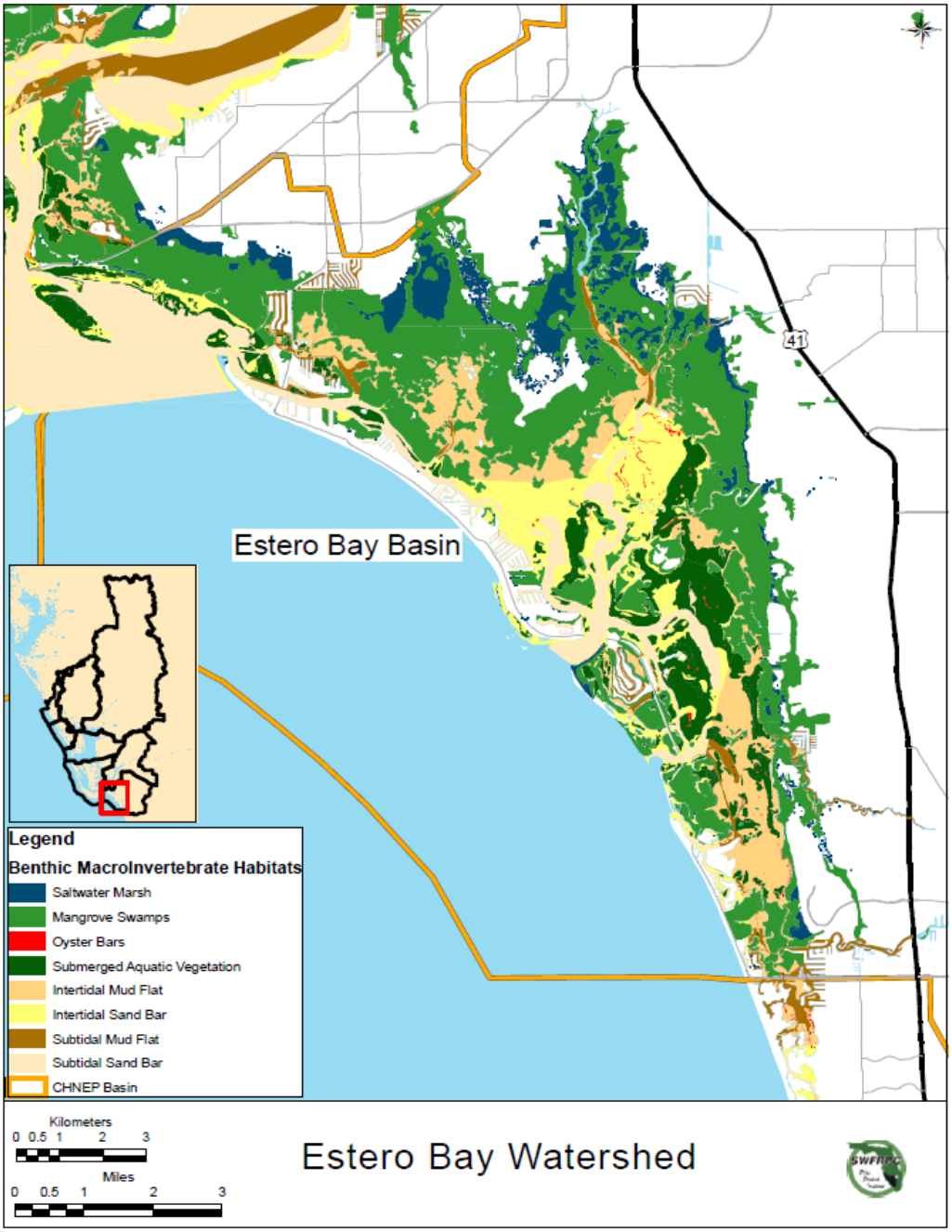


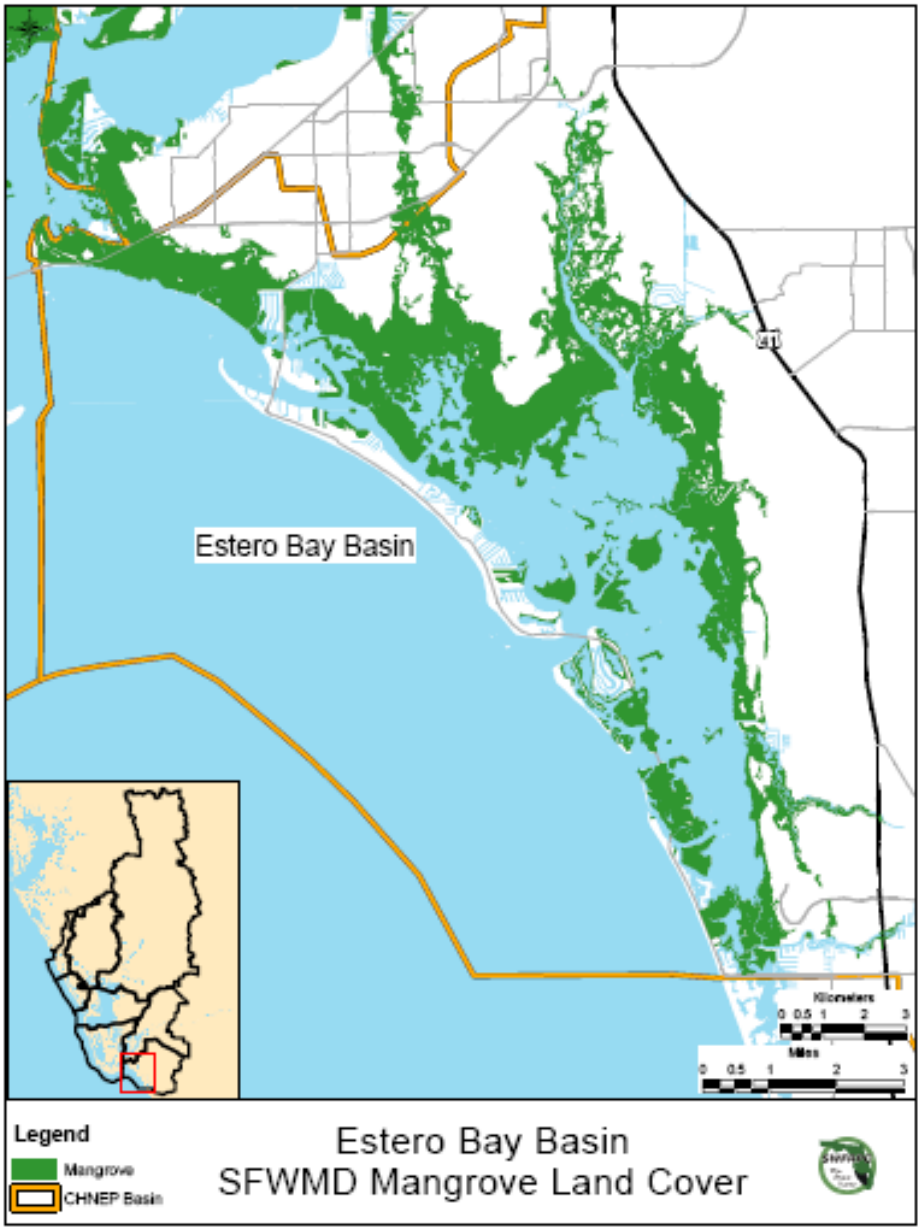
Figure 23: Oyster reefs of Estero Bay

The tidal mud flats, along with those previously discussed for Charlotte Harbor Proper, represent the most expansive flats of the study area. The large open areas provide unique and valuable habitats. In particular, this is perhaps the best example of a near pristine habitat mosaic within the CHNEP boundaries. Within this region, mangroves, seagrasses, oyster reef-hard bottom communities, and tidal/mud flats exist together in relatively large parcels.



Map 41: Benthic and Tidal Habitats of the Estero Bay Watershed

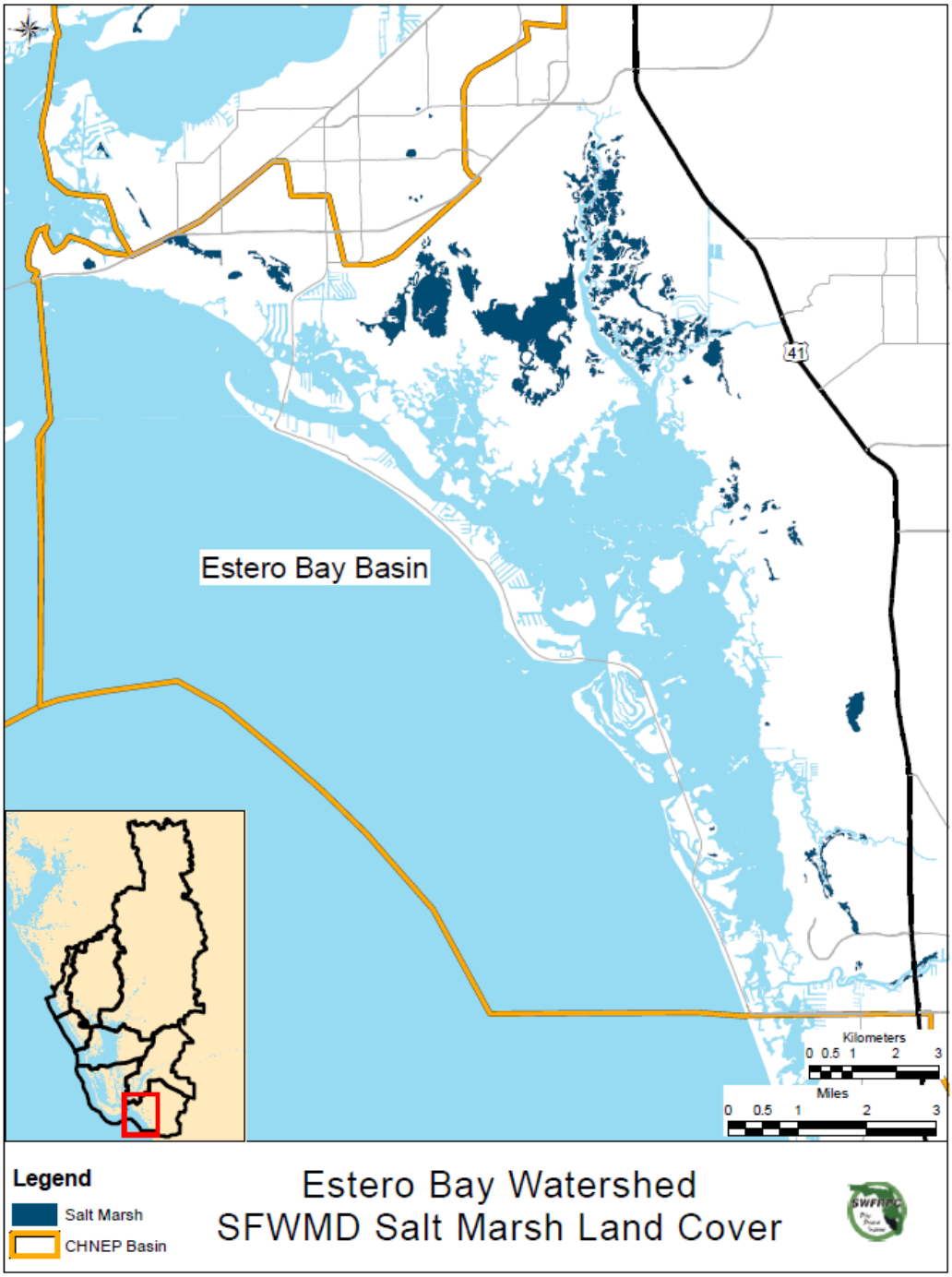
The Estero Bay mangrove forests are presented in Map 42. Based on these mapped data, Estero Bay supported a total of 4,594 hectares (11,352 acres) of mangroves. The mangroves of the Estero Bay region are primarily distributed as dense fringing forests along the mainland shore. The large width of these fringes makes them particularly isolated from anthropogenic disturbances. Other relatively large mangrove keys are located in the center of the bay and are isolated from the mainland by water. The particularly large key in the center of the Bay is the Native American constructed site known as Mound Key, mentioned above. Mangrove-covered tributaries, such as the split Spring Creek to the south, are also notable for this region.



Map 42: Mangrove Distribution in the Estero Bay Watershed

The Estero Bay salt marshes are presented in Map 43. Based on these mapped data, Estero

Bay supported a total of 665 hectares (1,644 acres) of salt marsh, with those in the northern portion of Estero Bay representing some of the largest of the pocket type marshes (previously discussed) in the study area. In particular, two expansive marsh systems exist along the northern shore of the Estero Bay Aquatic Preserve.



Map 43: Distribution of Salt Marsh in the Estero Bay Watershed

Shoreline Conditions in the Study Area

The shorelines of the CHNEP study area represent important harbor habitats. The natural shorelines, such as mangrove fringes, oyster reefs, and salt marshes, serve as feeding and nursery areas for living organisms, stabilize sediments, and buffer the estuary from the impacts of urban and industrial development. The anthropogenically altered shorelines of the study area include hardened seawalls, rock rubble, and pile bulkheads. These hardened shorelines often lower the value of shoreline habitats by reducing the amount and diversity of physical structure, and decreasing the stability of near shore sediments.

Shoreline Habitats at Risk

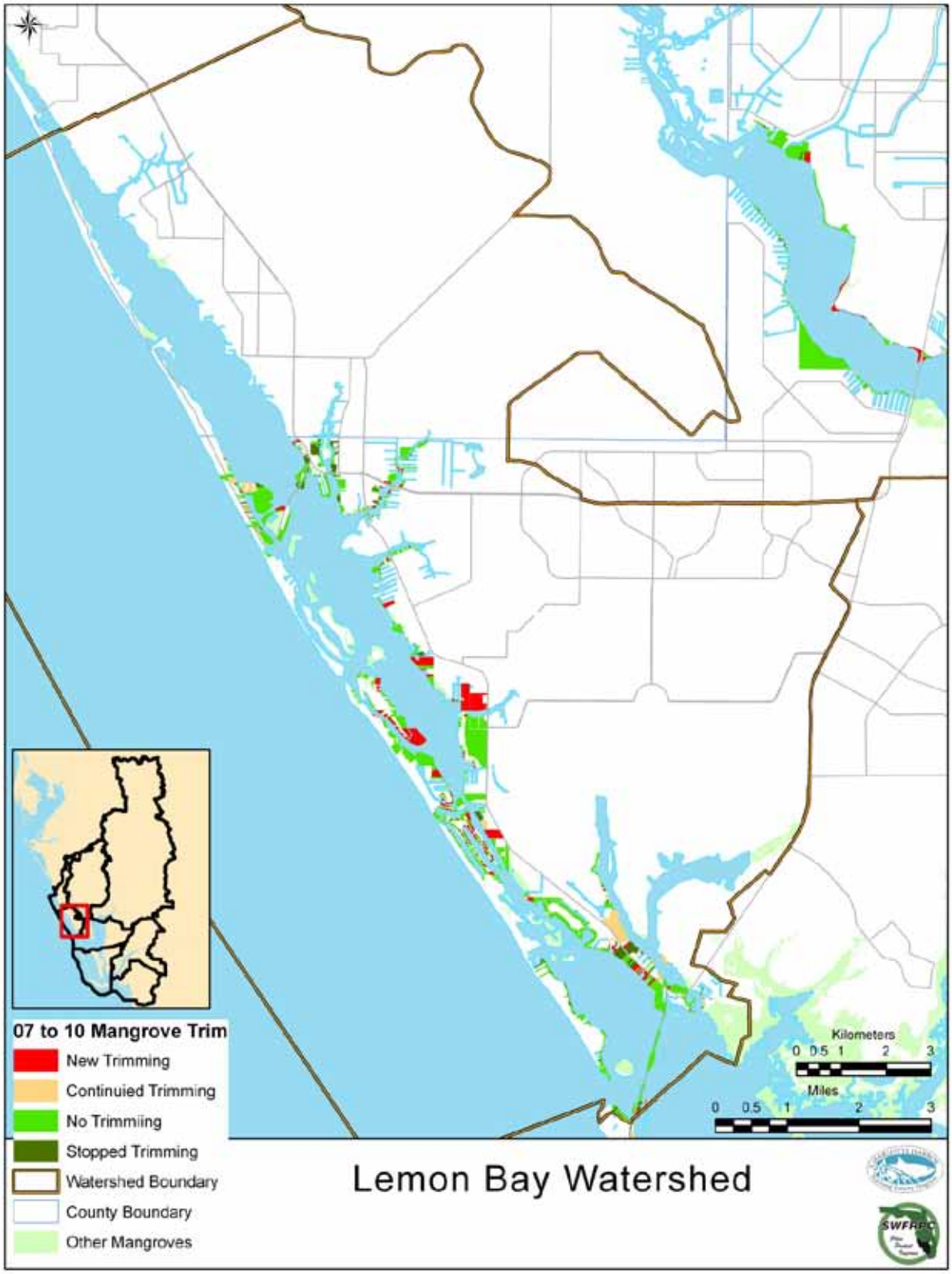
A number of factors combine to put at risk natural shoreline areas within the CHNEP. The root cause of such potential threats comes from intense development pressure along the barrier islands and other coastal areas. Historically, within certain areas of the CHNEP, natural shorelines were altered to reduce erosion by various hardening techniques, such as seawalls, rock rubble and rip-rap. Such hardened shorelines generally provide shoreline habitats of less biological value since the amount and diversity of physical variation is reduced from the natural condition.

Because of regulatory changes made during the 1970's and 1980's, permitted shoreline hardening has become far less common. In fact, compared to many other developed areas of the state, the natural shorelines within southwest Florida remain relatively intact. However, as coastal development continues to rapidly expand throughout the area pressures will intensify to modify natural shorelines. Such activities can be expected to include:

- trimming existing mangrove fringes to provide both residential access and enhanced views,
- construction of boat docks and access points, and
- stabilization of beaches, passes and navigation channels.

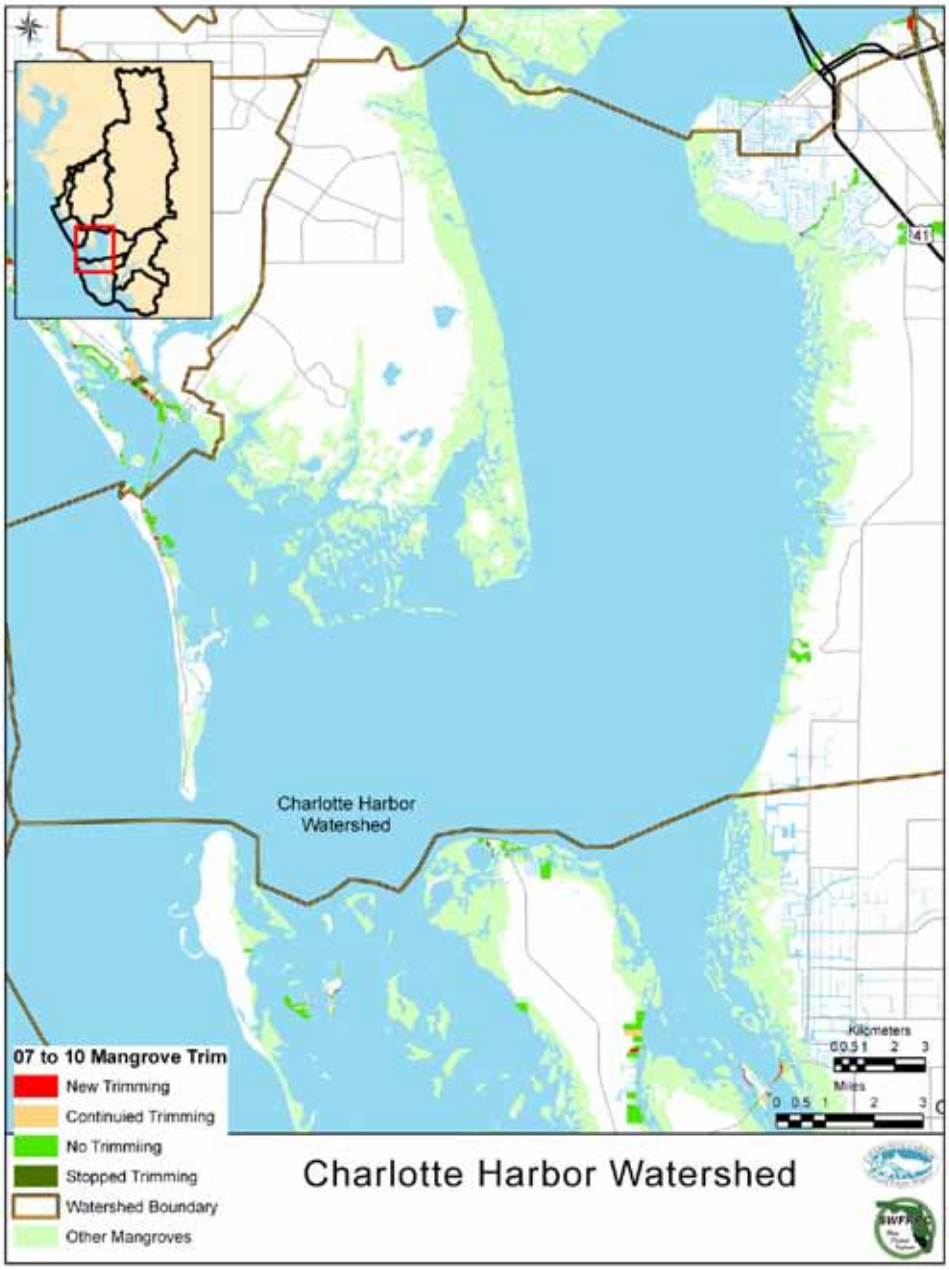
Areas where these activities have occurred are indicated in Maps 41 through 45.

The altered shorelines in Lemon Bay are presented in Map 44. The inland altered shorelines shown in this map are associated with the town of Englewood on the north, and the town of Grove City on the south. The inner shorelines of the barrier islands are primarily mangrove fringe, and the barrier islands are primarily used for recreational beach activities on the Gulf side. The major beaches include Stump Pass Beach, Englewood Beach, and Don Pedro Island.



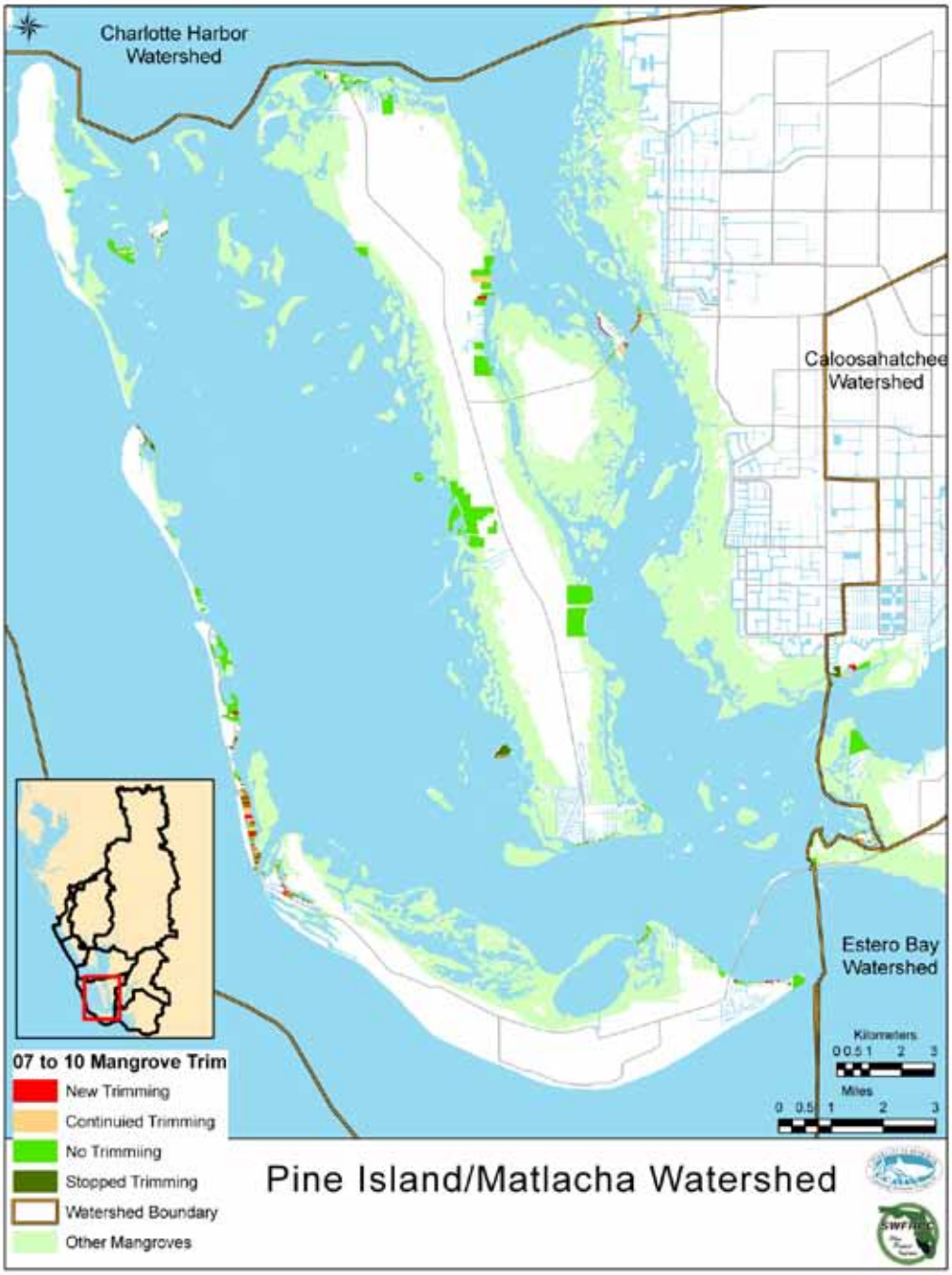
Map 44: Lemon Bay Mangrove Trimming 2010

Map 45 presents the altered shorelines in the Charlotte Harbor Proper region. For the expansive size of this estuary, it is remarkable that the majority of the shoreline remains in an unaltered state. This area represents one of the least impacted large-water body estuary shorelines in the United States. The altered shorelines in the Harbor proper are primarily associated with the cities of Port Charlotte, West Port Charlotte, and Punta Gorda to the north. These cities were built at the mouths of the Peace and Myakka Rivers, and the shorelines were developed accordingly. Other smaller areas of altered shoreline are located on the eastern side of the Harbor. They are Alligator Creek to the north and Pirate Harbor to the south.

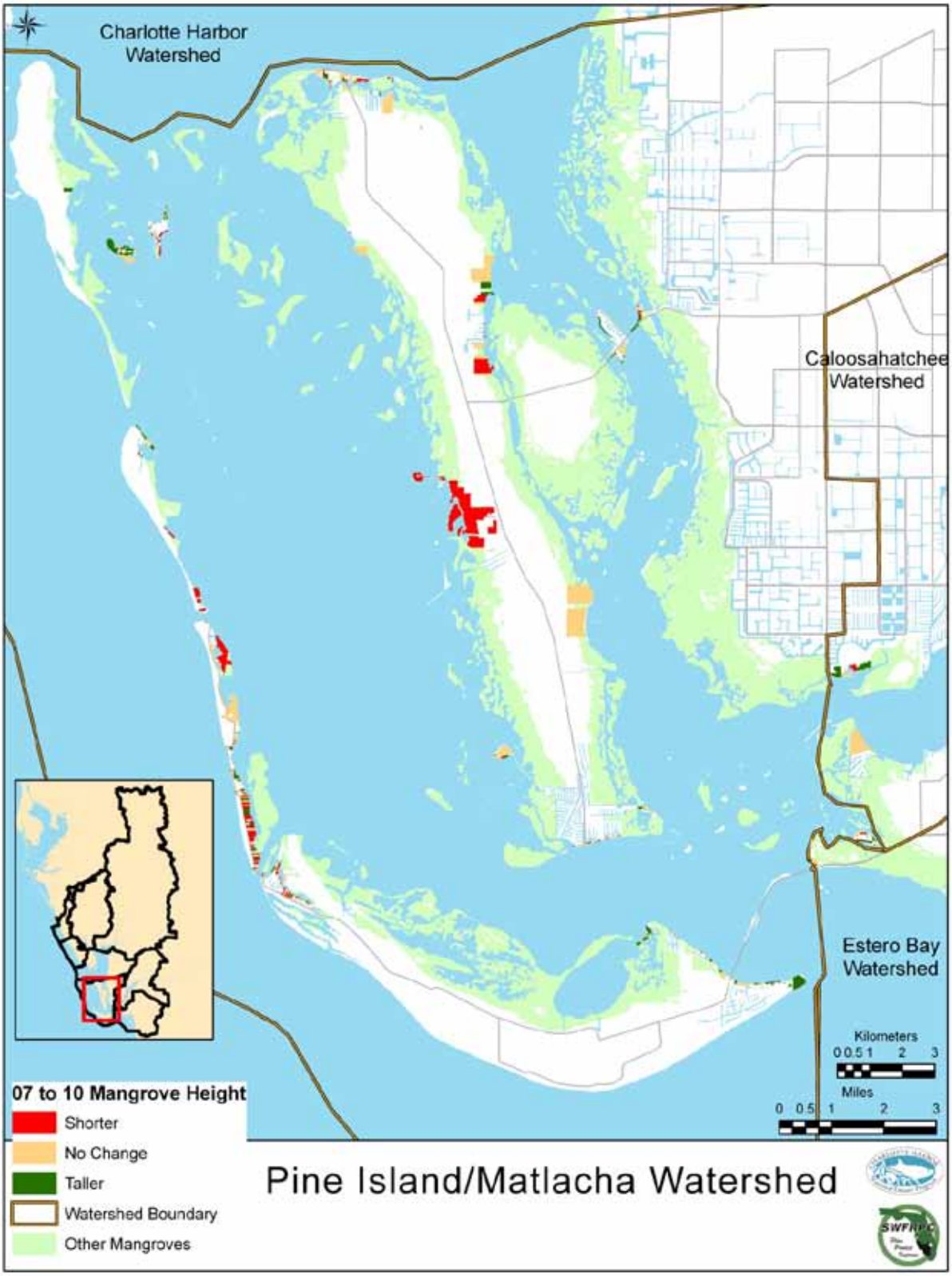


Map 45: Charlotte Harbor Proper Mangrove Trimming 2010

Map 46 summarizes the distribution of altered shorelines in the Pine Island Sound and Matlacha Pass region. Very little of the shoreline in this region has been altered. Along the Gulf Coast are primarily recreational beaches on Sanibel Island, and the shorelines of the interiors of the region are primarily mangrove forests as previously discussed. The altered shoreline shown at the south tip of Pine Island is the settlement of St. James City.

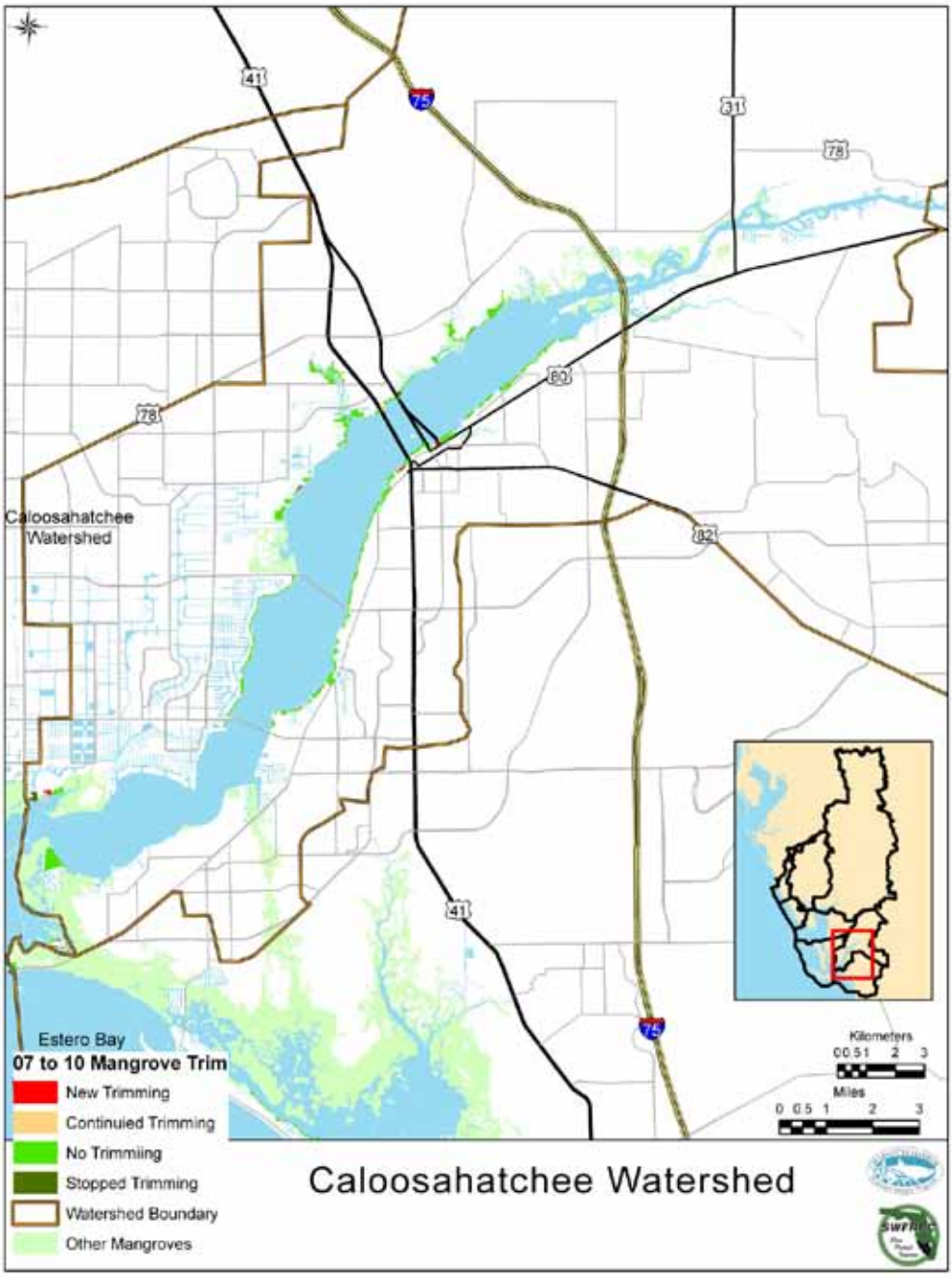


Map 46: Pine Island Sound / Matlacha Pass Mangrove Trimming 2010

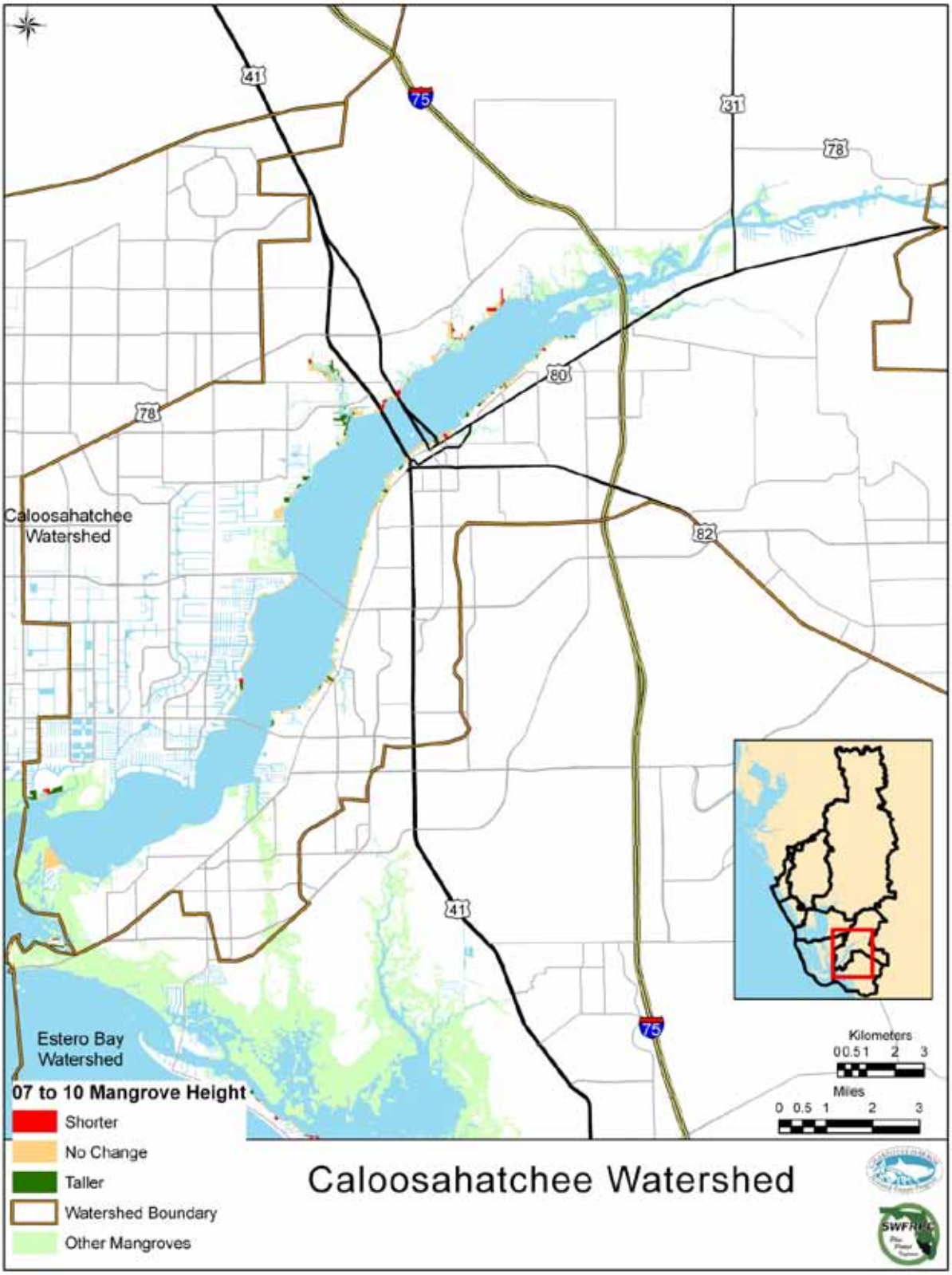


Map 47: Pine Island Sound / Matlacha Pass Mangrove Trimming Height Changes 2010

In contrast to the Charlotte Harbor Proper and Pine Island Sound/Matlacha Pass watersheds, the shores of the Caloosahatchee River have been almost entirely altered due to development. The altered shorelines of the Caloosahatchee River are presented in Map 48. These shorelines are the result of the relatively large urban areas of Cape Coral, Fort Myers, and North Fort Myers that were constructed along its shores. The few remaining unaltered shores of this portion of the river are primarily located to the north on the Caloosahatchee National Wildlife Refuge.

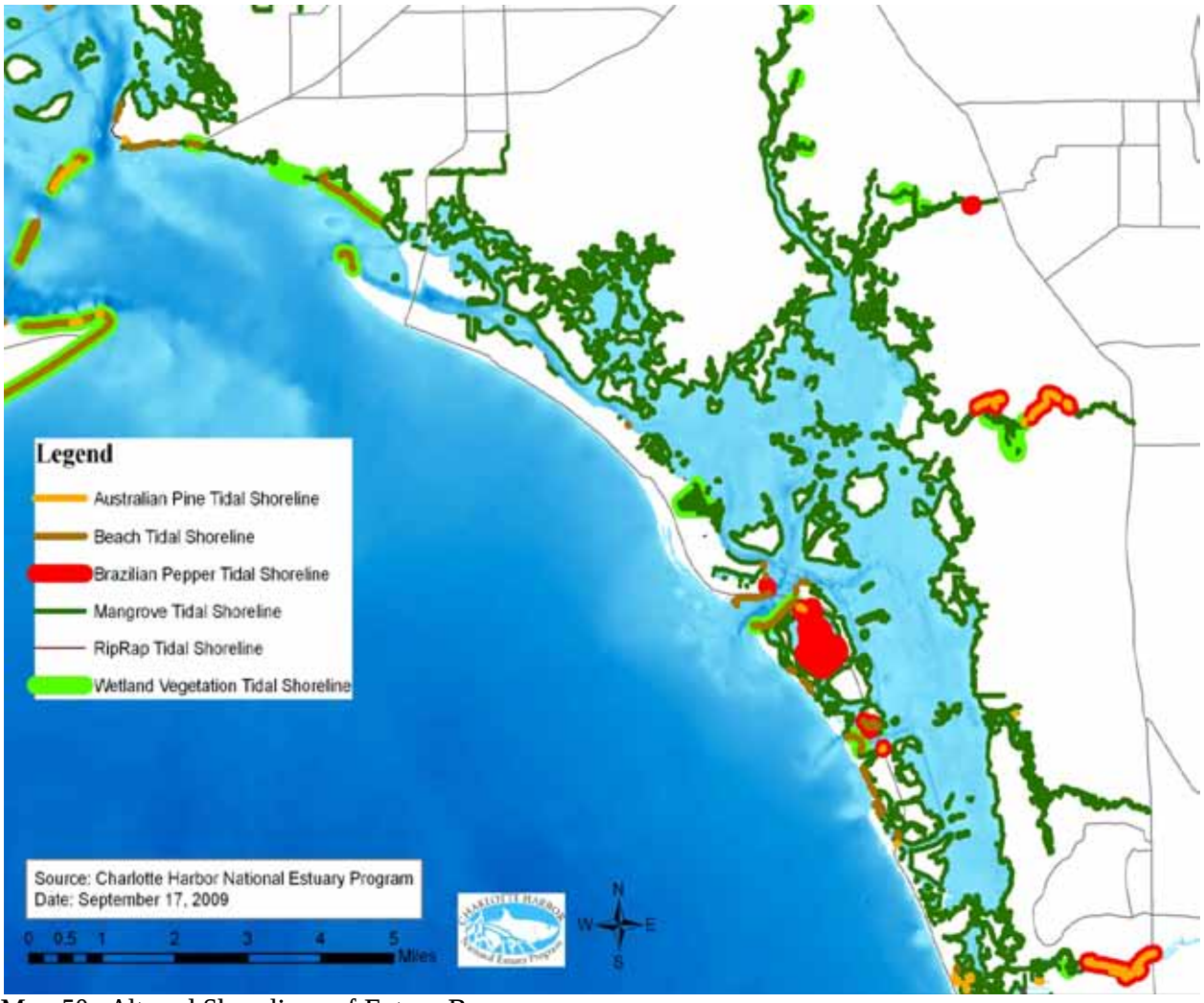


Map 48: Mangrove Trimming in the Caloosahatchee Watershed 2010



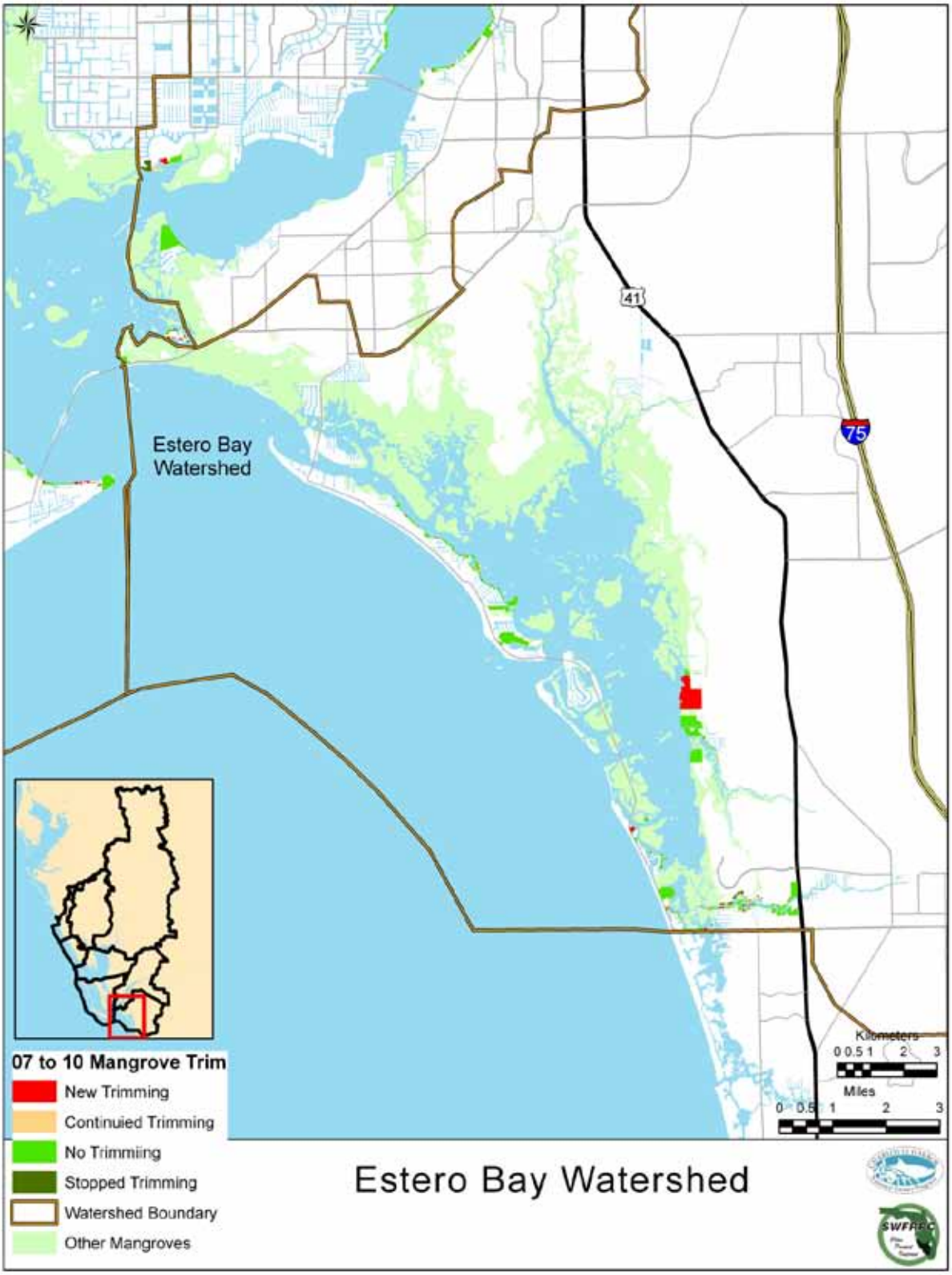
Map 49: Caloosahatchee River Mangrove Height Changes 2010

The altered shorelines of Estero Bay are presented in Map 50. The majority of the shorelines of Estero Bay are protected in conjunction with the buffer zones for the Estero Bay Aquatic Preserve. The altered shorelines of Estero Bay are almost entirely associated with the fully developed shores of the barrier island, Estero Island.

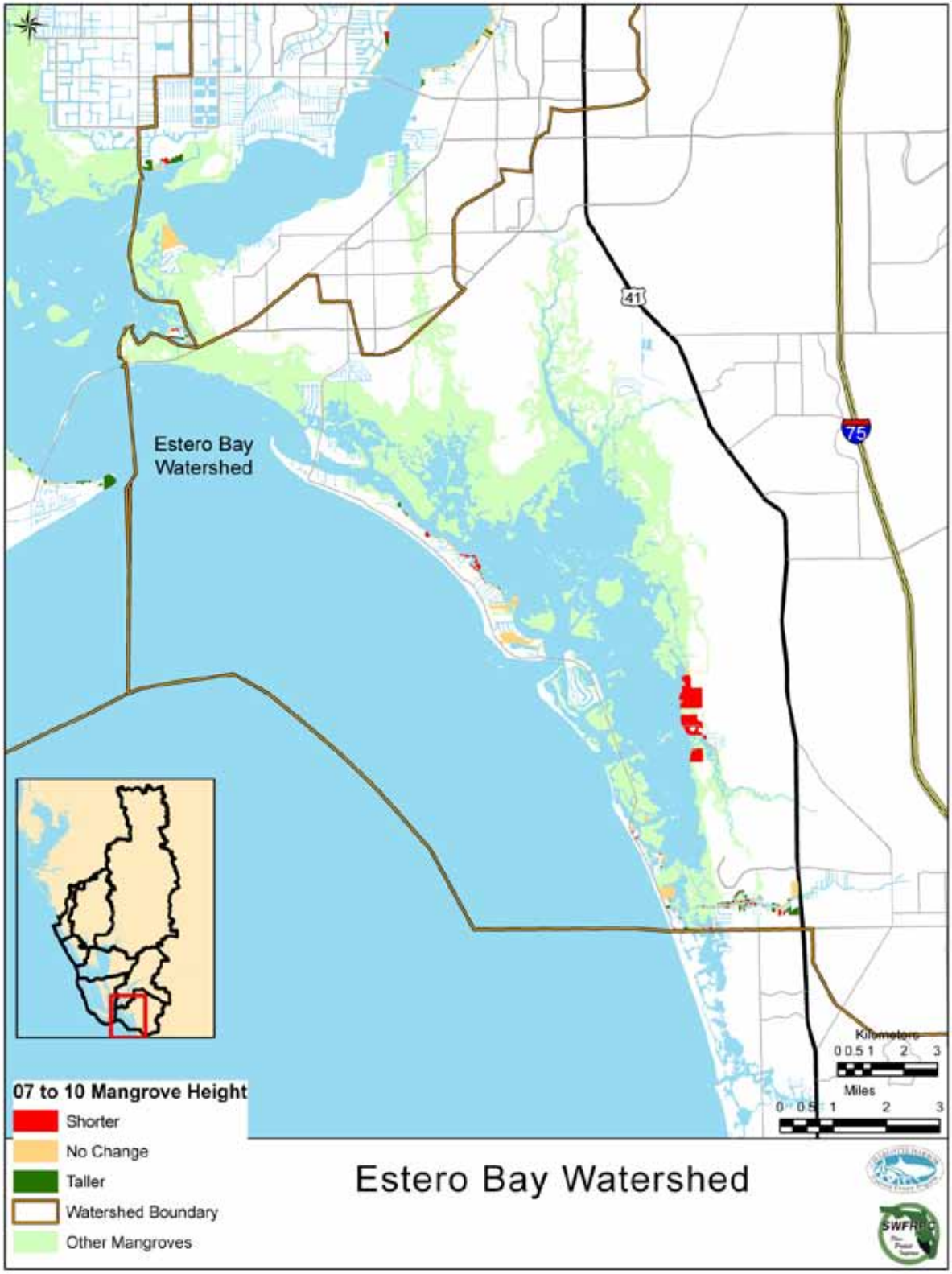


Map 50: Altered Shorelines of Estero Bay

For this project, the altered shorelines of the study area were delineated from topographic quadrangles, NOAA nautical charts, and field observations. The data were compiled in the form of a GIS database, and are summarized in the following maps.

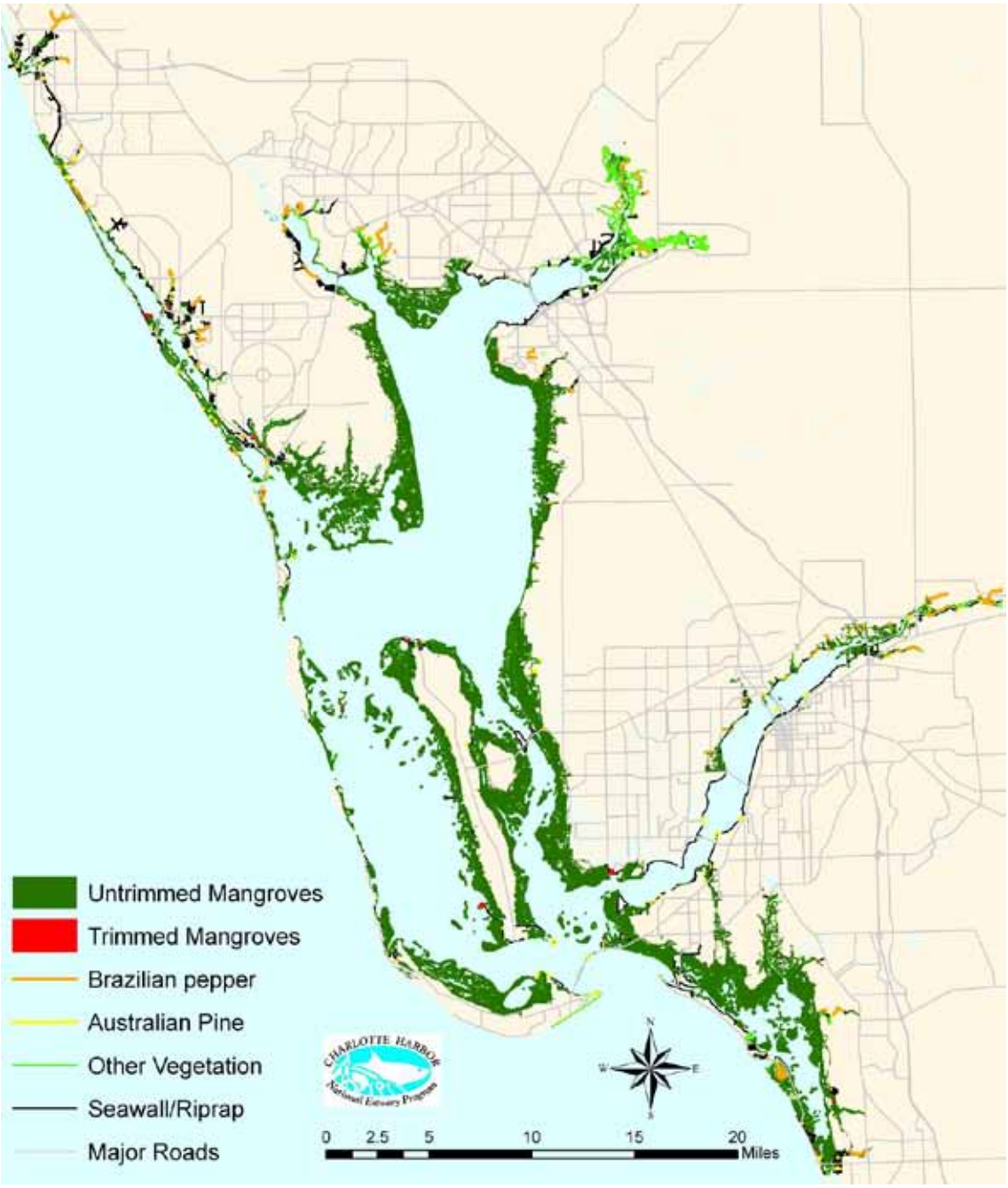


Map 51: Estero Bay River Mangrove Trimming Changes 2010



Map 52: Estero Bay River Mangrove Height Changes 2010

The project now reflects fully mapped shoreline wetlands in CHNEP area for the Year 2007. This is a snapshot of conditions with documentation from 2007 aerial photography. This GIS layer and data set is available for use as a baseline and in comparison to historic documentation of shoreline conditions. If a major estuarine disaster occurs this database could be useful in assessment of what resources were present prior to the disaster, whether it is a hurricane, oil spill, or boat grounding.



Map 53: CHNEP Shoreline Conditions 2007

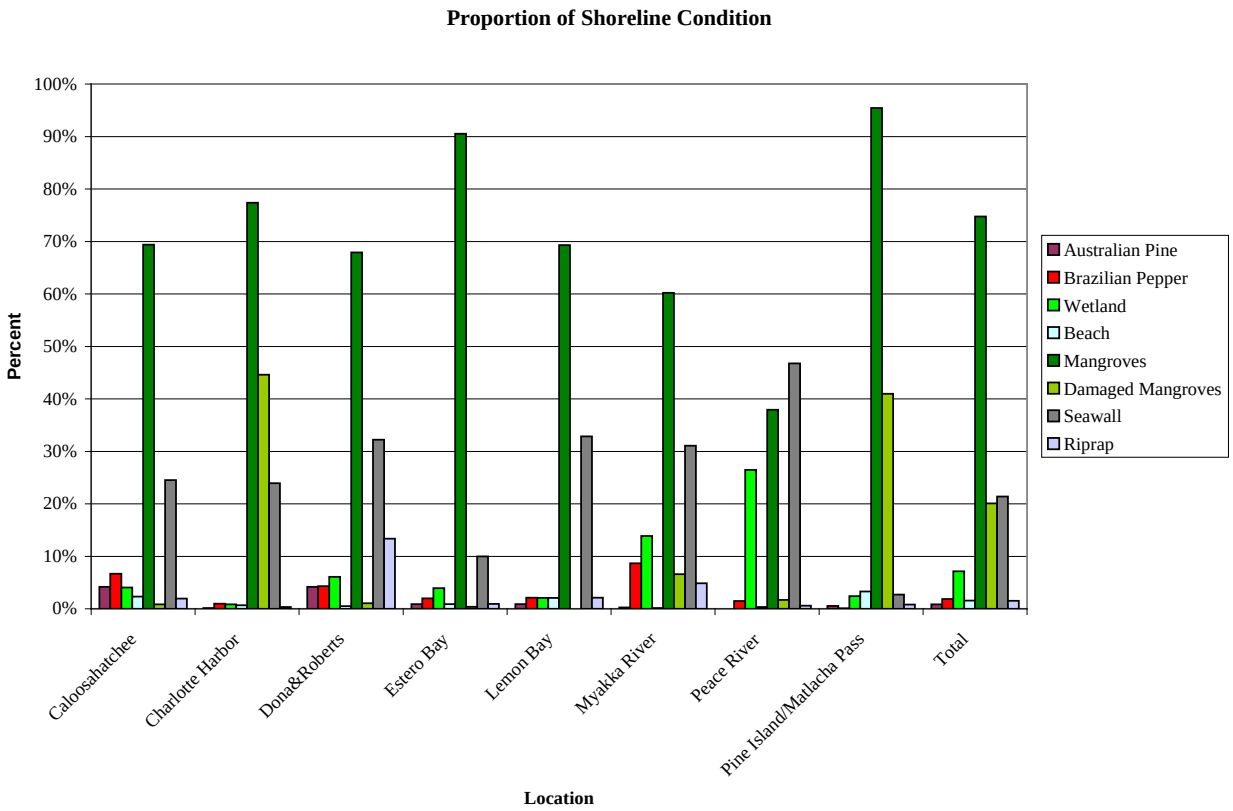


Figure 24: 2007 Shoreline Conditions

Figure 24 shows that, with the exception of the Peace River watershed, the majority of shorelines for the CHNEP watersheds are healthy mangrove fringe. Damaged mangroves are the second most frequent shoreline category for Charlotte Harbor, Pine Island Sound, and Matlacha Pass. This damage is principally from the wind effects of Hurricane Charley in 2004. Seawalls are the most common shoreline type in the Peace River watershed and are the second most frequent shoreline for Dona and Roberts Bays, Lemon Bay, Myakka River, the Caloosahatchee River and Estero Bay. Seawalls are the third most frequent shoreline for Charlotte Harbor.

Ninety-three Percent of the shoreline in Pine Island Sound and Matlacha Pass is mangrove fringe. Estero Bay (83%) and Charlotte Harbor (82%) are also dominated by mangrove shorelines. The Caloosahatchee River and Lemon Bay both have 62% mangrove shoreline. The Myakka River and Dona and Roberts Bays have 53% mangrove shorelines. The Peace River has 34% mangrove shoreline.

Shoreline hardening (seawalls and riprap) is greatest in the Peace River watershed (36.96% of total shoreline hardening in the CHNEP). This is followed by Charlotte Harbor (18.97%), Lemon Bay (12.5%), the Caloosahatchee River (8.37%), Dona and Roberts Bays (5.9%), Myakka River (5.74%), and Pine Island Sound/Matlacha Pass (4.27%). See Figure 24 above.

As shown in Figure 25, Pine Island Sound has the highest proportion of mangrove area (39.9%) in the CHNEP. This is followed by Charlotte Harbor (23.12%), Estero Bay (13.62%), Peace River (7.29%), Lemon Bay (5.98%), Caloosahatchee (5.37%), Myakka River (2.58%) and Dona and Roberts Bays (2.16%).

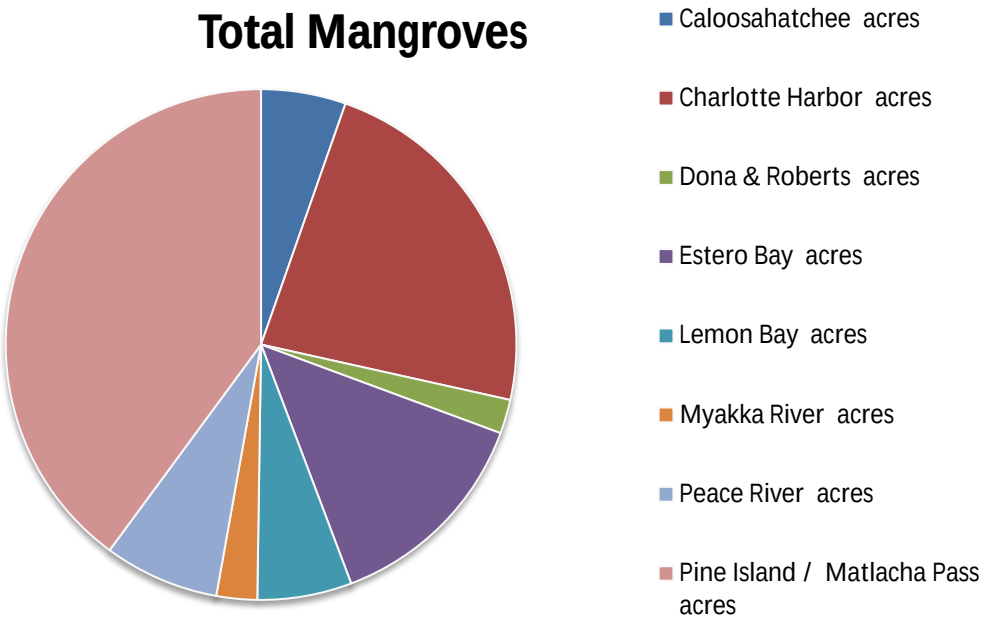


Figure 25: Proportion of mangrove shoreline

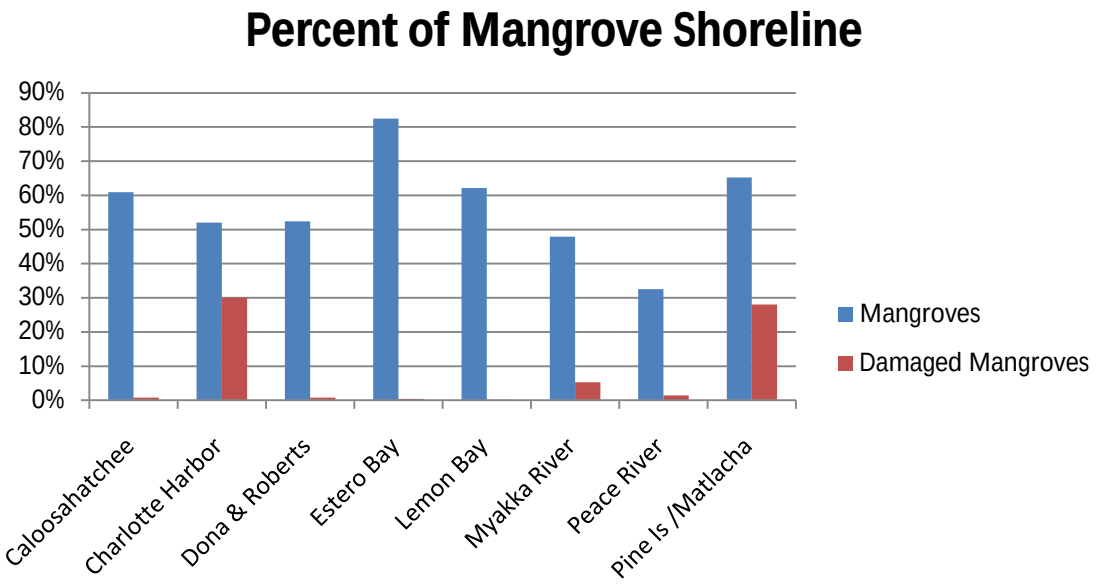


Figure 26: Percent of mangrove shoreline by watershed

In contrast, when damaged versus undamaged mangroves are analyzed, Estero Bay has the highest proportion of undamaged mangroves (83%), followed by Pine Island Sound/Matlacha Pass (65%), Lemon Bay (62%), Caloosahatchee River (61%), Charlotte Harbor and Dona and Roberts Bays at 52%, Myakka River (48%) and Peace River (33%). See Figure 26.

Emergent native herbaceous wetland shorelines, which include smooth cordgrass, black rush, and tidal freshwater marshes, can constitute a significant part of river watershed shorelines. The Peace River marshes clearly dominate the distribution of tidal salt marshes in the CHNEP.

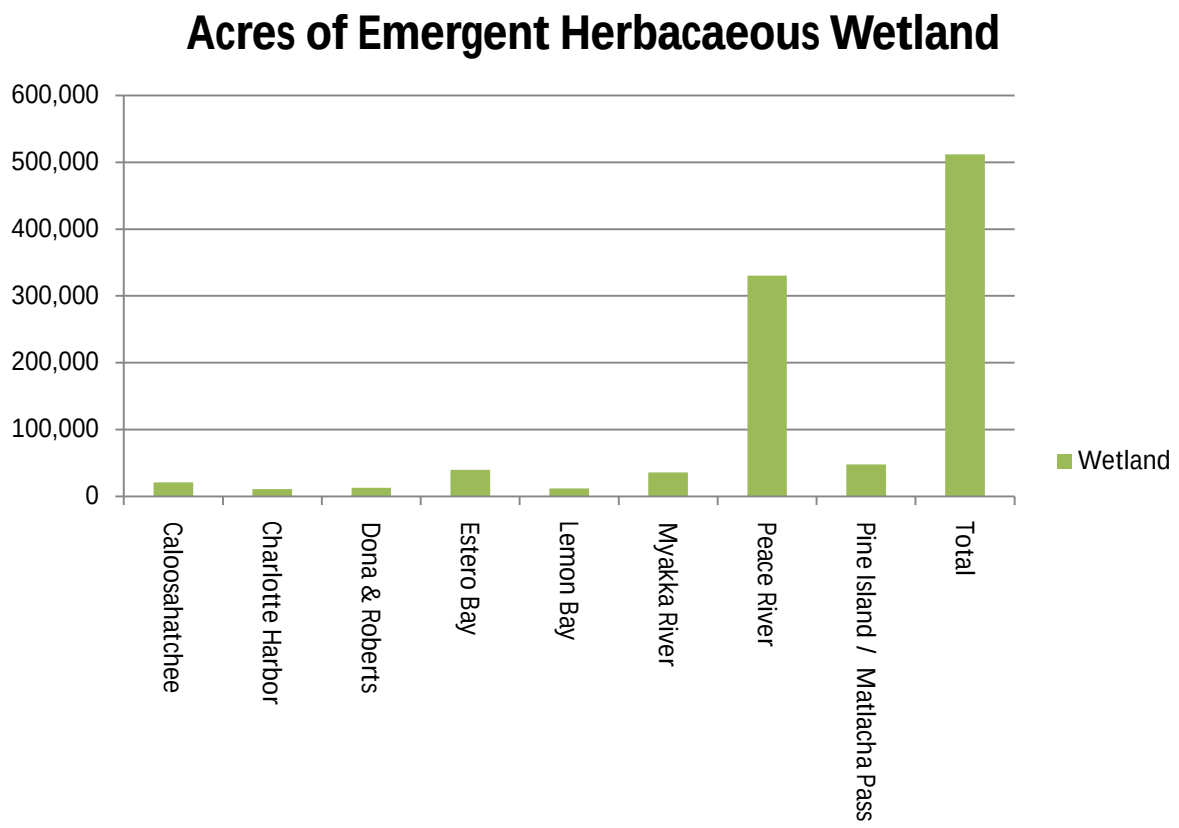


Figure 27: Acres of emergent herbaceous wetland shoreline by watershed

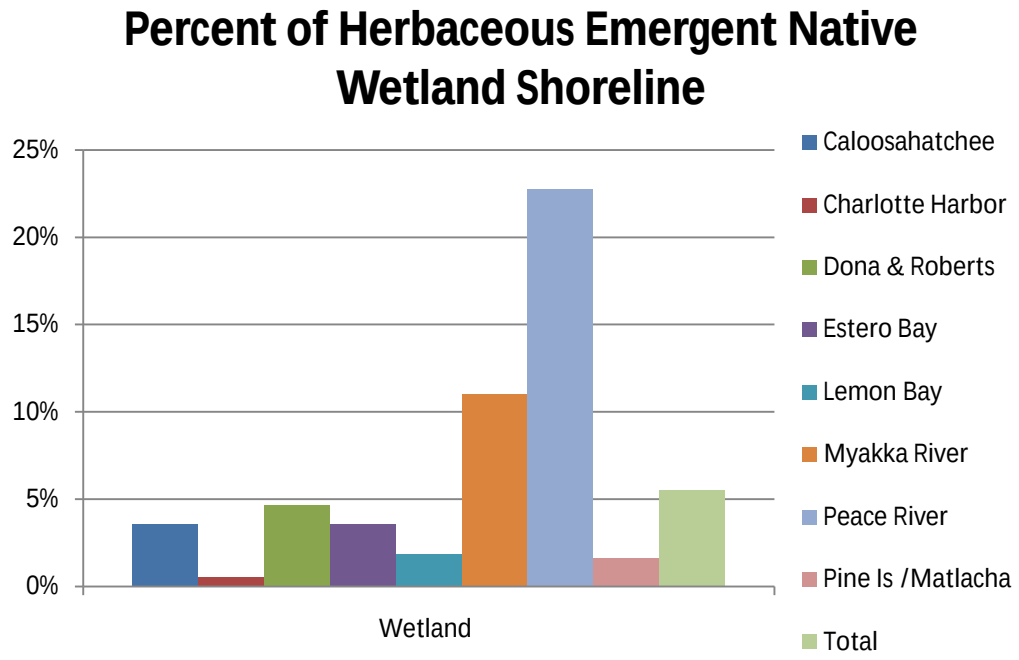


Figure 28: Percentage of emergent herbaceous wetland shoreline by watershed

These marshes constitute 23% of the Peace River shoreline and 11% of the Myakka River shoreline. Tidal marshes are 6% of the Caloosahatchee River, 5% of the Dona and Roberts Bays and also Estero Bay. Pine Island Sound, Matlacha Pass and Lemon Bay have 4% tidal marsh shoreline. Charlotte Harbor has the least at 1%.

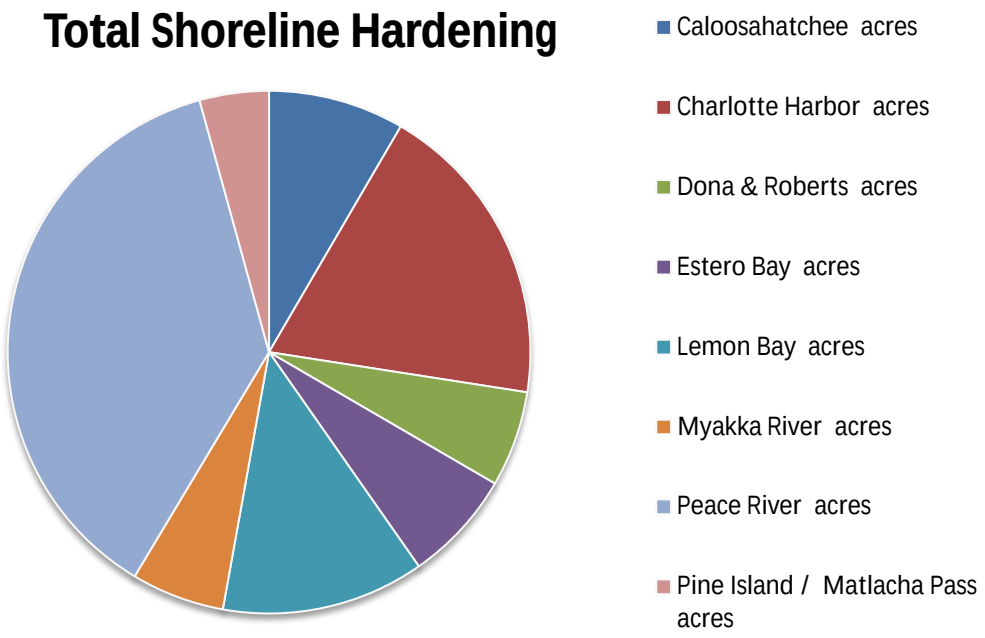


Figure 29: Relative distribution of area of shoreline hardening by watershed

In contrast, the relative proportion of shoreline hardening is 41% for the Peace River, 29% for Lemon Bay, 5% for both Dona and Roberts Bays and the Myakka River, 22% for the Caloosahatchee River, 16% for Charlotte Harbor, 9% for Estero Bay, and 2% for Pine Island sound/ Matlacha Pass.

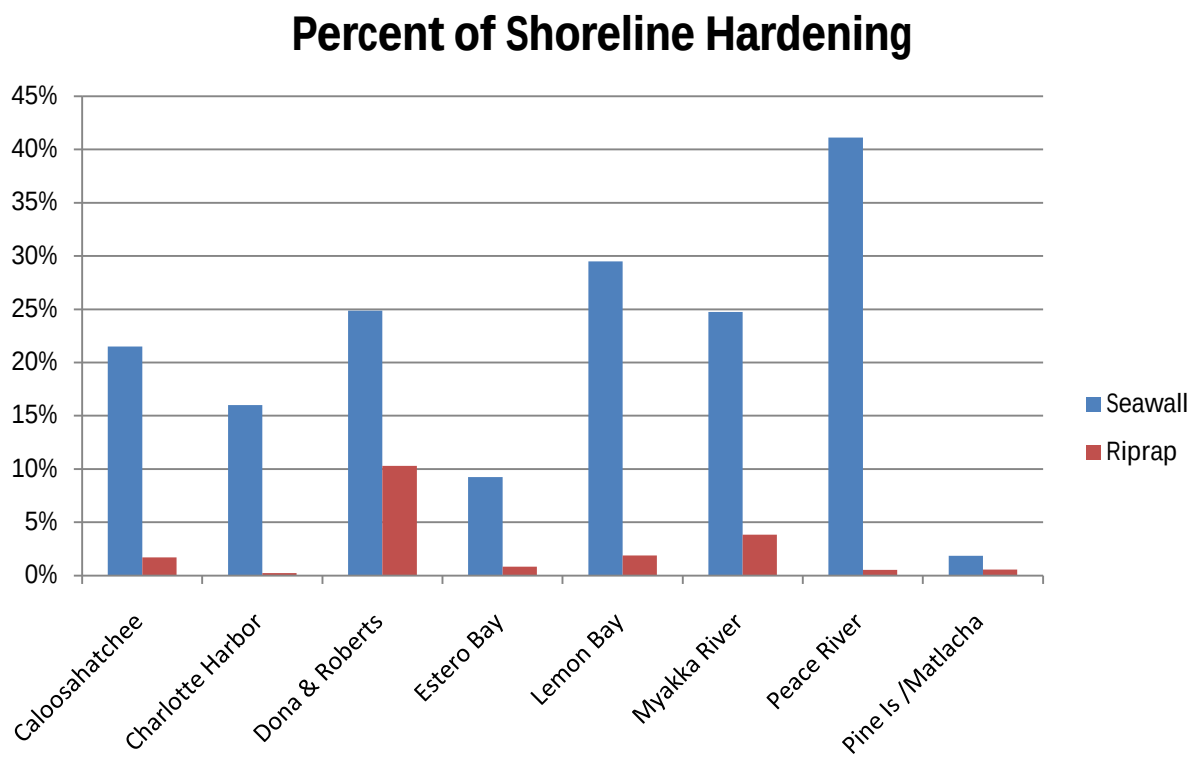


Figure 30: Percentage of shoreline hardening by watershed

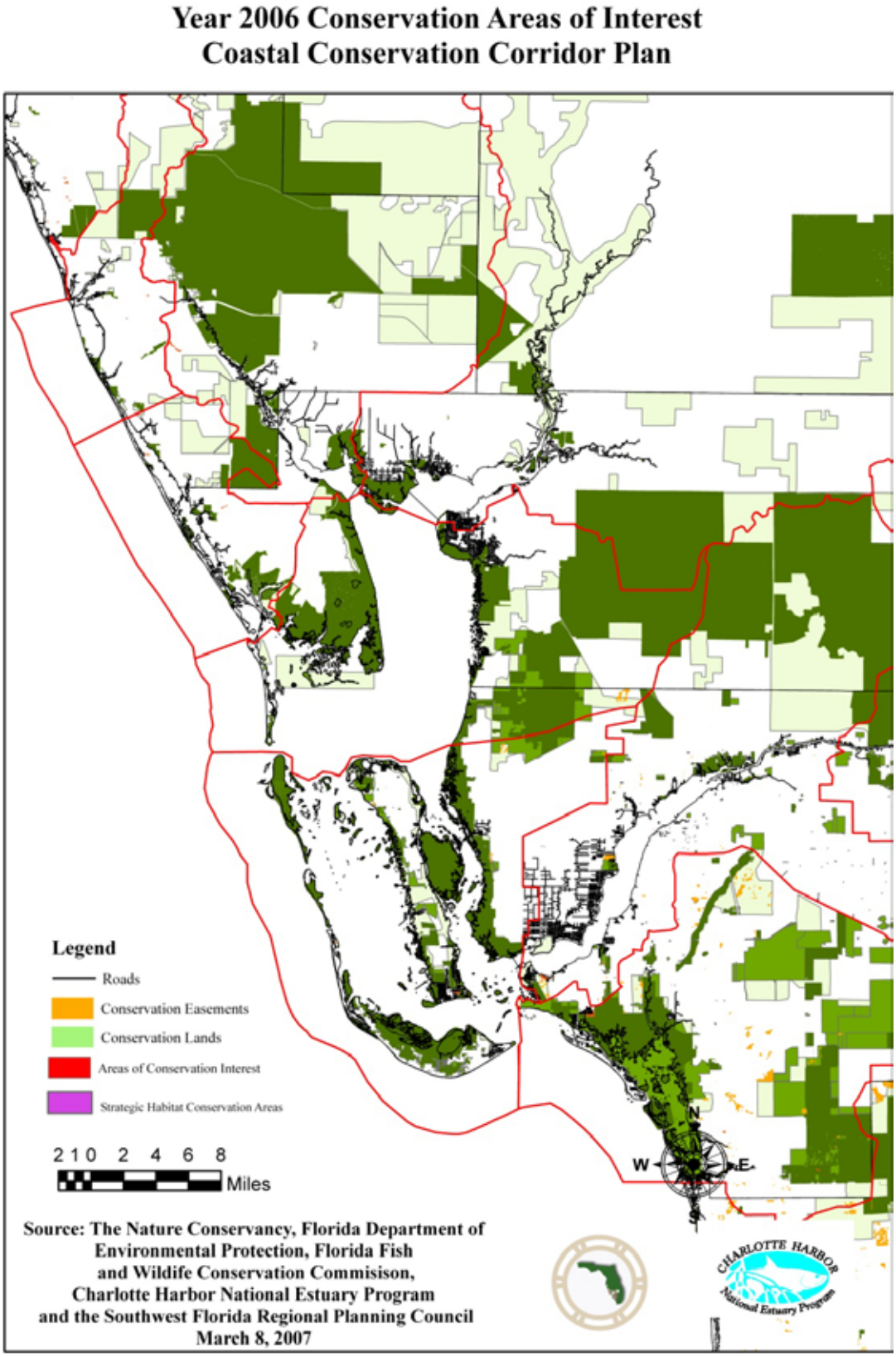
Shorelines dominated by exotic plant species are of greatest prevalence along the rivers of the CHNEP especially the Caloosahatchee, Myakka, and Dona and Robots Bays. See Table 5.

This project has established the current baseline shoreline condition against which all future wetlands impacts may be measured. In addition, the project established a baseline at the beginning of the period of record which will utilized for additional comparisons.

Class	**Caloosahatchee**	**Charlotte Harbor**	**Dona & Roberts**	**Estero Bay**	**Lemon Bay**	**Myakka River**	**Peace River**	**Pine Island / Matlacha Pass**	**Total**
	linear feet	**linear feet**	**linear feet**	**linear feet**	**linear feet**	**linear feet**	**linear feet**	**linear feet**	**linear feet**
Australian Pine	21,615	1,822	8,857	9,190	5,315	655	233	11,263	58,950
Brazilian Pepper	34,537	12,601	9,119	20,326	12,387	22,696	18,655	1,596	131,917
Wetland	20,999	10,978	12,867	40,098	12,211	36,226	330,194	48,059	511,632
Beach	11,994	8,868	1,101	8,802	12,017	334	4,194	65,307	112,617
Mangroves	359,351	993,728	143,933	918,975	405,079	157,370	473,219	1,892,202	5,343,857
Damaged Mangroves	4,486	573,234	2,225	4,077	114	17,231	21,013	812,288	1,434,668
Seawall	126,880	305,965	68,282	102,908	192,108	81,242	597,102	53,677	1,528,164
Riprap	10,139	4,444	28,324	9,449	12,352	12,658	7,675	16,183	107,921
Total	517,754	1,279,572	211,894	1,031,152	584,471	261,414	1,277,253	1,983,805	7,147,315
Percentages	**Of shoreline**	**Of shoreline**	**Of shoreline**	**Of shoreline**	**Of shoreline**	**Of shoreline**	**Of shoreline**	**Of shoreline**	**Of total shoreline**
Australian Pine	4%	0%	4%	1%	1%	0%	0%	1%	1%
Brazilian Pepper	7%	1%	4%	2%	2%	9%	1%	0%	2%
Wetland	4%	1%	6%	4%	2%	14%	26%	2%	7%
Beach	2%	1%	1%	1%	2%	0%	0%	3%	2%
Mangroves	69%	77%	68%	91%	69%	60%	38%	95%	75%
Damaged Mangroves	1%	45%	1%	0%	0%	7%	2%	41%	20%
Seawall	25%	24%	32%	10%	33%	31%	47%	3%	21%
Riprap	2%	0%	13%	1%	2%	5%	1%	1%	2%

Table 5: Shoreline conditions of the CHNEP Study Area 2007

Note overlap can occur for example where a seawall and riprap are located together.



Map 54: Conservation Areas of the Coastal CHNEP

Federal, state, and local coastal wetland resource conservation and mitigation goals

Federal: U.S Environmental Protection Agency and U.S. Army Corps of Engineers

Mitigation is a critical aspect of U.S. Army Corps of Engineers (USACOE or the Corps) permit decisions, and different USACOE districts have varied in the amount of rigor that has been included in permit conditions. The National Resource Council (NRC) issued a report in June, 2001, titled *Compensating for Wetland Losses under the Clean Water Act.* This report faulted USACOE mitigation in several ways, including failure of mitigation projects, mitigation projects not being built, lack of a watershed approach to mitigation, as well as too much reliance on on-site mitigation, which often fails because of altered hydrology on the site where draining and filling of aquatic areas has occurred. This report concluded that the Corps needed to increase the effectiveness of and compliance with mitigation requirements for authorized impacts to the aquatic environment, including wetlands.

One month earlier, the General Accounting Office had issued a report in response to Congressional requests entitled *Assessments Needed to Determine Effectiveness of In-Lieu-Fee Mitigation*. This report recommended that the USACOE districts establish procedures to clearly identify whether developers or recipients of the fees are responsible for the ecological success of mitigation efforts and, using the same success criteria applicable to in-lieu-fee arrangements, to develop and implement procedures for assessing mitigation success.

In response to the recommendations of these reports and requests for guidance from Corps districts, on October 31, 2001, the Director of Civil Works of the USACOE signed the first Regulatory Guidance Letter (RGL) in five years. The USACOE had developed the RGL system as a management tool for organizing and tracking written guidance issued to their field offices. RGLs are normally issued as a result of evolving policy, judicial decisions, and changes to Federal regulations affecting the permit program. RGLs are used only to interpret or clarify existing regulatory program policy, but do provide mandatory guidance to USACOE district offices while still allowing them flexibility to address project-specific and area-specific concerns. The RGL also responds to requests for clarification from USACOE District Offices.

Issuance of the October 31 letter generated considerable, and unexpected, discussion among wetland professionals and in the press, since it was designed to be an improvement. It did not affect the permit process or the 404(b) (1) guidelines analysis nor did it reduce environmental protection under the USACOE regulations. It only addressed compensatory mitigation plans once the permit evaluation has determined the need for this type of mitigation. It supported efforts to meet the national no overall net loss of wetlands goal by improving the quality of wetland mitigation required as a condition of USACOE permits, and was planned to improve the USACOE ability to ensure permittees understand and comply with required mitigation. One area the RGL focused on is utilizing a watershed approach, requiring wetland mitigation in the

context of the watershed's ecological needs and built on 1990 guidance as well as subsequent guidance (still in effect) contained in the interagency *Federal Guidance for the Establishment, Use and Operation of Mitigation Banks* and the interagency *Federal Guidance on the Use of In-Lieu-Fee Arrangements for Compensatory Mitigation under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act*.

The RGL provided direction concerning factors that affect compensatory mitigation success including: baseline information, goals of the mitigation, success criteria, monitoring and contingency plans, site protection, financial assurances and a designation of the responsible party for long-term maintenance. Inclusion of these components in a mitigation plan was to ensure that the enforcement of mitigation compliance would be easier and that there was more consistency in mitigation plans between districts. It also provided more specific information to the public regarding what details would be required in mitigation plans, thereby reducing the requests to applicants for additional information.

The RGL discusses the use of "credits" and "debits" when evaluating mitigation proposals and the identification of the methodology used to assign credits and debits. It also discusses the mix of wetlands, uplands and open water areas to increase the level of certain aquatic functions. The RGL does not allow "credit" for upland areas unless those areas enhance one or more aquatic functions.

All of NRC recommendations were considered when developing the RGL, including using a holistic watershed approach when requiring mitigation; considering the resource needs of the immediate and nearby watershed; legal and financial assurances for long-term maintenance of the mitigation project; the requirement of monitoring reports; the recommendation that impact sites should be evaluated using the same assessment tools as used for the mitigation site. But, not all of the recommendations of the NRC report were addressed by the RGL. For instance, recommendations concerning data collection and statistical analysis were not addressed. Further, the RGL could only promote using tested and proven functional assessment methods, but allows the flexibility of using new methodologies as they are developed.
On December 26, 2002, USEPA and USACOE announced the release of a comprehensive, interagency National Wetlands Mitigation Action Plan to further the achievement of the goal of no-net-loss of wetlands. The goals and objectives of the National Mitigation Action Plan (2002) have subsequently been incorporated into the 2008 Final Compensatory Mitigation Rule (USEPA 2010).

In November 2003, Congress called for the development of standardized regulatory standards and criteria for the use of compensatory mitigation in the section 404 program.
Section 314 of the National Defense Authorization Act (NDAA) for Fiscal Year 2004 required the Secretary of the Army, acting through the Chief of Engineers, to issue regulations ''establishing performance standards and criteria for the use, consistent with section 404 of the Federal Water Pollution Control Act (33U.S.C. 1344, also known as the Clean Water Act), of on-site, off-site, and in lieu fee mitigation and mitigation banking as compensation for lost wetlands functions in permits issued by the Secretary of the Army under such section.'' This provision also requires that those regulations, to the maximum extent practicable, ''maximize available credits and opportunities for mitigation, provide flexibility for regional variations in wetland

conditions, functions and values, and apply equivalent standards and criteria to each type of compensatory mitigation.''

In response to this directive, USACOE and USEPA published a proposed rule in the March 28, 2006 issue of the Federal Register (71 FR 15520), with a 60-day public comment period. As a result of several requests, USACOE and EPA extended the comment period by an additional 30 days. The comment period ended on June 30, 2006.

In the preamble for the March 2006 proposal, it is stated that the majority of the federal guidance regarding compensatory mitigation and the use of the mechanisms for providing compensation existed in a number of national guidance documents released by the USACOE and EPA over the prior seventeen years (sometimes in association with other federal agencies such as the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS)). Since these guidance documents were developed at different times, and in different regulatory contexts, concerns were raised regarding the consistent, predictable and equitable interpretation and application of these guidance documents.

On March 31, 2008, EPA and the USACOE issued revised regulations governing compensatory mitigation for authorized impacts to wetlands, streams, and other waters of the U.S. under Section 404 of the Clean Water Act. These regulations were designed to improve the effectiveness of compensatory mitigation to replace lost aquatic resource functions and area, expand public participation in compensatory mitigation decision making, and increase the efficiency and predictability of the mitigation project review process (USEPA 2010). These regulations established performance standards and criteria for the use of permittee-responsible compensatory mitigation, mitigation banks, and in-lieu programs to improve the quality and success of compensatory mitigation projects for activities authorized by Department of the Army permits. The rule was intended to improve the planning, implementation and management of compensatory mitigation projects by emphasizing a watershed approach in selecting compensatory mitigation project locations, requiring measurable, enforceable ecological performance standards and regular monitoring for all types of compensation and specifying the components of a complete compensatory mitigation plan, including assurances of long-term protection of compensation sites, financial assurances, and identification of the parties responsible for specific project tasks (USACOE and USEPA 2008).

The rule applies equivalent standards to permittee-responsible compensatory mitigation, mitigation banks and in-lieu fee mitigation to the maximum extent practicable. Since a mitigation bank must have an approved mitigation plan and other assurances in place before any of its credits can be used to offset permitted impacts, this rule establishes a preference for the use of mitigation bank credits, which reduces some of the risks and uncertainties associated with compensatory mitigation. This rule also significantly revises the requirements for in-lieu fee programs to address (USACOE and USEPA 2008).

The federal government states that compensatory mitigation involves actions taken to offset unavoidable adverse impacts to wetlands, streams and other aquatic resources authorized by Clean Water Act section 404 permits and other Department of the Army (DA) permits. As such, compensatory mitigation is a critical tool in helping the federal government to meet the

longstanding national goal of ‘‘no-net-loss’’ of wetland acreage and function. For impacts authorized under section 404, compensatory mitigation is not considered until after all appropriate and practicable steps have been taken to first avoid and then minimize adverse impacts to the aquatic ecosystem pursuant to 40 CFR part 230 (i.e., the CWA Section 404(b)(1) Guidelines).Compensatory mitigation can then be carried out through four methods: the *restoration* of a previously-existing wetland or other aquatic site, the *enhancement* of an existing aquatic site’s functions, the *establishment* (i.e., creation) of a new aquatic site, or the *preservation* of an existing aquatic site.
There are three federally-accepted mechanisms for providing compensatory mitigation: *permittee-responsible compensatory mitigation, mitigation banks* and *in-lieu fee mitigation.* Permittee-responsible mitigation is the most traditional form of compensation and continues to represent the majority of compensation acreage provided each year. As its name implies, the permittee retains responsibility for ensuring that required compensation activities are completed and successful. Permittee-responsible mitigation can be located at or adjacent to the impact site (i.e., on-site compensatory mitigation) or at another location generally within the same watershed as the impact site (i.e., offsite compensatory mitigation).

Mitigation banks and in-lieu fee mitigation both involve off-site compensation activities generally conducted by a third party, a mitigation bank sponsor or in-lieu fee program sponsor. When a permittee’s compensatory mitigation requirements are satisfied by a mitigation bank or in-lieu fee program, the responsibility for ensuring that the required compensation is completed and that the project is successful shifts from the permittee to the bank or in-lieu fee sponsor. Mitigation banks and in-lieu fee programs both conduct consolidated aquatic resource restoration, enhancement, and establishment and preservation projects.

Under current practice, there are several important differences between in-lieu fee programs and mitigation banks. First, in-lieu fee programs are generally administered by state governments, local governments, or non-profit non-governmental organizations while mitigation banks are usually (though not always) operated for-profit by private entities. Second, in-lieu fee programs rely on fees collected from permittees to initiate compensatory mitigation projects while mitigation banks usually rely on private investment for initial financing. Most importantly, mitigation banks must achieve certain milestones, including site selection, plan approval, and financial assurances, before they can sell credits, and generally sell a majority of their credits only after the physical development of compensation sites has begun. In contrast, in-lieu fee programs generally initiate compensatory mitigation projects only after collecting fees, and there can be a substantial time lag between permitted impacts and implementation of compensatory mitigation projects. Additionally, in-lieu fee programs have not generally been required to provide the same financial assurances as mitigation banks. For all of these reasons, the federal government considers there is a greater risk and uncertainty associated with in-lieu fee programs regarding the implementation of the compensatory mitigation project and its adequacy to compensate for lost functions and services.

State of Florida: Florida Department of Environmental Protection; South Florida Water Management District; Southwest Florida Water Management District

Florida implements an independent state permit program that operates in addition to the federal dredge and fill permit program. This comprehensive state regulatory program regulates most upland, wetland, and other surface water alterations throughout the state under part IV of Chapter 373 of the Florida Statutes. It also includes a mangrove trimming and alteration program under Chapter 403 of the Florida Statutes. The regulatory program includes a federal State Programmatic General Permit (SPGP) and implementation of a statewide National Pollutant Discharge Elimination System (NPDES) program. Activities located on or using state-owned sovereign submerged lands also require applicable proprietary authorizations (including Consents of Use, Leases, and Easements).

Florida has statutes and rules governing activities in wetlands independent of the existing federal laws. Although Florida's program essentially contains all the required elements of a State Wetland Conservation Plan, Florida has never packaged the program for USEPA review and sign-off. Therefore, Florida does not operate under a USEPA-approved State Wetland Conservation plan at this time.

Florida does not have an official goal of no-net-loss or gain of wetland ***acreage*****.** However, the regulatory rules are written so as to be implemented in a manner that achieves a programmatic, and project permitting, goal of no-net-loss of wetland or other surface water ***functions*** (not including activities that are exempt from regulation or that are authorized through a Noticed General Permit). An Environmental Resource Permit (ERP) standard is that activities must not adversely impact the value of functions provided to fish and wildlife and listed species by wetlands and other surface waters. The wetland resource permit program does not actually contain the above stated goals, but operates such that an activity must not be contrary to the public interest, which typically includes offsetting wetland impacts.

Features of the State of Florida wetland regulatory programs differ from the federal wetland regulatory programs in the following ways:

1. The comprehensive nature of the state program is broader than the federal program in that it also regulates alterations of uplands that may affect surface water flows, including addressing issues of flooding and stormwater treatment.
2. The state program is **in addition to**, **not in place of** or superseded by the federal dredge and fill permit programs. There are no thresholds wherein some activities are reviewed by the state and others by the federal government. In essence, applicants must get all applicable permits and authorizations from both the state and the federal government before beginning work.
3. There is a division of responsibilities between the FDEP and the water management districts.
4. There is a linkage between the state regulatory and proprietary programs.

5. A wetland delineation methodology ratified under state law that is binding on all state, regional, and local governments throughout Florida is specific to Florida, and differs from the federal wetland delineation methodology.
6. There is a statewide mitigation banking program implemented by FDEP and three of the state's five water management districts.
7. ERPs are permits that are valid for the life of the system (including all structures and works authorized for construction or land alteration). The ERP does not automatically expire after the construction phase (typically a five-year period), and continues to cover operation (use of) of the system.
8. There is a program to authorize regional mitigation for FDOT projects by a fee (typically to a mitigation bank or a water management district.
9. There is a joint permit application form. Applicants for a federal dredge and fill permit apply directly to either FDEP or the applicable water management district using the same form that is used for the state ERP or wetland resource permit. The FDEP and the water management district then forward the application to the USACOE for concurrent federal permit processing (which can only be issued after issuance of the applicable state permit that grants or waives water quality certification).
10. There is a program that regulates the trimming or alteration of mangroves.
11. The issuance of a SPGP from the USACOE to the FDEP that provides that certain activities (such as docks, seawalls, dredging, and activities that qualify for state exemptions or general permits) that qualify under the state regulatory program also will receive the associated federal dredge and fill permit.
12. There is a limited delegation of the ERP program from the FDEP and the SFWMD to Broward County.

The state regulatory permit program is implemented differently, depending on the location of the activity. In the CHNEP area (encompassing the geographic territory of parts of two water management districts), an environmental resource permit (ERP) program regulates virtually all alterations to the landscape, including all tidal and freshwater wetlands and other surface waters (including isolated wetlands) and uplands. The ERP addresses dredging and filling in wetlands and other surface waters, stormwater runoff quality (i.e. stormwater treatment) and quantity (i.e. stormwater attenuation and flooding of other properties), and impacts that result from alterations of uplands. This program regulates everything from construction of single family residences in wetlands and convenience stores in the uplands, to dredging and filling for any purpose in wetlands and other surface waters (including maintenance dredging), to construction of roads located in uplands and wetlands and agricultural alterations that impede or divert the flow of surface waters. Issuance of an ERP also constitutes a water quality certification or waiver under section 401 of the Clean Water Act, 33 U.S.C. 1341. In addition, issuance of an ERP in coastal counties constitutes a finding of consistency under Florida Coastal Zone Management Program under Section 307 (Coastal Zone Management Act). The ERP program is implemented jointly by the FDEP and the two water management districts in accordance with an operating agreement that identifies the respective division of responsibilities.

The FDEP wetland resource permitting program was originally authorized pursuant to the Warren S. Henderson Wetlands Protection Act (Sections 403.91 - 403.929, Florida Statutes (F.S.)) in 1984. The prior wetland resource program was used for activities which are grandfathered according to Sections 373.414(11), (12) (a), (13), (14), (15), and (16). In the 2006 legislative session, through amendments to S. 373.4145, F.S., the Northwest ERP rulemaking was authorized. The rules addressing stormwater quality and quantity went into effect on October 1, 2007.

The following statutes and rules govern activities regulated by the FDEP ERP wetland resource permit program:

- Chapter 120, Florida Statutes (F. S.), Administrative Procedures Act
- Part IV, Chapter 373, F. S.
- Chapter 403, F.S., including the permitting of activities in wetlands (Sections 403.91 929) F.S. [Note: Although these sections have been repealed by FERA, these sections remain applicable for the wetland resource permit program until the ERP rules become effective, pursuant to Section 373.414(9), F.S.]
- Mangrove Trimming & Preservation Act 403.9321 – 403.9333, F.S.
- Water Quality Standards - Chapters 62-3 and 62-302, F.A.C.
- Rule and Procedures for Permits - Chapter 62-4, F.A.C.
- Rule and Procedures for Dredge and Fill Activities - Chapter 62-312, F.A.C.
- Regulation of Stormwater Discharge - Chapter 62-25, F.A.C.
- 25-Year Permits for Maintenance Dredging in Deep Water Ports Chapter 62-45, F.A.C.

Permits are required for dredging, filling and construction of structures within the landward extent of wetlands and other surface waters unless the activity specifically qualifies for one of the following exemptions: the excavation (dredging) of channels, canals, ditches, lakes; deposition of fill; construction of docks, fishing and observation piers, wharves, mooring piles, dolphins, boardwalks, platforms, artificial reefs, navigational markers and signs, boat ramps, fences, dams, jetties, groins, dikes, bridges, utility lines, mines, salvage operations, including treasure salvage; and other dredging or filling activities in or connecting to jurisdictional waters.

Project Review

The FDEP has a standard 24-step protocol that is followed in sequence when considering a wetland resource permit:

1) Is an application required/Is a permit required?

2) Does the activity consist of dredging and filling? "Dredging" is defined as the excavation, by any means, in wetlands or other surface waters. It also includes the excavation, or creation, of a water body which is, or is to be, connected to waters, directly or via an excavated water body or series of excavated water bodies. [F.A.C. Rule 17-312.020(6)]. "Filling," - Deposition, by any means, of materials in waters. [F.A.C. Rule 17-312.020(10)]. "Materials" includes pilings, but excludes the placement of crab traps, similar devices, and oyster cultch [F.A.C. Rule 17-312.020(13)].

3) Once it has been determined that the activity consists of dredging or filling, the next step is to determine whether or not the activity is located within the landward extent of wetlands or other surface waters. The methodology for making this determination changed effective July 1, 1994. Under section 373.421 of the Florida Statutes, Florida has adopted a wetland delineation methodology. The new methodology is contained in Chapter 62-340, F.A.C., which was adopted pursuant to Section 373.421, F.S., and became effective upon the effective date of the legislative ratification of the rule in Section 373.4211, F.S. This new methodology, which delineates the landward extent of all wetlands and other surface waters, including isolated wetlands, is binding on all state, regional, and local governments throughout Florida and applicable throughout the state, except within the Jurisdictional limits of the Northwest Florida Water Management District (NWFWMD) until July 1, 1999, and except for activities, project areas, and former wetland delineations which meet the criteria in Sections 373.414(12) (b) or (c), (13), (14), (15), or (16), F. S. The landward extent of wetlands and other surface waters may be determined by the submittal of a permit application, by petitioning the Department or a District for a formal wetland determination, or through an informal, non-binding determination by the Department or the Districts on a "time-available" basis

4) Once an activity is determined to consist of dredging or filling within the landward extent of wetlands or other surface waters, the next step is to determine whether the activity qualifies for any of the exemptions contained in Section 403.813(1), F.S., and Section 62-312.050, F.A.C. Such a determination can be made by a permit applicant simply by reviewing the criteria in the applicable statute and rule. An application is not required, but it is suggested because a determination that an activity qualifies for an exemption under Chapter 403, F.S., does not necessarily mean that the activity does not need other state, federal, or local authorizations. When an application is submitted, it is distributed to other agencies so those agencies can make their own determinations regarding the need for other authorizations. The submittal of such an application does not require the submittal of an application fee. In any case, a determination that an activity qualifies for an exemption does not relieve the requirement that water quality standards must be maintained during the performance of the work, nor from the requirement to obtain all other needed Federal, State, and local approvals.

5) Once it is determined that an activity located within the landward extent of wetlands or other surface waters does not qualify for one of the exemptions described in statute, the next step is to determine whether the activity qualifies for any of the general permits contained in Sections 62-312.801 - .822, F.A.C. A general permit is a self-executing permit which does not undergo individual review by the Department or District. If the activity meets all the criteria of the applicable listed general permit, a Notice of Intent to Construct Works Pursuant to Wetland Resource General Permit must be provided to the Department or District at least 30 days prior to initiating activity. Once the notice has been submitted, an applicant may presume they qualify for the general permit, unless notified by the Department or District that the activity does not qualify 30 days after notice was received by the Department or District. The notice requires the submittal of a $100.00 application fee. As with exemptions, an activity which qualifies for a wetland resource general permit is still subject to any other state, local and federal authorizations which may be required. For those activities which require permits but which do not

qualify for a general permit, an individual permit is required. To apply for an individual permit, a Joint Application for Works in the Waters of Florida must be submitted to the appropriate Department or District office in accordance with the activity based division of responsibilities discussed below, and in accordance with the procedural rules of the Department and District. A copy of the joint application form may be obtained by contacting the local office of the Department or District. To be considered by the Department or District, the application must be submitted with the complete, appropriate processing fee. For the Department, the list of such processing fees is contained in Chapter 62-4; F.A.C. Fees for applications to the Districts are contained in the appropriate procedural rules of the Districts. In general, permit fees range from $300 to $4,000 (depending on the size of the project) for a five-year permit, and $6,000 to $25,000 (depending upon the duration of the permit) for permits of between six years and 25 years in duration. The Department, the Districts, and the USACOE have developed a joint application process. Under this process, the Department or the District (again, depending upon the activity based division of responsibilities) will serve as the initial agency to whom the application should be submitted. Once received, the agency will distribute a copy of the application to the USACOE. Both the USACOE and the Department or District will independently process the application, including separate requests for additional information and separate evaluation processes. Generally, the USACOE will not issue their permit until the Department or the District issues the required state authorization under Chapter 403, F.S., because issuance will also constitute state water quality certification under Section 401 of the Clean Water Act. The USACOE cannot issue their corresponding federal permit without a state water quality certification.

6) When submitting an application for an individual permit to the Department, the fee for the permit is dependent upon whether the activity is a "short form" application, which would be processed by one of the six FDEP district offices, or a "standard form" application, which would be processed by the Bureau of Submerged Lands and Environmental Resources (BSLER) in Tallahassee. Most applications are processed as "short form" (District review) projects by the Department district offices. Projects which do not meet the short form criteria are processed by the Bureau of Submerged Lands and Environmental Resources in Tallahassee as "standard form" (Bureau Review) applications. The following projects qualify for processing as "short form" applications:

    a. Excavation or filling of < 10 acres of jurisdictional waters of the State
    b. Docking facilities > 10 wet slips which are not associated with commercial or boating supplies or services, or the addition of not more than 20 docking slips to existing functional facilities where the total facility will not exceed 50 slips and the existing and proposed facilities are not associated with commercial or boating supplies or services
    c. Seawalls < 500 linear feet
    d. The installation of buoys, aids to navigation, signs, fences, and ski ramps, and the installation of fish attractors by the Florida Wildlife Conservation Commission (FWC)
    e. Dredging or filling associated with salvage operations or bridge demolition activities
    f. Installation of subaqueous utility lines

g. Artificial reefs
h. Any other project designated for short form review at the Secretary's discretion

7) Both the FDEP and the WMD staff are available for pre-application meetings to discuss applications prior to their submittal. Through such a meeting, staff can help the applicant through the large number of options that exist regarding whether a permit is needed, whether the activity is located within the landward extent of surface waters and wetlands, whether the activities may qualify for an exemption or general permit, to which agency the application should be submitted, and the proper fee for the application. Further, staff can help recommend ways for applicants to minimize project impacts prior to the submittal of an application. Therefore, it is recommended that agency staff be consulted prior to preparing the permit.

8) Activities that are located on submerged lands that are owned by the state of Florida (otherwise called sovereign submerged lands) may also require a corresponding authorization from the Board of Trustees of the Internal Improvement Trust Fund (BOT). When a wetland resource permit application is received for activities which appear to be located on sovereign submerged lands, a copy of the application and drawings is forwarded to the Division of State Lands (DSL) in the FDEP for determination of ownership. In the event the activity is located on state-owned submerged lands, the appropriate type of authorization is processed by the Department. In addition to the above *regulatory* permit programs, activities that are located on sovereign submerged lands also require a *proprietary* authorization for such use under chapter 253 of the Florida Statutes. Such lands generally extend waterward from the mean high water line (of tidal waters) or the ordinary high water line (of fresh waters) both inland and out to the state's territorial limit (approximately 16 kilometers (ten miles) into the Gulf of Mexico). If such lands are located within certain designated Aquatic Preserves, the authorization also must meet the requirements of chapter 258 of the Florida Statutes. Such authorization considers issues such as riparian rights, impacts to submerged land resources, and preemption of other uses of the water by the public. Authorizations typically are in the form of consents of use, easements, and leases. This program is implemented jointly by the FDEP and four of the state's five WMD in accordance with the same operating agreement that governs the ERP program. The program is structured such that applicants who do not qualify at the time of the permit application for *both* the regulatory permit and the proprietary authorization cannot receive either permit or authorization.

9) In addition to the above, a separate permitting process exists for altering mangroves when the mangrove alteration does not occur as part of a wetland resource permit or exemption. The trimming or alteration of mangroves (defined as including the red mangrove *Rhizophora mangle;* black mangrove *Avicennia germinans;* and white mangrove *Laguncularia racemosa*) is regulated in accordance with the Mangrove Protection Act of 1996 (sections 403.9321-40*3.9334, F.*S.) Levels of regulation include exemptions, general permits, and individual permits, depending on the extent of trimming or alteration.

10) Stormwater is reviewed using the criteria of the water management district rules which cover the area in which the project is located. When stormwater permits are required as part of an activity that also requires a wetland resource permit under review by the Department, the stormwater authorization is reviewed and approved or denied as part of the wetland resource permit. Grandfathered stormwater permits are reviewed pursuant to Chapter 62-25, F.A.C.

11) Additional information must be requested by the FDEP or WMD within 30 days of receipt of the application. Further processing is usually suspended until the additional information submitted. Additional requests for information are prepared as necessary within 30 days of receipt of information submitted after first request for additional information (RAI). An application is determined to be complete when all information is submitted. A permit must be issued or denied within 90 days of receipt of a complete application, unless this time period is waived by the applicant. The overall time to process an application is determined by how long it takes to submit a complete application, which is largely dependent upon the level of detail submitted by the permit applicant, and the responsiveness of the applicant to submitting requested information.

12) There are three major components to the evaluation of a permit application. These are:

13) ***Water quality.*** Pursuant to Section 62-312.070, the applicant must provide reasonable assurance that the proposed dredging and filling will not result in violations of the water quality criteria of Chapters 62-3 and 62-302, F.A.C. Activities located within Outstanding Florida Waters (OFWs) must additionally not degrade ambient water quality, in accordance with Chapter 62-4.242, F.A.C. If a project cannot meet standards because ambient water quality does not meet standards, the Department or District must consider measures that cause a net improvement of water quality. When appropriate, a mixing zone may be granted to meet compliance with these criteria, or a variance may be granted.

    a. ***Public Interest.*** A wetland resource permit shall not be issued unless the applicant provides reasonable assurances that the project is not contrary to the public interest. For projects in OFWs, an applicant must provide reasonable assurance that the project is clearly <u>in</u> the public interest. In determining public interest, the Department or District shall consider and balance whether the project will:

        i. Adversely affect public health, safety, welfare or property of others;
        ii. Adversely affect conservation of fish and wildlife, including endangered or threatened species or their habitats;
        iii. Adversely affect navigation or the flow of water or cause harmful erosion or shoaling;
        iv. Adversely affect fishing or recreational values or marine productivity in the vicinity of the project;
        v. Be of a temporary or permanent nature;
        vi. Adversely affect significant historical or archaeological resources; and
        vii. Adversely affect the current condition and relative value of functions performed by the wetlands.

b. ***Cumulative Impacts***. The Department or District, in their decision whether to issue or deny a permit also shall consider the cumulative impact of other projects (Section 403.919, F.S.), based on the following factors:

   i. Projects which are existing, under construction, or for which permits or jurisdictional determinations have been sought;
   ii. Projects which are under review, approved or vested pursuant to Section 380.06, F. S.; and
   iii. Other projects which "may reasonably be expected to be located within" the jurisdiction of the Department or a District. This determination is to be based upon existing land use regulations and restrictions.

14) **Mitigation.** If a project has adverse impacts which render it unable to meet the permitting criteria, the applicant, the Department, or the District may propose measures which will mitigate for the otherwise unpermittable adverse impacts. If the Department or District determines that the proposed mitigation will offset or compensate for the adverse impacts to an extent which will make the project not contrary to the public interest, or clearly in the public interest if in an OFW, the project may then receive a permit.

15) Mitigation may not be considered "up front" or until the project is determined not to be permittable without mitigation, except for mining applications. Mitigation will not be evaluated until the Department or a District have first considered practicable alternatives to reduce or avoid the unpermittable aspects of a project, although the "the no project alternative" is not an acceptable modification. Mitigation is defined as measures which compensate for or enhance aspects of projects which do not meet permitting criteria. Appropriate mitigation proposals can consist of one or a combination of

   a. Restoration of wetlands or other surface waters
   b. Enhancement of wetlands or other surface waters
   c. Creation of wetlands or other surface waters
   d. Preservation of wetlands and other surface waters
   e. Net improvement of water quality or aquatic habitat

16) However, mitigation may not be able to offset impacts in some cases, such as to offset significant degradation to Outstanding Florida Waters, when endangered species are adversely affected, or when there is a likelihood that the mitigation will not be able to successfully create, restore, or enhance a particular wetland type.

17) For projects which cannot meet the public interest or water quality criteria, an applicant may propose mitigation to offset the adverse impacts which otherwise make the project ineligible for a permit, in accordance with section 373.414(l) (b), F.S.

18) Florida has a state-wide wetland mitigation assessment method for use to determine the amount of mitigation needed to offset adverse impacts to wetlands and other surface waters and to determine the number of mitigation bank credits awarded and debited. The Uniform Mitigation Assessment Method (UMAM) is described in Chapter 62-345, Florida Administrative Code. The method is binding on the FDEP, the WMD, local government and other state governmental entities, in the form of an “exclusive and consistent process” for the evaluation of wetlands and the determination of mitigation

amount. The type of wetland mitigation used to offset a project's impact depends greatly upon the type of permitted impact and what wetland functions have been impacted. The mitigation plan for a permitted project often involves multiple types of mitigation.

19) The procedures for evaluating mitigation proposals are contained in Sections 62-312.300 - .390, F.A.C. In all cases, reasonable assurance must be provided that mitigation can be successful, as determined on a case by case basis (see Sections 62-312.340 and 350, F.A.C.). When mitigation is determined to be appropriate, the mitigation proposal from an applicant must be in writing, and will not restart the 90 day processing time clock.

20) Off-site mitigation is considered appropriate in some instances, such as road corridors and utility alignments, but typically requires higher mitigation ratios than on-site mitigation. In addition, off-site mitigation must be determined to offset the otherwise unpermittable aspects of the project, which typically requires that the mitigation be as close as possible to the site of impact and within the same waterbody or same drainage basin as the affected waters.

21) Preservation of mitigation sites may be required to ensure that the site will remain undisturbed for a time period sufficient to ensure that the site can become successful. Long term mitigation may be required to prevent future cumulative impacts and to provide reasonable assurance that the functions which are designed to be offset by the mitigation activity will continue into the future. Conservation easements and land conveyances may be considered as mitigation if they offset impacts that otherwise make the project unpermittable. Property restrictions on uplands can be appropriate when they will protect wetland functions.

22) The rule Section 62-312.390, F.A.C. contains detailed information which is required for applicants to provide reasonable assurance of financial responsibility sufficient to ensure the success of the mitigation activity, including monitoring and contingency efforts when the estimated cost of the mitigation is $25,000 or more. The amount of the financial assurance must be 100% of the estimated cost of the mitigation.

23) The success criteria which must be met include:

    a. Water quality criteria
    b. Hydrologic regime sufficient to maintain viability
    c. Success criteria in permit.

24) When making a success determination, climatic conditions will be considered. A comparison to reference waters is required when insufficient information exists to judge success. Reference waters must be sufficiently similar to the mitigation site, but do not need to exactly duplicate conditions at the mitigation site.

Permits are usually good for 5 years, but the length of the permit may be extended up to 25 years. Permits with a 5 year or greater duration are reviewed and updated at 5 year increments. A permit may not be extended or renewed once expired. Permits are issued to a specific person and do not "run with the land". Transfer of a permit is possible only when approved in writing by the Department or District.

Modifications of permits can be made, and are evaluated with respect to whether the modification is considered minor or major. Minor modifications do not have the potential to change the environmental impact of a project, and can be evaluated for a $250 processing fee. Major modifications have the potential to have new environmental impacts and are evaluated upon payment of a complete new application fee equivalent to a new permit application. The submittal of a major modification request and application fee will restart the 90 day time clock and will be evaluated as a new application, including the potential for new public notices.

There is a separate stormwater permit program under chapter 62-25 of the Florida Administrative Code that regulates construction and land alterations (typically in uplands) that collect, convey, channel, hold, inhibit or divert the movement of stormwater and that discharge into surface water waters. This program only addresses the *quality* of water discharged from stormwater systems, not the *quantity* of water (i.e. it does not address flooding issues as does the ERP permit program in the rest of the state.) This program is implemented solely by the FDEP, except the City of Tallahassee has received a delegation to review and take agency action on stormwater general permits within their geographic limits.

Federal Coordination/Delegation

The issuance of a state ERP or WRP permit also constitutes a state water quality certification or waiver thereto under section 401 of the Clean Water Act, 33 U.S.C. 1341, and, in coastal counties, a finding of consistency under Florida Coastal Zone Management Program under Section 307 (Coastal Zone Management Act). When a corresponding federal dredge and fill permit is required, it is issued independently from the state permit by the USACOE after issuance or waiver of the state water quality certification and applicable coastal zone consistency concurrence.

In addition to the above state regulatory programs, Florida has statewide authorization to implement the federal NPDES permit program for stormwater. Areas of regulation include municipal separate storm sewer systems, certain industrial activities, and construction activities. The municipal program has jurisdiction over large and medium municipalities. The industrial program covers selected industries and is identified by Standard Industrial Code. New construction may also require a stormwater permit if the clearing, grading, or excavation work disturbs five or more acres of land and discharges to either a surface water of the state or to a Municipal Separate Storm Sewer System “MS4”. The NPDES stormwater permit needed is called the Generic Permit for Stormwater Discharge from Construction Activities that Disturb Five or More Acres of Land. Copies of the permit, application forms, guidance materials, and other information about the permit and NPDES stormwater program can be downloaded from the following website: http://www.dep.state.fl.us/water/stormwater/npdes/.

SPGP — the Corps has delegated to the FDEP the ability to issue the federal dredge and fill permit under section 404 of the Clean Water Act for certain activities that qualify for an ERP or wetland resource permit or exemption (see below).

Evaluation Methodology for All Environmental and Wetland Resource Permits

The first step in the review of all environmental and wetland resource permit applications involves a consideration of eliminating and reducing otherwise unpermittable adverse impacts

(note that this is a different test that the "Alternatives Analysis" used by federal agencies; it does not provide for considering an alternate site).

Staff from the FDEP or from the applicable WMD (in accordance with the Department/Water Management District Operating agreements described above) evaluates (using their best professional judgment) whether an activity will adversely affect fish, wildlife, listed species, and their habitats. Upon receipt, a copy of each application also is initially copied to the Florida's Fish and Wildlife Conservation Commission (FWC). Comments and suggestions regarding listed species and other wildlife impacts from the FWC are considered during processing of the application. The FWC also may object to issuance of an ERP or wetland resource permit under Florida's Approved Coastal Zone Management Act coordination process. The FDEP and WMD do not rely on, but will also consider, comments from the federal resources agencies (FWS and the NMFS) when such comments are made in a timely manner during the processing of a state permit. Consideration is given under the environmental resource permit program to upland buffers that are designed to protect the functions that uplands provide to wetlands and other surface waters. When considering impacts to the listed (endangered, threatened and special concern) species under the environmental resource permit program, the agencies may only consider adverse impacts to aquatic or wetland dependent listed species that use wetlands and other surface waters or that use upland habitats for nesting and denning.

All activities must be found to not result in violations of state surface and groundwater water quality standards (there are no separate water quality criteria for wetlands—see discussion on water quality). In addition, for projects located in Outstanding Florida Waters (these waters are identified in chapter 62-302, F.A.C.), the activity must be found to not cause degradation of ambient water quality. The siting of marinas and other activities that may affect the flow of waters includes hydrographic evaluations that are useful in predicting whether water quality standards will be met. The rules also provide for mitigation in the form of net improvement when an activity will cause or contribute to discharges in waters that do not currently meet state water quality standards for the constituents of those discharges.
When evaluating the value and functions that wetlands and other surface waters provide for fish, wildlife, listed species, and water quality, the state utilizes the Uniform Mitigation Assessment Method (UMAM) rule (Chapter 62-345, F.A.C.) that went into effect on February 2, 2004. Although only the FDEP was required to adopt the method by rule, it is now the sole means for all state entities, including the water management districts, local governments, and other State of Florida governmental entities, to determine the amount of mitigation needed to offset adverse impacts to wetlands and other surface waters and to determine mitigation bank credits awarded and debited.

In addition to evaluating direct, construction-related impacts to wetlands and other surface waters, the ERP and wetland resource rules and associated case law require a consideration of secondary and cumulative impacts when evaluating adverse impacts of an activity.
Secondary impacts are those actions or actions that are very closely related and directly linked to the activity under review that may affect wetlands and other surface waters and that would not occur but for the proposed activity. Secondary impacts to the habitat functions of wetlands associated with adjacent upland activities are not considered adverse under the environmental

resource permit program if buffers of a certain minimum size are provided abutting the wetlands (with some exclusionary provisions).

Cumulative impacts are residual adverse impacts to wetlands and other surface waters in the same drainage basin that have or are likely to result from similar activities (to that under review) that have been built in the past, that are under current review, or that can reasonably be expected to be located in the same drainage basin as the activity under review.

Regulated and Exempted Activities

Certain activities have been exempted by statute and rule from the need for regulatory permits under state law or by agency rule. To be exempt by rule, the activities have been previously determined by the agencies to be capable of causing no more than minimal individual and cumulative adverse impacts to wetlands and other surface waters.

Examples (by no means inclusive) of exempt activities include:

- construction, repair, and replacement of certain private docking facilities below certain size thresholds;
- maintenance dredging of existing navigational channels and canals;
- construction and alteration of boat ramps within certain size limits;
- construction, repair, and replacement of seawalls and rip rap in artificial waters;
- repair and replacement of previously permitted structures; and
- construction of certain agricultural activities (see below).

In addition, the state has issued a number of "noticed general permits" for activities that are slightly larger than those that qualify for the above exemptions and that otherwise have been determined to have the potential for no more than minimal individual direct and secondary impacts. These include (by no means comprehensive):

- construction and modification of boat ramps of certain sizes;
- installation and repair of riprap at the base of existing seawalls;
- installation of culverts associated with stormwater discharge facilities; and
- construction and modification of certain utility and public roadway construction activities.

Anything that does not specifically qualify for an exemption or noticed general permit generally requires an ERP permit. Activities that are not specifically exempt and that involve dredging or filling in connected wetlands and other surface waters in the panhandle generally requires a wetland resource permit.

Special Provisions for Agriculture and Forestry

Sections 373.406 and 403.927, F.S., exempt certain agricultural activities from the need for ERPs and WRPs. These include the rights of any person engaged in the occupation of agriculture, silviculture, floriculture, or horticulture to alter the topography for purposes consistent with the practice of such occupation, provided the alteration is not for the sole or predominant purpose of impounding or obstructing surface waters. All five WMDs in the state have adopted specific rules to regulate other agricultural activities, including the adoption of noticed general permits. The review of all agricultural activities, including permitting, compliance, and enforcement, is the responsibility of the WMD. Florida's Department of Agriculture and Consumer Services (FDACS), in cooperation with the FDEP and the WMDs also have developed various best management practices handbooks to assist the agriculture community in working in a manner that will minimize adverse impacts to wetlands and other surface waters.

Certified aquaculture activities that apply appropriate best management practices adopted under section 597.004 are exempt from the need for permits under part IV of chapter 373, F.S. Compliance, enforcement, and permitting of such aquaculture activities are the responsibility of FDACS. Compliance, enforcement, and permitting of activities that are not so certified continue to be the responsibility of the FDEP.

The SWFWMD has developed a unique Agricultural Ground and Surface Water Management (AGSWM) program.

Permit Tracking

The FDEP and each water management district have their own tracking system to record the progress of each permit application and all enforcement cases. However, some common data are tracked, reviewed, and reported statewide.

The FDEP's permit tracking system is called "Permit Application". It keeps track of permit application numbers, processors, time clocks (date received, dates of requested information, date application became complete, date of agency action), agency action (issued, denied, withdrawn, exempt, general permit), and geographic locators (including section, township and range). Enforcement and compliance tracking in the FDEP is recorded in the Compliance and Enforcement Tracking system.

Each water management district has its own tracking system that, at a minimum, also tracks the above information. Some, such as the SFWMD, automatically generate a staff report based on input information; that system also includes extensive pre- and post-project water level and other engineering data. Other information includes extensive tracking of permit condition compliance and mitigation success status, and are fully integrated with Geographic Information System (GIS) linkages. For example, the SWFWMD permit tracking system is called the Resource Regulation Database (RRDB). The RRDB tracks permit applications as they are processed, and compiles selected project details. GIS is used to collect selected location information. Compliance and enforcement activities are tracked from the time at which action is initiated until the action is resolved.

State General Permit (PGP or SPGP) for 404

In order to avoid duplication of permitting between the USACOE and the FDEP for minor work located in waters of the United States, including navigable waters a SPGP was established in 1997, that applies throughout Florida, excluding Monroe County and those counties within the jurisdiction of the Northwest Florida Water Management District. This general permit, referred to as SPGP III, eliminated the need for separate approval from the USACOE for certain activities including:

- construction of shoreline stabilization activities (such as riprap and seawalls; groins, jetties, breakwaters, and beach nourishment/re-nourishment are excluded);
- boat ramps and boat launch areas and structures associated with such ramps or launch areas;
- docks, piers, marinas, and associated facilities;
- maintenance dredging of canals and channels;
- selected regulatory exemptions; and
- selected ERP noticed general permits.

Applications that are received for the above activities are first reviewed to determine if they meet all the conditions of the SPGP. Those that do are processed as "green," in which case issuance of the FDEP permit constitutes issues of the corresponding federal dredge and fill permit. Those that do not are processed as "yellow," in which case a copy of the application is forwarded to the USACOE. These applications are reviewed by the USACOE and are either returned to the state for processing with or without additional federal conditions; or retained for processing by the USACOE.

At this time, permits processed by the WMD are not included in the SPGP. However, negotiations continue on expanding the SPGP to include ERP permits processed by the WMD and Broward County.

Assumption of Section 404 Powers

Florida investigated the possibility of assuming delegation of Section 404 several years ago. Substantial impediments exist to such an assumption

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Most of Florida's waters are "non-assumable" because they are navigable, navigable in fact, or navigable with improvement, and hence are covered by Section 10 of the Rivers and Harbors Act. Considerable confusion would exist, at both the public and the staff level, with a permitting system that would require determination of the status of such waters and the wetlands associated with them.

There are differences between the methodologies used by the state of Florida and by the federal government to delineate the landward extent of wetlands and other surface waters (see discussion above). While in many areas those differences are not significant, that is not the case across the state. Two key species (slash pine, *Pinus elliottii*, and gallberry, *Ilex glabra*) are primarily responsible for these differences. Florida does not consider areas dominated by these species (in the absence of other indicators, such as hydric soils) to be wetlands, although those areas may be classified as wetlands under the federal methodology. The Florida legislature would have to

expand the state methodology to include those areas. At this time it does not appear that the federal government has the authority to make regional adjustments to the 1987 Corps of Engineers Wetland Delineation Manual, which forms the official basis for federal wetland regulation (Environmental Laboratory 1987). Absent an ability to use "one line" in Florida, considerable confusion would exist with the public and the agencies in identifying such areas, and developing a workable solution to authorize activities in such areas that are claimed as wetlands by one agency and not the other.

Joint Permitting

The USACOE and Florida have adopted joint ERP and wetland resource application booklets and forms, and coordinate under an Operating Agreement. Under this agreement, the FDEP or WMD initially receive all ERP and wetland resource permit applications. Copies of those applications that do not qualify under the SPGP (see above) are forwarded to the USACOE within five working days. At that point, both the USACOE and the FDEP or water management district independently process their respective applications. The USACOE cannot act on applications that require a federal dredge and fill permit until the state ERP or wetland resource permit has been issued, which contains the federal water quality certification and coastal zone consistency concurrence determination (or waiver thereto).

Special Area Management Plans and Advanced Identification Plans

A Special Area Management Plan was developed by the USACOE for Bird Drive Basin in Dade County between 1992 and June 1995, and is still in effect. The FDEP and Metropolitan Dade County (Department of Environmental Resources Management, DERM) entered into a Memorandum of Understanding dated April 27, 1993, that directs that applicants requiring mitigation within the basin will contribute a specified amount of money to Miami-Dade County, which is in turn used to implement the Hole in the Donut Mitigation Bank within Everglades National Park.

Advanced Identification Plans (ADIDs) have been developed for western Biscayne Bay (for the shoreline east of Cutler Ridge), the Florida Keys (Monroe County), the Loxahatchee River (Palm Beach County), Eastern Everglades (near the 8 1/2 square mile area), and Rookery Bay (Collier County). These plans help applicants identify areas where permitting difficulties can be expected, but they do not otherwise directly affect the state permitting process. An ADID for western Broward County was developed but never approved by EPA.

In addition to the above, the Jacksonville office of the USACOE has developed an innovative Comprehensive Conservation, Mitigation and Permitting Strategy that targets areas around the state that are experiencing significant development pressure with concurrent concerns of long term habitat and water quality impacts, or where large scale projects are underway that can be expected to result in significant regional impacts. These include the Dade County Lake Belt, Santa Rosa County, St. Joe Development area (in the panhandle), Walt Disney World, and an Environmental Impact Statement for southwest Florida. Each of these has involved coordination with the FDEP and the WMD.

State Mitigation Policy

It is the intent of the state's environmental resource permitting program that there be "no net loss" of wetland or other surface water functions (note: this is different from acreage of wetlands or other surface waters). Furthermore, protection of wetlands and surface waters is preferred to destruction and mitigation.

Mitigation may be considered only after practicable modifications have been made to eliminate or reduce otherwise unpermittable adverse impacts. The environmental resource and wetland resource permit rules recognize that, in some cases, mitigation may not be able to offset impacts sufficiently to yield a permittable project.

Mitigation is best accomplished through restoration, creation, enhancement or preservation of ecological communities similar to those being impacted. However, other means or communities may be acceptable and can be considered on a case-by-case basis, as long as the impacts are offset.

Mitigation may be completed off-site if on-site mitigation is not expected to have long-term viability or if off-site mitigation would provide greater ecological value. Mitigation is typically located within the same basin as the impacts to avoid potential unacceptable cumulative impacts within the basin.

Cash donation is not considered mitigation, unless specified for use in an endorsed environmental project that will serve to offset the impacts. However mitigation banks and "in-lieu-fee" programs are allowed, given that they are already authorized by the state and serve to offset the impacts.

Prior to the adoption of UMAM, the environmental resource and wetland resource permit rules provided recommended guidelines for impact to mitigation ratios:

Creation--1:1 to 6:1

Enhancement--4:1 to 20:1

Preservation--10:1 to 60:1

These ratios were adjusted for each project to account for the relative ecological value of the impacts and proposed mitigation, the time lag between impacts and offsetting those impacts, and the likelihood of success of the mitigation.

With the adoption of UMAM (Chapter 62-345, F.A.C.) on February 2, 2004, mitigation ratios were superseded and were no longer utilized by the FDEP or the water management districts.

Mitigation Banks

In response to a legislative directive, Florida adopted a mitigation banking rule in 1994 (Chapter 62-342, F.A.C.). This rule established guidelines for the operation of public or private banks. Each bank must obtain an environmental resource/mitigation bank permit, from FDEP or the appropriate water management district that provides for the following requirements:

- The banker must have sufficient legal interest in the property to preserve it by a perpetual conservation easement or donation to the state prior to any release of credits;

- A detailed mitigation plan must be in place to support viable and sustainable functional improvements for the regional watershed;
- The number and type of potential mitigation credits must be established, as well as the environmental criteria and schedule for the release of those credits for use;
- The mitigation bank must maintain a ledger to track the number and type of credits released and used;
- A mitigation service area, based on watersheds and other ecological criteria, must be established;
- A long-term management plan must be established to maintain the mitigation success in perpetuity;
- Financial assurance must be established for both the implementation and perpetual management of the bank.
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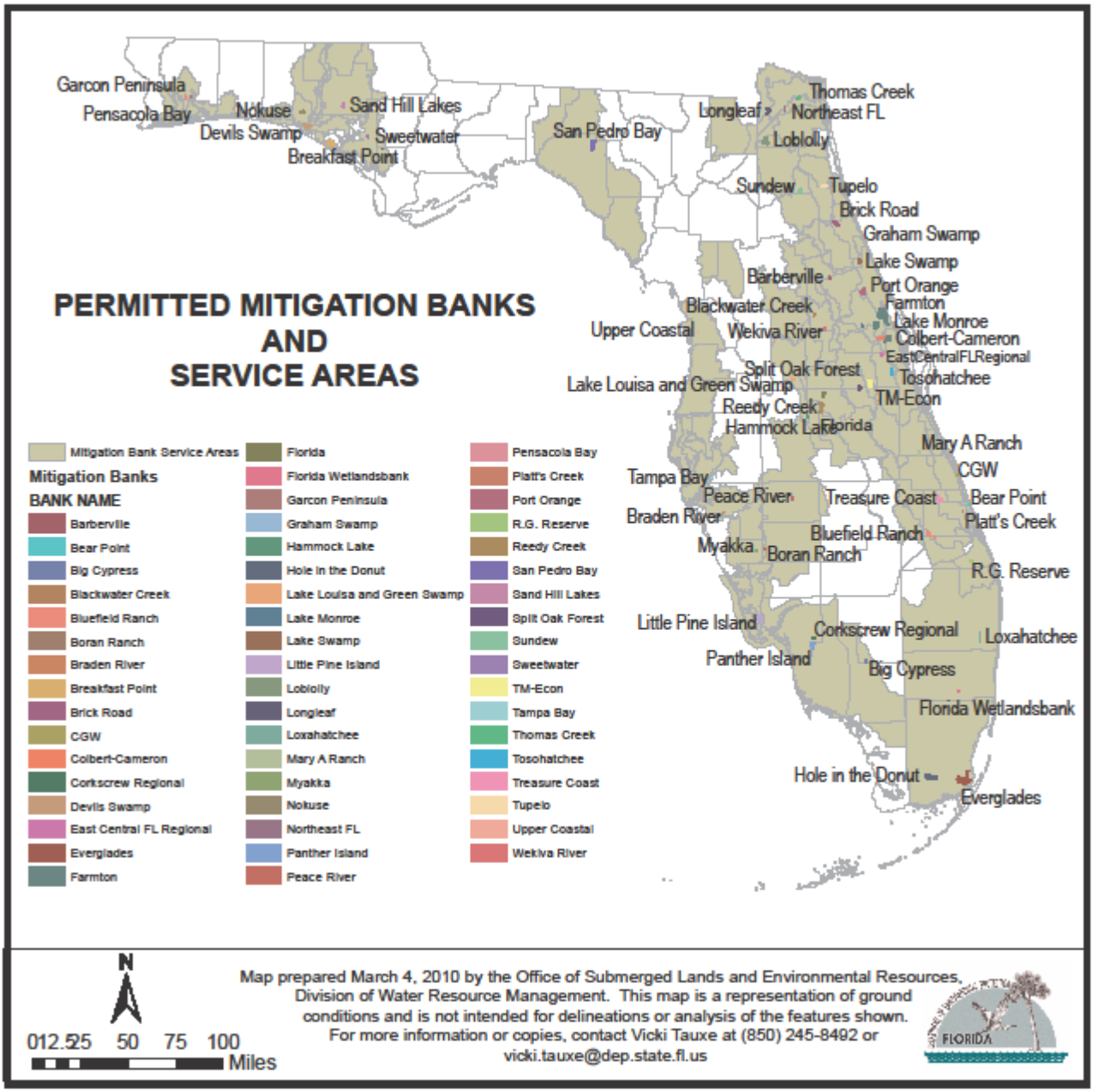
As of March 2010, 55 mitigation banks have been permitted by the state, with a total of 36,929 potential credits, and over 50,111 hectares (123,828 acres. Two banks sell credits to FDOT only.



Map 55: Permitted Mitigation Banks and Service Areas as of March 4, 2010

In Lieu Fee Program

In 2000, legislation was passed that stipulated the requirements by which FDEP, a water management district or a local government could sponsor a Regional Offsite Mitigation Area (ROMA) project that is paid for by monies accepted as mitigation.

A Memorandum of Agreement (MOA) is required between the sponsoring agency, and the FDEP or Water Management District, as appropriate, for any ROMA used for five or more

projects or for more than 35 acres of impact. The MOA must address most of the same requirements required by mitigation bank permits, including: the mitigation plan and timeline, success criteria, mitigation credit and tracking, service area, acquisition, preservation and long-term management provisions. In addition, the sponsoring agency must provide a full cost accounting of the monies received to ensure that all monies were used in the purchase, preservation, permitting, implementation and management of the mitigation area.
The major differences between a ROMA and a mitigation bank are that a ROMA can include an acquisition element and does not have to provide the same financial assurance as is required in a mitigation bank permit.

In 1995, the state established a mitigation program specific to meet FDOT's mitigation needs (Section 373.4137, F.S.), whereby FDOT annually provides an inventory of anticipated wetland impacts to each of the regional water management districts. The state's five WMDs develop mitigation plans that serve to offset those impacts, in coordination with other state and federal regulatory agencies. The plan is presented to the water management district's governing board for conceptual approval, and then submitted to the FDEP for state authorization and approval. Once approved, the mitigation work may commence. This program does not relieve FDOT from eliminating or reducing impacts to the extent practicable or from obtaining permits for the impacts. FDOT appropriates a specified amount of money (adjusted annually) for the mitigation needed to offset each acre of impact, and this money is disbursed to the WMD to conduct the mitigation work.

FDEP and WMD staff who review wetland resource and environmental resource permits also review mitigation proposals as part of reviewing permit applications. Depending on the organization of each office, these staff also review the mitigation work for compliance and enforcement. In other offices, additional staff are dedicated to compliance and enforcement of permitted actions (including those that authorize mitigation) and unauthorized actions.

Wetland Classification and Assessment

Florida does not use a wetland classification system. The "status" of wetlands, and the functions they provide, is determined on a project-by-project basis through the permit application review process.

Wetland Training and Education

The FDEP and WMD have regular and active training programs for their staff and staff of associated local governments. These programs concentrate on delineation of wetlands, and implementation of the regulatory and proprietary rules. When time and funding allow, this training is occasionally provided to consultants and other members of the public.

Upon request, staff makes presentations covering the wetland regulatory and proprietary programs to professional, private and public organizations. Offerings generally include two "short course" conferences per year to consultants and other representatives of the regulated community hosted by the Florida Chamber of Commerce.

All of the FDEP and WMD programs have developed Internet sites with program information and publications concerning wetlands and surface water regulations.

There is no single "wetland team" in Florida to guide or control all the programs that regulate, acquire, and manage Florida's wetlands. However, mechanisms are in place to foster interagency communication on issues related to wetlands and other surface waters. FDEP and WMD:

- frequently coordinate on individual permitting actions;
- meet approximately four times per year on statewide issues involving implementation and coordination of the environmental resource permit program;
- meet frequently to discuss issues related to water use and water consumption, both of which may adversely affect wetland and other surface water levels and functions; and
- regularly attend permit coordination meetings with the USACOE.

Southwest Florida Regional Planning Council

The Southwest Florida Regional Planning Council (SWFRPC) described the regional wetland systems in Volume One of the Strategic Regional Policy Plan, Natural Resources chapter. Goals to protect wetlands are described in the Natural Resources section of Volume Two. There are two major Natural Resource Goals, identified as Goal 2 and Goal 4, which relate to wetlands and utilize the regional acreage of wetlands protected and restored as indicators of success. The language is listed below.

NATURAL RESOURCES PROTECTION

Goal 2: The diversity and extent of the Region's protected natural systems will increase consistently beyond that existing in 2001.

The Southwest Florida Region has a variety of natural systems that range from open water marine and freshwater systems to upland sandhill forest systems. These systems together provide a solid base of economic, environmental, spiritual, aesthetic and recreational values and functions that serve the permanent and seasonal residents of the Region.

Sustainability and ecosystem management are the latest approaches that are being considered today for management of our natural resources. This approach to management not only considers the natural resource, but also how man and nature interact with each other. For example, it is well known that our local economy relies on our natural resources not only to provide a product or resource (i.e. fishing, shellfish) but a quality of life.

Regionally significant natural resources are depicted on Map 54. Identification of named proposed reserves/preserves is solely for planning purposes and not for regulatory purposes. Better, site-specific data (if available) for any feature or resource shown on this map should be used to identify whether any natural resource of regional significance is in fact present on that site for preparation of local comprehensive plans and for consideration of site specific land use requests.

Strategy: To identify and include within a land conservation or acquisition program, those lands identified as being necessary for the sustainability of Southwest Florida, utilizing all land preservation tools available.

Actions:

1. To help eliminate possible duplication or competition on a tract of land between entities, provide a clearinghouse and inventory of lands included in all land acquisition programs in a central location so various entities can see if any other entities were involved in a specific location. A future Web Site would be a useful tool and provide easy access.

2. Support continued acquisition of lands targeted for conservation and recreation by Public Land Acquisition Programs including CARL, SOR, Florida Communities Trust, Lee County CLASAC, CREW, WRDA and other efforts in the Region.

3. Assist Florida Communities Trust staff to evaluate projects that have been submitted for consideration under the Florida Forever program, as requested by Trust staff on an application-by-application basis. 4. Support continued preservation of lands targeted for conservation and recreation by Private Environmental Land Trust Programs in the Region.

5. Facilitate and assist in the coordination of all land acquisition programs in the Southwest Florida Region by sponsoring periodic meetings of all public and private initiatives.

6. Create a map depicting land that has been set aside for conservation purposes within approved developments (existing conservation easements).

7. Create a map depicting regionally significant lands that private landowners agree will be voluntarily managed to maintain their environmental value, yet still provide them with economic benefits, without the need for public acquisition consideration (such lands would be candidates for future conservation easements).

8. Working with the various entities and utilizing the following Criteria and Guidelines, create a non-regulatory gaps planning map of land needed for recreation, hunting/fishing, flood control, forestry activities, etc.; to provide support for future populations and to protect existing ecosystems. Potential gaps may include lands which are not included in any current acquisition/conservation /preservation program, have not already been set aside as conservation areas within approved development or lands which may be within private ownership and may be potentially proposed for future agricultural or urban intensification, which would preclude their environmental value.

9. Workings with the various acquisitions programs identified in this Plan and working with Local Governments and private landowners develop a strategy to protect gaps lands identified in the above action, using the Tools outlined in this plan.

10. Assist in the preparation of applications of existing programs for funding of land acquisitions for gaps lands shown on the above-mentioned planning map.

11. Investigate the potential of forming a new Programs, Land Trusts, or encourage existing Land Trusts, to focus on land acquisition, and on other land conservation techniques within portions of Southwest Florida not currently within a program and depicted on the above mentioned gaps map.

12. Working with the various entities, encourage the establishment of management funding at the time of acquisition and refine existing Management Strategies to insure that the lands acquired are maintained in the natural condition that led to their preservation status. Management strategies should include provisions for fire management.

Indicators:

• Acres of protected natural systems, terrestrial and aquatic.

• Net change in wetland acreage as a result of permitted activities.

• Net change in wetland viability as a result of permitted activities.

Resources: Outstanding Florida Waters; beaches and dunes; wetlands; aquatic preserves and state buffer preserves; and other natural areas owned by local governments, water management districts, other local, regional, state, and federal agencies; privately held natural preserve areas, depicted on Map 48.

Goal 4: Livable communities designed to improve quality of life and provide for the sustainability of our natural resources.

Economic prosperity is key to our Region's future. Growing according to our values is critical to our quality of life. Livable communities embrace both values. In livable communities, young and old can walk, bike, work and play together. Livable communities are places where we not only protect historic old neighborhoods, but where farms, green spaces, and forests add vigor, context and beauty to the newest of suburbs; places where we work competitively, but spend less time in traffic and more time with our families, friends, and neighbors.

Each community faces different challenges and will find its own solutions. Strategies to create more livable communities may include efforts to: Preserve green space. Secure safe streets. Strengthen local economies. Reduce traffic and air pollution. Provide transportation choices. Create community-centered schools. Foster citizen and private sector cooperation. Promote collaboration among neighboring communities.

Strategy: Promote through the Council's review roles community design and development principles that protect the Region's natural resources and provide for an improved quality of life.

Actions:

1. Working in cooperation with agencies and local governments provide for the disposal of man's liquid and solid wastes in a manner that will not lead to long-term degradation of air, ground, and water resources.

2. Working in cooperation with agencies and local governments insure that beaches and inlets that have been damaged by human activity are replaced/renourished and/or managed in order to have the total system function naturally.

3. Working in cooperation with agencies and local governments provide for Air quality improvement and maintenance as our population and urban areas increase.

4. Working in cooperation with agencies and local governments insure that all mining and borrow operations prepare and implement reclamation programs that restore and ensure long-term sustainability of their watersheds and native habitats.

5. Working in cooperation with agencies and local governments insure that agricultural operations are compatible with our identified natural resource protection areas.

6. Working in cooperation with agencies and local governments insure that new public facilities, facility expansions and additions avoid designated natural resource protection areas.

7. Working with all levels of government within Southwest Florida actively plan and prepare for the potential long-term impact of sea level rise upon the Region's natural systems.

8. Working with all levels of government within Southwest Florida actively plan for lands that have been acquired for natural resource purposes to be maintained and managed to preserve their environmental integrity.

9. Insure that opportunities for governmental partnerships and public/private partnerships in preserving wildlife habitats are maximized.

Indicators:

• Drinkable swimmable water; Clean air; wildlife biodiversity; public access to natural resources; acres of natural and restored wetlands.

• Number of environmental education programs for the community; acres of environmentally sensitive areas preserved.

Local Governments

Section 373.441, F.S., and its implementing rule, Chapter 62-344, F.A.C., provide the procedures and considerations for the FDEP and the WMD to delegate the ERP program to local governments. Delegations can be granted only where:

1) the local government can demonstrate that delegation would further the goal of providing an efficient, effective, and streamlined permitting program; and

2) the local government can demonstrate that it has the financial, technical, and administrative capabilities, and desire, to effectively and efficiently implement and enforce the program, and that protection of environmental resources will be maintained.

To date, no local government in the CHNEP has received ERP delegation. Only one local government in the state,, Broward County, has received a comprehensive, albeit geographically and project-type specific, delegation of the ERP program from the FDEP and the SFWMD. The County's responsibilities include permitting, compliance, and enforcement of activities for which they have been given responsibility under a Delegation Agreement adopted in chapter 62-113, F.A.C. Miami-Dade County has a limited delegation from the FDEP to confirm sovereign submerged lands Consents Of Use under chapter 253, F.S., for activities that qualify for the s. 403.813(2) (b), F.S., regulatory exemption for private single-family docks. The City of Tallahassee has a delegation from FDEP to review, take agency action on, and perform compliance and enforcement of stormwater general permits under chapter 62-25, F.A.C., in accordance with a Delegation Agreement adopted in chapter 62-113, F.A.C.

Charlotte County

The Charlotte County Comprehensive Plan Natural Resources and Coastal Planning Element provides an inventory and analysis of the current condition of the County's natural resources, and discusses potential opportunities and threats posed to these resources by existing and future land use activities. Included in this inventory are air, ground and surface waters, soils, commercially valuable mineral deposits, agricultural lands, native habitats, and flora and fauna. The element also provides an inventory and analysis of natural resources and land use concerns specific to the County's coastal area, including beach and coastal systems, beach erosion, public access to the shoreline and coastal waters, development and maintenance of infrastructure in the coastal area, existing and future land use activities in the coastal area, and hurricane evacuation times and shelter capacity.

This element is done in fulfillment of Sections 9J-5.012 and 9J-5.013 of the Florida Administrative Code, and Chapter 163, *Florida Statutes* (*FS*). It is structured to be consistent with the State Comprehensive Plan and Southwest Florida Regional Comprehensive Policy Plan. The inventory and analysis indicates that, both within and outside of the coastal area, Charlotte County's natural resources are still considered to be in generally good condition, though impacts from polluted run-off due to development continue. These impacts will require new management strategies to maintain level of service standards as well as protect the existing resources that make Charlotte County desirable to residents and visitors.

Charlotte County provides protective regulation for wetlands in 14 different locations in their development code including:

- The **Surface Waters and Wetlands Protection Ordinance (#89-54)**, which provides guidelines and standards for development within or adjacent to wetlands and surface water areas within unincorporated Charlotte County. The ordinance requires the creation of an upland buffer with a minimum average width of fifteen feet (4.6 meters) which must be maintained in natural vegetation.
- Part III, Land Development and Growth Management, Chapters 3 through 5, of the Land Development Code, specifically:
    - Article II. District Regulations, Sec. 3-5-117 (4). Performance standards for stormwater plan and Sec. 3-5-118. Contents of the stormwater plan;
    - Article III. Special Regulations, Sec. 3-9-64.1. Fertilizer Regulations;
    - Article IV. Clearing, Filling and Soil Conservation Requirements, Sec. 3-5-95. Erosion Control At Development Sites;
    - Article V. Stormwater; Floodplain; Wetlands;
    - Article Xv. Surface Water and Wetland Protection; Sec. 3-5-347. Local, State and Federal Permits Required.
    - Article VIII. Flood Damage Prevention; Sec. 3-2-178. Standards for Coastal High Hazard Areas.
    - Article VIII. On-Site Sewage Treatment and Disposal Systems, Sec. 3-8-256. Regulations. Sec. 3-8-256. Regulations;

- Article XV. Surface Water and Wetland Protection; Sec. 3-5-348. Standards. (A) (4) *Mitigation Requirements;*
- Article XVIII. Landscaping and Buffers; Sec. 3-5-406. Types Of Buffering.
- Article XX. Transfer Of Density Units;
- Article XXI. Excavations, Sec. 3-5-449. Reclamation Plan; And
- Article XXIII. Excavation and Earthmoving Sec. 3-5-482. Permit application contents. Sec. 3-5-483. Reclamation plan.

Charlotte County regulations provide the following mitigation standards:

- Article XV. Surface Water and Wetland Protection; Sec. 3-5-348. Standards. (a) (4) *Mitigation requirements.* a. Compensatory wetlands mitigation shall require that any area of wetlands created, enhanced or restored be large enough to assure that environmental benefits of wetlands destroyed or degraded will be completely and successfully replaced. In cases of mitigation for altered wetlands and surface waters, the ratio of replacement to destroyed wetlands or surface waters shall conform to federal or state permits issued for the project. Development is encouraged within altered natural drainage features to create new drainage works which, on balance, improves on the adverse effects of previous alterations. Mitigation for impacts to relatively unaltered surface waters shall be in compliance with federal and state permits issued for the project.

- b. *Exemptions.* Isolated wetlands under one-half acre in size shall be exempt from the requirements of this article unless known to provide feeding or nesting habitat for a threatened or endangered species. (Ord. No. 89-54, § 7, 6-22-89)

Lee County

The Lee County Division of Environmental Sciences provides for the identification and conservation of natural systems, native vegetation and wildlife through project review, permit issuance and enforcement of Lee County environmental land use regulations. The regulations include the environmental sections of the Lee County Comprehensive Plan and Land Development Code (LDC). This permitting program applies to the unincorporated areas of Lee County.

Lee County wetlands are those areas defined by Florida Statutes Subsection 373.019(17). These areas are usually inundated or saturated by water long enough to create oxygen poor soils which under normal circumstances support wetland vegetation as defined in Chapter 62-340.450 of the Florida Administrative Code (F.A.C.). There are various natural plant communities typical of wetlands in Florida. Hydric pine flatwoods, cypress domes and strands, hydric hammocks, mangrove swamps, marshes and wet prairies are some of the wetland plant communities found in Lee County.

Wetlands are determined using the Florida Uniform Wetland Delineation Methodology detailed in Chapter 62-340, F.A.C., and summarized above in this report. Persons trained in using this methodology determine if an area contains wetlands based on the type of vegetation present, hydric indicators in the soil, and evidence of hydrology. The historical Soil Survey of Lee

County, completed in the early 1980s, serves as a guideline for locating potential wetland areas. Frequently flooded, slough (sheet-flow) and depressional (ponding and muck) soil types can indicate areas of wetland formation; however, a site visit needs to be conducted by a person trained in wetland delineation methodology to verify the presence or absence of wetlands. Just because a parcel does not contain a hydric soil mapping unit number does not automatically mean wetland conditions are not present. And the opposite is true – just because a parcel is mapped with a hydric soil number does mean that a wetland is definitely present. Thus, the need for a site inspection by trained personnel.

Lee County no longer conducts independent wetland determinations since the passing of Land Development Code Wetland Protection Amendments. However, if a hydric soil mapping unit, according to the Soil Survey of Lee County, is present on a parcel, Lee County requires a wetland determination prior to the approval of applications for single family residence building permits, planned development rezonings, lot splits, and development orders. FDEP provides wetland determinations for single family residence parcels. SFWMD handles parcels zoned for commercial, agriculture and multi-family use. If a wetland determination reveals wetlands are present on a parcel, an Environmental Resource Permit must first be obtained prior to the issuance of Lee County permits and development orders.
Prior to the release of Lee County development orders and building permits on parcels containing wetlands, an ERP must be obtained and a copy provided to Lee County. Conditions of the FDEP or SFWMD Environmental Resource Permit are incorporated into Lee County development orders and permits. Lee County Environmental Sciences staff participate in the compliance and enforcement of permit conditions.

Since July 1, 1996, Lee County has generally not been involved in the regulation of mangrove tree pruning.

Environmental Sciences staff conduct inspections of development sites to ensure compliance with environmental regulations and permit conditions including enforcement of tree protection regulations, sea turtle protection regulations, zoning conditions, protected species management plans and monitoring reports and development order requirements. If projects or properties are not in compliance, enforcement action may be necessary. Enforcement action can include the issuance of a stop work, citation, and/or a notice of violation. Abatement conditions of a notice of violation typically include compliance with approved permits and/or restoration of the site. If a violation is not abated within the time frame given, it is scheduled before the Hearing Examiner. The Hearing Examiner can impose a fine in the form of a lien on a property of up to $250.00 per day and the cost of prosecution for the violation case.

Environmental violations include the unpermitted clearing of trees or other vegetation, improper tree pruning, and noncompliance with development approval requirements and protected species issues. Environmental violations should be reported to the Environmental Sciences Enforcement staff member.
Lee County provides protective regulation for wetlands in 16 major locations in their Comprehensive Plan and in seven ordinances in the land development code including:

- II. Future Land Use, Objective 1.5: Wetlands. Policies 1.5.1, 1.5.2 And1.5.3

- Goal 104: Coastal Resource Protection. , Objective 104.1: Environmentally Critical Areas. , Policy 104.1.1
- Goal 107: Resource Protection. , Objective 107.1: Resource Management Plan. , Policy 107.1.1
- Objective 107.3: Wildlife. , Policy 107.3.1
- Goal 113: Coastal Planning Areas, Objective 113.1: Coastal Planning Area In General. , Policy 113.1.5
- Goal 114: Wetlands. , Objective 114.1, Policies 114.1.1, 114.1.2, 114.1.3, 114.1.4:
- Goal 125: Water Access. , Objective 125.1: Scenic Waterways Program., Policy 125.1.1
- Goal 128: Shoreline Management. Objective 128.5: Marine Facilities Siting Criteria. Policy 128.5.7 And Policy 128.5.11
- Goal 158, Objective 158.1, Policy 158.1.7
- Xii. Glossary: Wetlands
- Ordinance Numbers 94-30, 98-09, 00-22, 05-19, 07-09, 07-12, 07-16

Sarasota County

Sarasota County discusses wetlands and provides wetlands protection in 173 locations in the comprehensive plan including: Chapter 2, Environment; Chapter 9, Future Land Use; Chapter 9-RMA, Sarasota 2050; and Chapter 11, Intergovernmental Coordination and Citizen Participation. Sarasota County also provides protective regulation for wetlands in 26 different locations in their development code including the *Low-Impact Development Manual for Sarasota County*, which provides that "Wetlands are those areas that are inundated by surface or ground water with a frequency sufficient to support, and under normal circumstances do support, a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction" (Sarasota County Code of Ordinances, Ch. 74, Art. I, § 74-7).

Further, from Chapter 74, Art. I, §74-7,Mitigation Areas are defined as "Areas that are created, restored, enhanced, or preserved and maintained to compensate for habitat loss."

The County emphasizes that regional watershed planning, floodplain protection, uplands preservation, wetlands protection, stream/watercourse protection buffers, riparian area and habitat protection; tree canopy protection, density and clustering provisions, street width requirements, and curb and gutter requirements are among the key land use, development, and natural resource management issues that must be considered when planning for Low Impact Development (LID).

There are some distinct differences between Sarasota County and state and federal standards for mitigation. For example, in instances where the UMAM requirements do not apply, mitigation is required to consist of wetland creation at a one-to-one ratio for herbaceous wetlands and two-to-one ratio for forested wetlands, in accordance with Level I performance standards.
All alterations in wetlands which result in a loss of habitat are required to be mitigated in accordance with performance standards adopted by the Board of County Commissioners. These performance standards shall require that the wetland mitigation provides values and functions equal to or, particularly in the case of an impacted or degraded wetland, greater than those of the wetland qualifying for alteration in perpetuity. Reasonable assurance shall be provided such that

the wetland mitigation will exhibit the defined environmental function, nature, and, where hydrologically feasible, similar type of the altered wetland. Wetland mitigation shall consist of the creation, restoration, and/or enhancement of wetlands and/or preservation of upland habitats. The amount of mitigation needed to offset alterations that result in loss of wetland habitat shall be determined by the Uniform Mitigation Assessment Method (UMAM) (Chapter 62-345 Florida Administrative Code). In instances where the UMAM requirements do not apply, the mitigation shall consist of wetland creation at a one to one ratio for herbaceous wetlands, and two to one ratio for forested wetlands, in accordance with Level I performance standards.

City of Bonita Springs

The City of Bonita Springs addresses wetlands 69 times in 7 major locations in its comprehensive plan and ordinances. These include:

Future Land Use Map Series **Figure 3** Beaches, Shores, Estuarine Systems, Water Bodies And Wetlands

Figure 4 Evaluated Wetlands Outside of Planned Developments

Policy 1.1.2 Density, Affordable Housing Density Bonus, and Wetlands Transfer of Density

Policy 1.1.5 Low Density Residential

Policy 1.1.10 Moderate Density Mixed-Use/Planed Development

Policy 1.1.10.1 Urban Fringe Community District

Policy 1.1.10.1: Major Resource Protection Areas

Policy 1.1.19: Conservation

Policy 1.1.20: Resource Protection

Policy 1.7.6: Environmentally Critical Areas

Policy 1.7.7: Transfer of Density from Wetlands

Objective 4.1: Environmentally Critical Areas

Policy 4.1.1: Rare and Unique Upland Habitats

Objective 7.1: Resource Management

Policy 7.1.1: The Measures to Enhance the Protection of Natural Resources

Policy 7.3.1: Upland Preservation In and Around Preserved Wetlands

Policy 14.1.5: Environmentally Sensitive Coastal Areas

Goal 15: Wetlands. The City shall maintain and enforce a regulatory program for development in wetlands that is cost-effective, complements federal and state permitting processes, and protects the fragile ecological characteristics of wetland systems.

Objective 15.1: The natural functions of wetlands and wetland systems shall be protected and conserved through the enforcement of the City's wetland protection regulations and the goals, objectives, and policies in this plan. "Wetlands" include all of those lands, whether shown on the Future Land Use Map or not, that are identified as wetland in accordance with F. S. 373.019.

Policy 15.1.1: Development in wetlands shall be limited to very low density residential uses and uses of a recreational, open space, or conservation nature that are compatible with wetland functions. The maximum density in wetlands is one unit per 20 acres, except that one single-family residence will be permitted on lots meeting the standards in the administration section of the Future Land Use Element of the City's Comprehensive Plan.

Policy 15.1.2: The City's wetlands protection regulations will be consistent with the following:

a. In accordance with F.S. 163.3184(6)(c), the City will not undertake an independent review of the impacts to wetlands resulting from development in wetlands that is specifically authorized by a FDEP or SFWMD dredge and fill permit or exemption.

b. No development in wetlands regulated by the State of Florida will be permitted by the City without the appropriate state agency permit or authorization.

c. The City shall incorporate the terms and conditions of state permits into City permits and shall prosecute violations of state regulations and permit conditions through its code enforcement procedures.

d. Every reasonable effort shall be required to avoid or minimize adverse impacts on wetlands through the clustering of development and other site planning techniques. On- or off-site mitigation shall only be permitted in accordance with applicable state standards.

e. Mitigation banks and the issuance and use of mitigation bank credits shall be permitted to the extent authorized by applicable state agencies.

Policy 15.1.3: The Future Land Use Map Series

Policy 15.1.4: Wetland Protection Measures

Policy 15.1.5: Very low density residential uses and uses of a recreational, open space, or conservation nature that are compatible with wetland functions.

Policy 15.1.7: All mangrove swamp wetlands (FLUCCS #612) and stream and lake swamp wetlands (FLUCCS #615)

Policy 15.1.8: portion of a wetland is protected through an existing development order

Policy 15.1.9: Wetland #1 as identified on the map of evaluated wetlands contained in the Future Land Use Map Series and classified as FLUCCS #621

Policy 15.1.10: Exotics shall, where feasible, be restored to their historical hydrology, functions, and habitat.

Objective 20.2: Scenic Waterways Program

Policy 20.2.1: Vegetated buffer

Policy 22.3.8: Marinas, multi-slip docking facilities, and boat ramps

Policy 22.3.12: adequate uplands

City of Cape Coral
The City of Cape Coral addresses wetlands 48 times in three major locations in its comprehensive plan and ordinances. These include:

Conservation and Coastal Management Goals, Objectives, Policies

Goal 1: Protecting Environmental Resources.
Objective 1.2, Policy 1.2.2: The City will assure that activities that require state and/or federal wetland permits obtain such permits prior to the issuance of City permits. The City will notify state and/or federal agencies if activities in violation of state and/or federal regulations are known to have been conducted.

Objective 1.5, Surface Water, Policy 1.5.2: The City will continue to conserve and protect its wetlands in accordance with standards set by FDEP and SFWMD. The City shall direct future land uses incompatible with protection and conservation of wetlands away from wetlands. The evaluation of incompatibility shall include the following factors for land uses: types, intensity, density, extent, distribution, and location of allowable land uses. The evaluation of incompatibility shall include the following attributes of the wetlands: types, value, function, size, conditions, and location.

Future Land Use Element

Goal: To protect the public investment by encouraging the efficient use of community infrastructure and natural resources…
Objective 1: Managing Future Growth and Development;

Policy 1.15: Land development regulations;

q. Mixed Use Preserve District (MUP): The purpose of this future land use classification is to promote non-residential and mixed use development intended to create additional employment opportunities while requiring preservation and open space standards that would protect significant environmental resources on or near the property; **1.URBAN MUP CLASSES; 1.** Residential units are transferred from wetlands within the Mixed Use Preserve Conservation classification…**2. MUP CONSERVATION; a.** Description of MUP Conservation; **b.** Uses within the MUP Conservation Class; **ii.** Residential development is permitted at a density of one dwelling unit per 20 acres for wetlands, and must be located on uplands in other Mixed Use Preserve classes…; **iii.** Inclusion of uplands isolated by surrounding wetlands in the Conservation classification; **c.** Development Standards within the MUP Conservation Class; **iii.** Protection of flow ways and floodway corridors within Mixed Use Preserve; **d.** Additional Conservation Lands: evaluation and inclusion of other wetlands; **e.** Implementing Land Use and Development Regulations; **3. DESIGN STANDARDS WITHIN THE MUP; a.** Surface Water Management; **i.** Best management practices for stormwater systems; **ii.** Design of surface water management systems; **g.** Open Space; **iv.** To include wetlands; **h.** Mandatory Buffers for Protection of Natural Areas; **i.** Zone 1;

Policy 1.23: Development Incentive Program (DIP);

Category 2: Preservation of Natural Resources.

City of Fort Myers

The City of Fort Myers addresses wetlands 47 times in two major locations in its comprehensive plan and ordinances. These include:

Future Land Use Element

Goal: To ensure that the general patterns and relationships (distribution, allocation, and intensity) of all land uses within, and adjacent to, the City remain or become acceptable to the present and future community of Fort Myers.

Objective 2: Protect distinct functional areas from intrusion and encroachment of incompatible uses.

Policy 2.1: Protect, preserve, and enhance existing viable single-family areas.

Action 2.1.8: Standards for the Heritage Lakes Single Family District

Standard 2.1.8.6: Replanting of the 50-foot upland/wetland preservation and restoration areas with 100% native vegetation.

Policy 2.17: Eastwood Village Mixed Use – A portion of the property was used for the discharge of water to artificially hydrate the well fields, which resulted in some created wetlands.. The existence of the artificially created wetlands within the Eastwood Village Mixed Use area results in some uncertainty as to the ultimate wetland/upland line…No regionally significant wetlands exist on the site. All non-regionally significant wetlands will be placed in a conservation easement in favor of the South Florida Water Management District at the conclusion of the environmental resource permitting process.

Policy 2.19: Conservation Lands – definition.

Standard 2.19.1.1: Regionally significant wetlands

Standard 2.19.1.4: Wetlands that are not regionally significant will be designated as CON if required by the South Florida Water Management or Army Corp of Engineers.

Policy 2.20: Mixed Use Residential

Action 2.20.3: Regionally significant wetland systems located within a Planned Unit Development

Action 2.20.6: Transfer of units from Conservation Lands (including wetlands) to Mixed Use Residential areas at a density of up to 3.0 dwelling units per acre.

Conservation and Coastal Management Element

Goal 2: Maintain, increase, and manage natural and coastal resources to preserve their quality and ability for use in the future while protecting human life and limiting public expenditures in areas subject to destruction by natural disasters.

Objective 3: Maximize public accessibility to and the use of natural resources without unacceptable adverse impact on them with appropriate development, public expenditures, and hazard mitigation planning.

Policy 3.3: The City will encourage recreational use of wetland preserve areas consistent with their function and the uses shall conform to requirements and criteria of 373.414 F.S.

Objective 6: Preserve significant natural open space areas, adjacent upland buffers, and historic resources.

Policy 6.1: Freshwater and saltwater wetlands, adjacent upland buffers, mangrove areas, seagrass beds, and estuarine system quality are to be preserved or restored.

Action 6.1.1: Whenever feasible, the City shall acquire wetland areas, adjacent uplands, mangrove areas, and seagrass beds for purposes of conservation and recreation.

Action 6.1.2: Preservation of viable wetlands, adjacent uplands, and buffers shall be required.

Standard 6.1.2.1: Definition of wetlands.

Standard 6.1.2.2: The definition of wetlands shall be consistent with Chapter 373.019, F.S.

Standard 6.1.2.3: Establishment/maintenance of an undisturbed, native vegetated buffer between a preserved wetland and adjacent upland development…

Standard 6.1.2.4: Wetlands that are created or that are low quality must be restored or mitigated. Mitigation options shall include, in order of preference: (a) preservation of the wetland; (b) restoration; (c) the payment of monies to a State-approved wetland mitigation band; or, (d) an approved City mitigation plan.

Objective 12: The City will coordinate with the South Florida Water Management District in its review of Environmental Resource Permits for Development within the City…

Policy 12.1: Coordination with SFWMD regarding appropriate setbacks and/or structural barriers from regionally significant wetlands.

Objective 13: The City will create an inventory, by December 2008, of its natural resources in order to protect and preserve these unique assets

Policy 13.1: The City will hire a consultant to inventory both uplands and wetlands in order to identify such areas and evaluate the health of the identified areas.

Town of Fort Myers Beach

The Town of Fort Myers Beach addresses wetlands protections and mitigation in 91 locations in four comprehensive plan elements; the Future Land Use Element, the Conservation Element, Chapter 14 Environment and Natural Resources, and Chapter 26 Marine Facilities, including the following:

Future Land Use Element:
Goal 4: Objective 4-B: Future Land Use Map Categories

Policy 4-B-9: "Wetlands": a conservation district applied to all remaining wetlands. The maximum density of residential development here is 1 swelling units per 20 acres. Other allowable uses, if compatible with wetland functions, are passive recreation, walking access to tidal waters (boardwalks and docks), and restoration of degraded habitats. Prohibited activities include placement of fill material; dredging of boat basins and channels, placement of seawalls or other shoreline stabilization; and removal of native vegetation.

Objective 4-C: Applying the Future Land Use Map

Policy 4-C-12: Wetland Buffers: Upland development shall maintain a 75-foot separation between wetlands and buildings or other impervious surfaces. This requirement shall not apply to platted lots, or to a previously approved development order to the extent it cannot reasonable be modified to comply with this requirement.

Conservation Element
Goal 6: To protect the natural resources in and around the town from further damage and improve their future health and sustainability through regulations, education, enforcement, timely management, public improvements, and cooperation with other entities with similar goals.

Objective 6-A: Estuaries and Bays

Policy 6-A-2: Regulations to protect the healthy functioning of the estuary

Objective 6-B: Wildlife and Native Habitats

Policy 6-B-4: Upland Habitats; (i): Land uses must not result in the degradation of the values and functions of adjoining and nearby wetlands.

Policy 6-B-8: Seawalls - The town shall encourage planting of mangroves or placement of rep-rap in artificial and natural canal systems to replace existing seawalls in need of repair. Build back of vertical seawalls will not be permitted along natural waterbodies if one or more of the following conditions exist (ii): Build back would threaten wetlands.

Objective 6-D: Wetlands – Preserve all remaining wetlands; protect them from further degradation; and improve their condition and natural functions.

Policies 6-D-1 through 6-D-4

Objective 6-G: Soil Erosion – Conserve and protect soils to reduce water and air pollution from wind and water erosion

Policy 6-G-1-iii: An erosion control plan shall be submitted and approved by the town prior to the issuance of a development order. Such plan shall reference the property's topography, vegetation, and hydrology and utilize the best management practices such as the use of staked hay bales or filter cloth between the development site and adjacent swales, surface waters, or wetlands…

Objective 6-J: Groundwater – Maintain the quality of groundwater resources and improve as necessary to meet state or federal standards.

Policy 6-J-2: The Town of Fort Myers Beach opposes offshore gas and oil exploration and excavation activities which may be reasonably expected to threaten the quality of coastal beaches and estuarine ecosystems; or would place oil- or gas-related facilities on coastal beaches, islands, or wetlands; or would require the placement of oil or gas storage facilities on the island.

City of Punta Gorda

The City of Punta Gorda addresses wetlands 25 times in three major locations in its comprehensive plan and ordinances. These include:

Policy 291.1.9.5: Punta Gorda will apply appropriate site planning requirements such as environmental surveys, on-site stormwater management, wetlands preservation, etc., according to the needs of the situation in the context of applicable law and sound planning practice. *Measurement: Development Review Committee applications processed each year and discussion of the required submittals.*

Objective 1.1.14: Punta Gorda will maintain a Future Land Use Map and land use classification system that provides for the distribution, extent and location of a variety of land uses. **Policy 391.1.14.1**: Residential lands are areas that are intended to be used predominantly for housing. Other uses that are consistent with residential character may be permitted subject to the requirements of the land development regulations. Examples of potentially compatible uses include, but are not limited to, houses of worship, nursing homes, parks, golf courses, libraries, schools, and day care centers. Allowances for increased density may be made under the PUD process where there is a commitment to provide affordable housing, to preserve wetlands or other resources, to provide land for needed public facilities, or to reduce the allowable density in a coastal high hazard area that results in a net reduction in the number of units allowed in such areas within the City, or when density can be reallocated from the downtown district to other areas within the CHHA that satisfy F.S. Chapter 163.3178 (9). The following residential land classifications exist to provide a range of housing densities and housing types. *Measurement: Existence of implementing zoning classifications and number of units in new construction plans approved each year pursuant to regulations governing these zoning classifications.*

Objective 2.1.2 48: Punta Gorda will cooperate in the strategic protection of natural resources in and around the City, including coastal and estuarine resources, with such protection strategy including the relationships of resources to larger environmental systems including fisheries, wildlife habitat, native vegetative communities and soils; and including environmentally sensitive land use and development practices. **Policy 2.1.2.1132**: Punta Gorda will protect existing publicly owned environmentally sensitive land in the City through the "Preservation" FLUM classification described in Policy 461.14.8 in the Future Land Use Element. (includes one unit per ten acres density limit).

Policy 2.1.2.2: Punta Gorda will pursue the acquisition of coastal wetlands and/or other environmentally sensitive lands within its jurisdiction through federal, state, local and nonprofit environmental land acquisition and Florida's Conservation and Recreational Lands(CARL) program or other appropriate funding sources. *Measurement: Acreage of environmentally sensitive lands acquired.*
Policy 2.1.2.8137:Punta Gorda will protect wetlands and their natural functions by educating citizens concerning stormwater quality, and by carrying out stormwater quality actions described in Policies 163,165, 166, 167, 168, 169, 170, and 172. 3.7.1.1 through 3.7.3.3.

Policy 2.1.2.11140: Punta Gorda will protect wetlands, habitat, native vegetative communities, and endangered and threatened species by maintaining or increasing the acreage in its

"Conservation" or "Preservation" FLUM categories as described in Policies 1.1.14.8 and1.1.14.9 46 and 47 of the Future Land Use Element. *Measurement: Acreage maintained or increased in* "Conservation" or "Preservation."

City of Sanibel

The City of Sanibel addresses wetlands in 19 locations in its ordinances. These include:

- **Part I Charter, Article II. City Council, Division 1. Generally, Sec. 82-32.** Actions Requiring Supermajority Vote of Council.
- **Part I Charter, Article III. Legislative, Section 3.10.3**. Ordinances Removing Lands from Certain Ecological Zones or Districts.
- **Part II Sanibel Code, Chapter 30 Environment, Article VI. Use Of Fertilizers**
- **Part II Sanibel Code, Chapter 38 Natural Resources, Article II. Mangrove Trimming And Preservation**
- **Part II Sanibel Code, Chapter 86 Development Standards, Article II. Site Preparation, Sec. 86-41.** Restoration Of Environmentally Sensitive Area or Wetland Damaged During Construction.
- **Part II Sanibel Code, Chapter 90 Fees, Article IV. Public Hearings, Division 2. Sanibel Plan Amendment, Sec. 90-347. Amendments to Official Maps; Sanibel Plan Article 4.**
- **Part II Sanibel Code, Chapter 114 Subdivisions*, Article II. Administration*, Division 5. Plats, Sec. 114-106.** Preliminary Plat.
- **Part II Sanibel Code, Chapter 118 Utilities, Article III. Wastewater Disposal, Division 1. Generally, Sec. 118-58.** Objectives.
- **Part II Sanibel Code, Chapter 126 Zoning*, Article II. Conditional Use Permits, Sec. 126-33.** Institutional Uses.
- **Part II Sanibel Code, Chapter 126 Zoning, Article IV. Development Permits, Division 2. Procedure, Subdivision III.** Long Form, Sec. 82-424. Action On Application
- **Part II Sanibel Code Chapter 126 Zoning, Article VI. Districts Generally**
- **Part II Sanibel Code, Chapter 126 Zoning, Article VII. Residential Districts Division 6.** D-1 Lowland Wetlands Zone, Sec. 126-242. Maps; Status.
- **Part II Sanibel Code, Chapter 126 Zoning, Article VII. Residential Districts, Division 6. D-1 Lowland Wetlands Zone**
- **Part II Sanibel Code, Chapter 126 Zoning, Article VII. Residential Districts, Division 7. D-2 Upland Wetlands Zone**

- **Part II Sanibel Code, Chapter 126 Zoning, Article IX. Interior Wetlands Conservation District** That creates an interior wetlands conservation district within the freshwater management area, in the center of the island.
- **Part II Sanibel Code, Chapter 126 Zoning*, Article X. Environmentally Sensitive Lands Conservation District,** Sec. 126-583. Findings.
- **Part II Sanibel Code, Chapter 126 Zoning, Article XIII. Environmental Performance Standards**
- **Part II Sanibel Code Chapter 126 Zoning, Article XVI. Planned Unit Development, Division 2. Wulfert Point Property**

City of Venice

The City of North Port addresses wetlands 40 times in 8 major locations in its Comprehensive Plan and ordinances. These include:

Policy 4.5 Airport Area Land Use Compatibility. As part of the site and development review process, the City shall consider the compatibility of the airport and surrounding land uses. Issues to be considered when evaluating compatibility include health and safety, noise, natural habitat, wetlands, character of the City and neighborhoods, natural environment, property values, views, traffic and odor.

Policy 1.10 Wetland and Aquifer Recharge Areas Protection. The City shall protect its groundwater sources, particularly in wetland and aquifer recharge areas, through its site and development review process by:

A. Directing development to first avoid impact to wetlands and aquifer recharge areas.
B. When impacts to wetlands and aquifer recharge areas are unavoidable, directing development to minimize impact and then mitigate for impacts to wetlands and aquifer recharge areas.
C. Limiting activities that are known to adversely impact such areas.
D. Requiring that site plans include an identification and analysis of natural drainage features, man-made drainage structures, and impact of the proposed development on drainage and topographic features.
E. Coordinating with federal and state review agencies on the designation of and permitting within such areas.
F. Wetlands shall be restored in connection with new development, where feasible.
G. The natural flow of water within and through contiguous wetlands shall not be impeded.
H. Buffers of existing upland vegetation that protect the function and values of the wetlands from the adverse impacts of adjacent development will be required.
I. The amount of wetland mitigation required will be based upon the most current state-approved methodology.

Policy 3.13 Wetland Protection.

A. Directing development to first avoid impacts to wetlands. The City shall protect its wetlands by:

B. When impacts to wetlands are unavoidable, directing development to minimize impacts and then mitigate for impacts to wetlands.
C. Limiting activities that are known to adversely impact wetlands.
D. Requiring that site plans include an identification and analysis of natural drainage features, man-made drainage structures, and impact of the proposed development on drainage and topographic features.
E. Coordinating with the applicable federal and state review agencies on the designation of and permitting within such areas.
F. Wetlands shall be restored in connection with new development, where feasible.
G. The natural flow of water within and through contiguous wetlands shall not be impeded.
H. Buffers that protect the function and values of the wetlands from the adverse impacts of adjacent development will be required.
I. The amount of wetland mitigation required will be based upon the most current state-approved methodology.

Policy 3.14 Wetland Encroachments.

A. Residential lots of record existing on or before the adoption of the Comprehensive Plan which do not contain sufficient uplands to permit development of a residence without encroaching into wetlands, may be developed with one residential dwelling. The City shall require development to identify and delineate wetland boundaries with final wetland delineations to be reviewed and approved by the applicable federal and state review agencies. Wetlands of 20 acres or more shall require structures to be located outside of wetlands and wetland buffers except as provided below. Such exceptions are applicable only when the land use designation on the property permits the development of land use activity listed below; site characteristics are such that wetland impacts cannot be avoided, the impacts are limited to the minimum necessary to allow the permitted use of the property; and the site development or use complies with federal and…
B. Resource-based recreational facilities such as trails, boardwalks, piers, and boat ramps.
C. Private water-related facilities, such as boathouses, docks and bulkheads.
D. Essential public services, access roads and appurtenant structures.

Policy 3.15 Wetland Considerations Relative to Setback Modifications. Wetland and water body protection shall be considered when the City evaluates applicable setback modifications that would move development away from wetlands and water bodies.

Policy 3.16 Wetland Habitat Site and Development Protection. Promote conservation and protection of natural wetland, stream, and river habitats in order to ensure the health and well-being of the City's natural communities. A. The amount of wetland mitigation required will be based upon the most current state-approved methodology.

Policy 3.17 Wetland Habitat Alterations. Wetlands and wetland habitats shall not be dredged, filled, or disturbed in any manner that diminishes their natural functions, unless appropriate mitigation practices are established in coordination with and approved by local, regional, state, and federal agencies.

A. The City, in cooperation with Sarasota County, will establish wetland mitigation policies and regulations.

Coastal wetland permit, conservation easement, and conservation areas data sets

Representatives of agencies involved with regulatory review of coastal wetland impacts and mitigation and pertinent documents were identified and consulted for this study. We then identified and evaluated available digital and hard copy coastal wetland permit data sets held by USACOE, FDEP, SFWMD, and SWFWMD.

Florida Department of Environmental Protection
Mapping /Inventory
Florida has not produced a statewide map of the wetlands as they would be delineated using the state methodology in s. 373.421 and 373.4211, F.S. Instead, as discussed above, wetlands are delineated on an "as requested" basis. Although maps of wetlands in Florida have been prepared by the National Wetlands Inventory (NWI), such maps are typically not at a level of detail that is sufficient for state and federal permitting purposes. Although the NWI maps are subject to groundtruthing, they are not binding on either the state or the USACOE. Nonetheless, they may provide a general picture of the potential presence of wetlands on a parcel of property. In any event, because maps have not been produced using the state methodology, there is no current statewide status and trends report of wetland gains or losses; only historic data is available.

Using a specialized GIS application called ERAtools (Environmental Resource Analysis tools), staff has had access to NWI maps and numerous other data sources for this study, including jurisdictional boundaries, land use, fish and wildlife resources, inter-agency permitted activities, water resources, and statewide aerial photographs.

Mitigation Databases
Mitigation bank credit releases and uses are tracked by means of a required ledger, as identified in the mitigation banking section above. Credits used are attributed to specific permits or agency actions. However, at this time, FDEP does not maintain a central database of mitigation projects permitted, or the success thereof.

Each water management district has its own tracking system. For example, SWFWMD maintains a central database tracking the acres of wetlands affected by the issuance of Environmental Resource Permits. In addition to the acreage of wetlands impacted, the database tracks wetland acreage created, wetland acreage improved, wetland acreage preserved, and "other mitigation" acreage.

Overall Wetland Gain and Loss Tracking System
The FDEP and the WMDs track the acreage of wetlands permitted to be dredged, filled, and mitigated through their permit application tracking systems. Annual wetland status reports were prepared and submitted to Florida's Legislature for the period 1986-1993, during which time a statewide reporting requirement was part of state law. During the period 1984 – 1995, the FDEP authorized the following acreage of wetland impacts:

Category of Impact	Acreage
Permanently destroyed	7,476
Temporarily destroyed	10,071
Preserved	22,195
Created	39,131
Improved	73,204,895 (due to accounting errors this figure actually may only be as low as 28,584)

Table 6: Statewide FDEP authorized wetland impacts 1984-1995 (before ERP)

There is no FDEP staffing specifically funded to track wetland gains and losses. As stated above, such tracking is done by the same staff that review wetland resource and environmental resource permit applications.

Restoration Resources

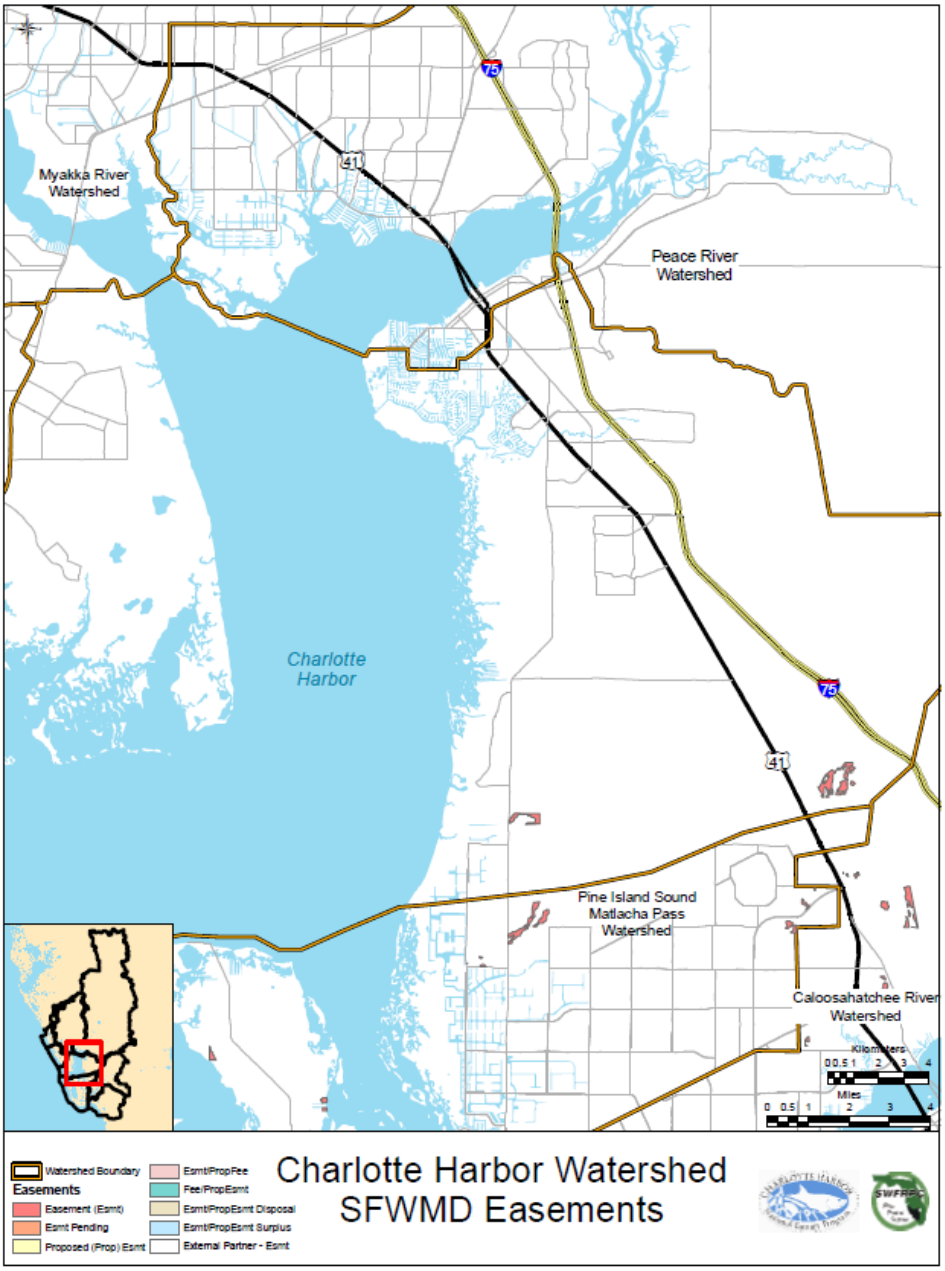
The FDEP's Florida Wetland Restoration Information Center provides information for a statewide ecological restoration program for wetlands and their associated uplands using ecosystem management and ecological principles. The Center has been developed to aid local governments and community organizations with their restoration efforts by providing online tools and research materials needed for the implementation and management of restoration projects.

A Restoration Guidance Handbook has been developed to provide guidance to local governments and community organizations on the process of wetland restoration, including how to assess the wetland site, determine appropriate restoration measures, as well as state of the science techniques.

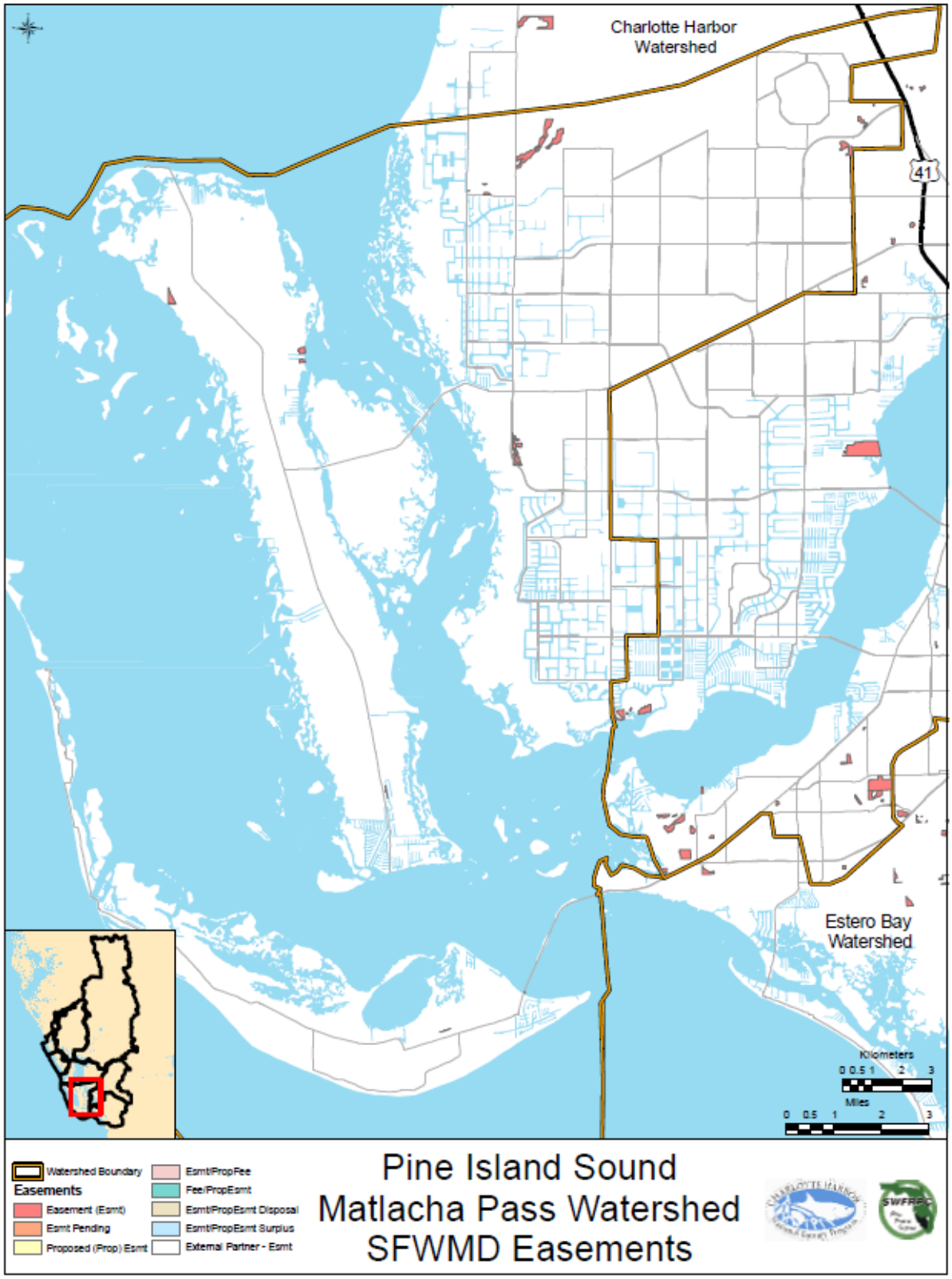
The Florida Ecological Restoration Inventory is a GIS compilation of the locations of current and proposed restoration activities on conservation lands. The inventory is available on the internet at http://tlhdwf7.dep.state.fl.us/feri/.

South Florida Water Management District

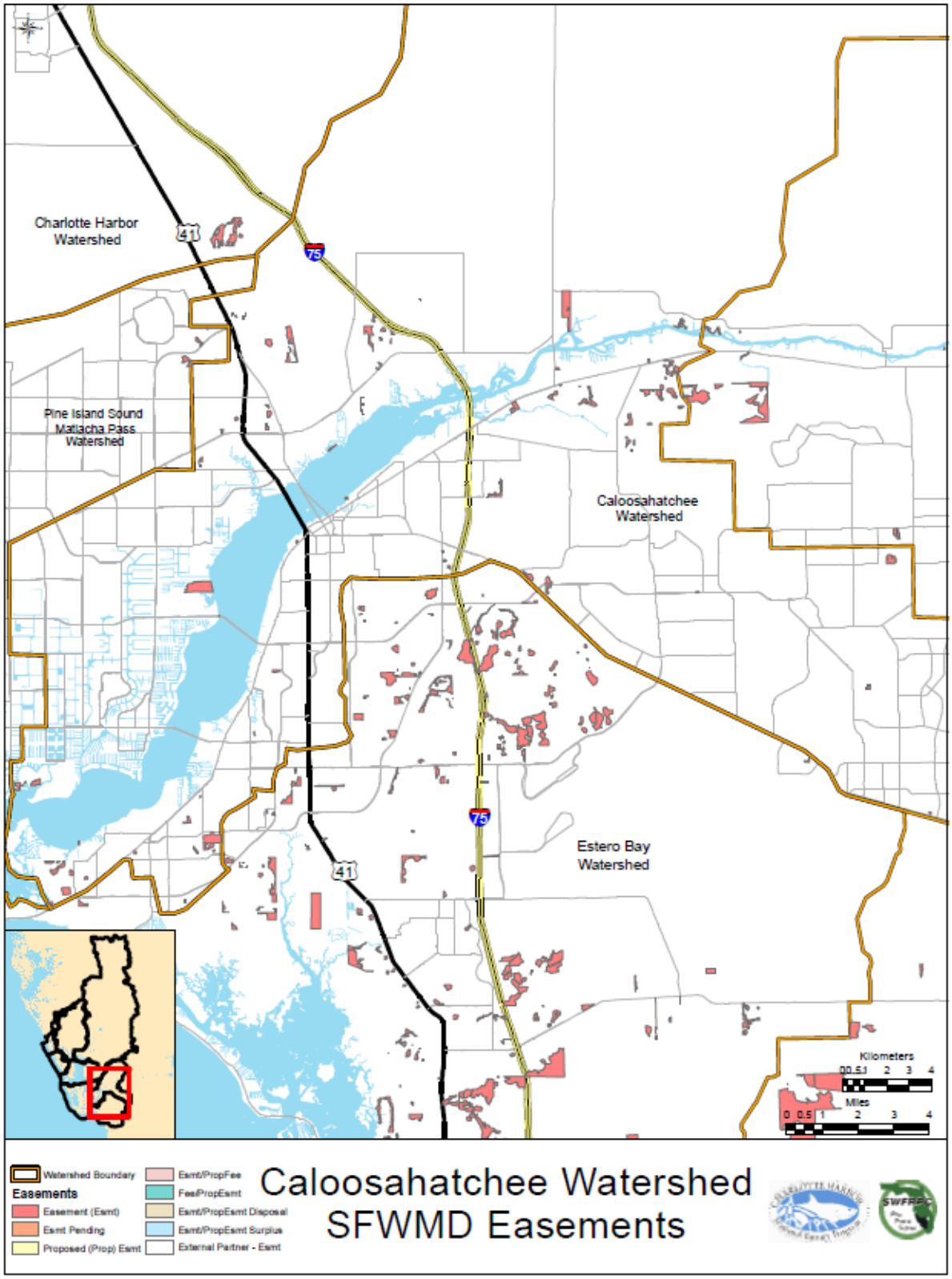
The SFWMD maintains a regularly updated database on conservation easements they hold as wetland mitigation and for other purposes such as restoration projects. As of 2010, the distribution of the conservation easements in the coastal watershed of the CHNEP was 1,815 hectares (4,486 acres) in the Estero Bay Watershed, 480 hectares (1,185 acres) in the Caloosahatchee River Watershed, 85 hectares (209 acres) in the Pine Island Sound/ Matlacha Pass Watershed, and 85 hectares (210 acres) in the Charlotte Harbor Watershed. The geographic distribution of these easements is displayed in maps 56 through 59.



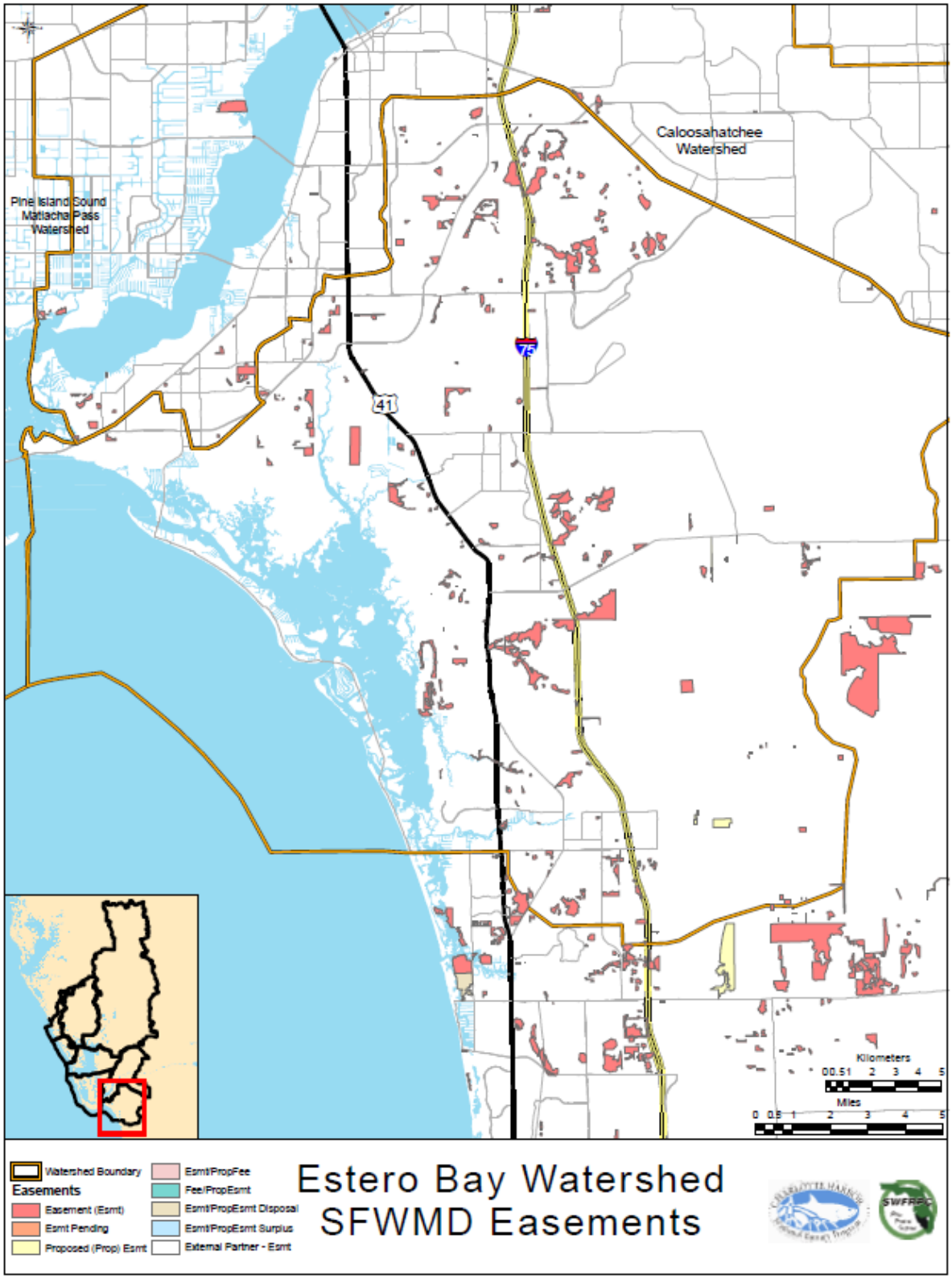
Map 56: SFWMD Conservation Easements in the Charlotte Harbor Watershed



Map 57: SFWMD Conservation Easements in the Pine Island Sound / Matlacha Pass Watershed



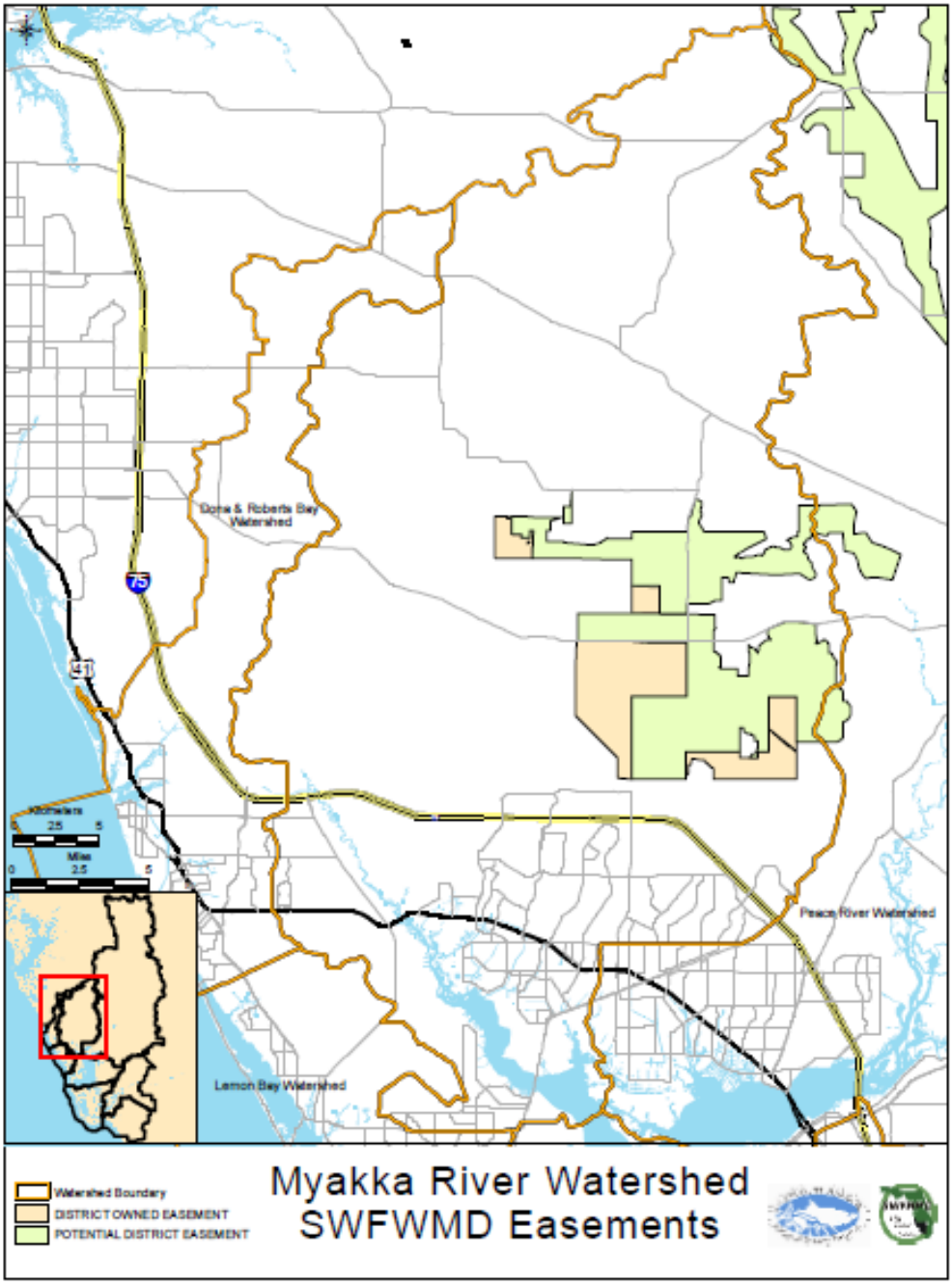
Map 58: SFWMD Conservation Easements in the Caloosahatchee River Watershed



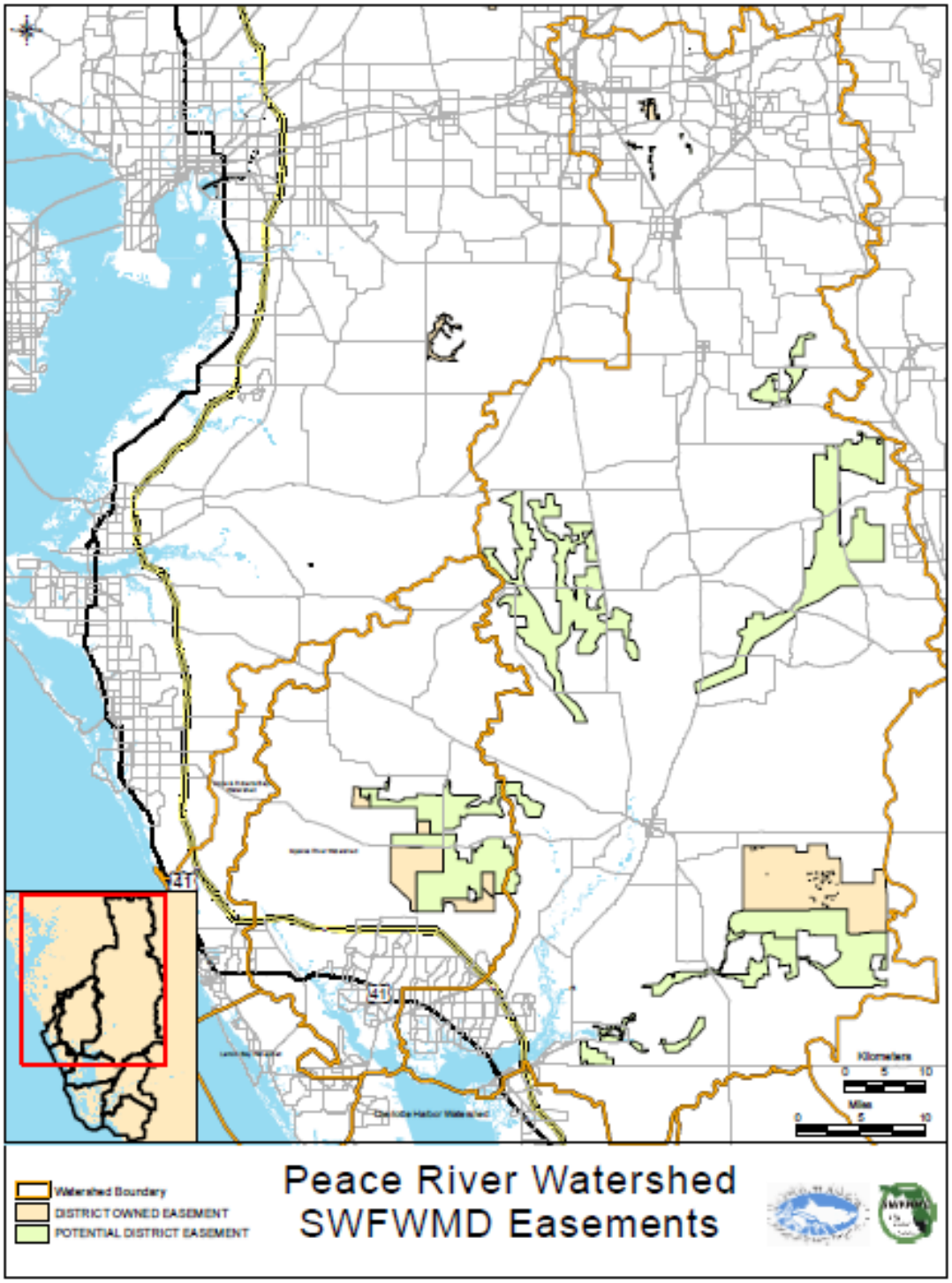
Map 59: SFWMD Conservation Easements in the Estero Bay Watershed

Southwest Florida Water Management District

Significant conservation easements have been purchased in the boundaries of the SWFWMD in the interior headwaters of river systems. Coastal conservation easements are less well represented. In the Myakka River Watershed there are 5,149 hectares (12,724) acres. In the Peace River Watershed there are 13,462 hectares (33,264 acres). There were no conservation easements in the Dona and Roberts Bays, Lemon Bay or Charlotte Harbor Proper Watersheds.



Map 60: SWFWMD Conservation Easements of the Myakka River Watershed



Map 61: SWFWMD Conservation Easements of the Myakka River Watershed

The conservation easements of the SWFWMD are large scale and directed toward water conservation goals and protection of riverine and headwater habitats.

Charlotte County

On November 7, 2006 Charlotte County citizens voted to tax themselves for the purchase of environmentally sensitive lands. They approved a referendum authorizing the county to issue up to $77 million in bonds to purchase environmentally sensitive lands. The bonds are paid for by a .20 mil ad valorem tax, equal to about 20 cents on every $1,000 of tax assessed land value. The tax will be levied annually for 20 years until 2027. All funds raised by these bonds will be used to buy and manage environmental lands and open space. These lands will be held in preservation for public use.

Under this program, anyone can nominate a site for acquisition. However, it is a willing seller program, which means it can only purchase property from people who want to sell their land. Eminent domain is not exercised to acquire land.

The program is committed to buying land distributed throughout Charlotte County. Many areas in the county have been identified by scientists as critical to the sustenance of the region's ecology. The Southwest Florida Coastal Conservation Corridor (SWFCCC) project, (partnership of environmental and governmental organizations) and the CHNEP Restoration Plan have identified potential conservation lands throughout the county. ELAAC (Environmental Lands Acquisition Advisory Council) has also identified possible conservation lands. Recommendations from these three groups are considered, with a focus on the most ecologically important areas in the county. All sites must meet a set of strict criteria adopted by the County Commission. Lands acquired include wetlands, rare or high-quality uplands, wildlife corridors (lands that link existing preserves), and other lands that provide habitat for rare or endangered species.

Sites are reviewed using science-based criteria by biologists from the Charlotte County Natural Resources Division. The biologists provide their evaluations to an Environmentally Sensitive Lands Oversight Committee. The oversight committee is mandated to review proposed properties and recommend specific properties to the County Commission for protection. The Board of County Commissioners has the ultimate authority to decide if a certain property is purchased. The Oversight Committee is comprised of seven members who are residents and electors of Charlotte County and have expertise in business, real estate, land development, environment, natural science, or are representatives of civic, charitable or homeowners groups or recreational users of lands or other community interests.
The following science-based criteria are used to evaluate nominated properties for protection:

- Rarity: Rarity of natural community types, such as pine flatwoods, hammocks or scrub; rarity of species, including rare and endangered species such as the Florida panther or Red-cockaded woodpecker; uniqueness of the sites special features
- Connectivity: Proximity to other protected lands to create green corridors
- Quality: Ecological quality; diversity of species; ecological integrity
- Water Resources: Important to maintaining water quality in either a natural water course, groundwater recharge area or estuarine environment
- Manageability: Potential for long-term viability and public enjoyment of lands

After a site is nominated, the Natural Resources staff conducts a site evaluation. Evaluation is based on the five selected criteria to determine eligibility. Natural Resources Division provides to Oversight Committee the following information: flood, soils, habitat, public lands, etc., maps and a one-page evaluation, including listed species, zoning, density, owner interest, etc. The Oversight Committee then discusses the site and recommends whether it meets the criteria and should be included in the program. A county agent/contractor determines if property owner is a "willing seller". Selections for proposed acquisition are then forwarded to the Board of County Commissioners (BCC). With the BCC approval, negotiations can commence. The BCC must approve each contract after negotiation.

Charlotte County has a successful history partnering with other programs to buy environmental lands. Creating a fund for conservation has enabled the County to receive matching grants from other governmental agencies. State and Federal government programs usually require a local match (often 50%) if a project is to be funded. Sharing costs with partners allows the Conservation Charlotte Program to purchase more lands than it could by acting alone.
The Charlotte County Natural Resources Division is responsible for the management of County lands. Fifteen percent of the monies collected for Conservation Charlotte are set aside for land management purposes. Land management includes conducting controlled burns, restoration, and exotic removal, installation of fencing, trail development, interpretive signage, and basic maintenance.

Preserves are generally larger environmental parcels with less urban interface and sensitive environmental habitats that are important to the community and are the guiding influence for management. Management of preserves will focus on environmental preservation and resources first and foremost with more intensive management and monitoring. Preserves have limited public use, less programming, and less structures/amenities.

Environmental parks are another type of land conservation strategy in Charlotte County. They are typically smaller in size than a preserve, have more urban interface, and may have some sensitive environmental habitats that are less important to the guiding influence of management. Management of these areas focuses not only on environmental preservation, but also the management the natural resources from a human dimension. There may less intensive management and monitoring in an environmental park; however there will be more public use, more programming, more interpretive features, amenities and multi-use trails.

Charlotte County has well over 1,600 hectares (4,000 acres) in preservation (Map 62).

Map 62: Charlotte County Conservation Lands

Lee County

A 1994 land use study found that only 10 % of Lee County was set aside for conservation. In comparison, nearly 28% of the State of Florida is owned and managed as conservation lands and other south Florida counties have from 40% to 85% set aside for conservation.

In 1995, a group of concerned citizens noted that the rate of development in Lee County had increased substantially and time was running short to preserve the undeveloped natural areas. These citizens took it upon themselves to take this cause to the local government and began lobbying for a county-based land acquisition program intended to protect these natural areas. The group of citizens lobbying for this cause called themselves “Conservation 20/20” to signify their vision of a future Lee County with large undeveloped areas of natural habitats.

In 1996, a majority of voters in Lee County voted to increase property taxes by up to 0.5 mils to fund the purchase and protection of environmentally critical lands. The Lee County Board of County Commissioners (BoCC) created a citizen advisory committee by Ordinance 96-12. Each Commissioner appointed three members with responsibility to oversee the selection and

purchase of properties and their management. The committee was named the Conservation Lands Acquisition and Stewardship Advisory Committee (CLASAC). The program became known as the Conservation 20/20 (C20/20) Program, named after the grass roots committee that fought for its creation.

CLASAC and the C20/20 Program have four main objectives:

- Protect and preserve natural wildlife habitat
- Protect and preserve water quality and supply
- Protect developed lands from flooding
- Provide resource-based recreation

CLASAC meets monthly to review nominations from willing sellers to ensure they meet the established criteria and to make recommendations to the BoCC for the purchase of these lands. These meetings are open to the public and everyone is welcomed and encouraged to attend.

The C20/20 Program is administered by two departments within Lee County: the Division of County Lands, and Lee County Parks and Recreation (LCPR). The Division of County Lands oversees the acquisition of new lands into the program following procedures outlined in Florida Statue 125.355 for negotiation of an offer. LCPR handles the management, stewardship activities, recreation opportunities and day-to-day running of the acquired properties.

There are several steps in the process of acquiring new land to the Conservation 20/20 Program. The following outline indicates the main phases of this process.

Willing sellers must submit a willing seller nomination form. There is no fee to apply and the landowner may withdraw the application at any time until (and if) the County and landowner enter into a contract for the County to acquire the property. During the review process, the landowner may concurrently pursue land development permits and continue to market the property to other potential buyers. These provisions ensure that the landowner remains a willing seller throughout the review process, and that private properties rights are not adversely affected.

On the nomination form, the owner <u>must</u> provide an asking price and all owners of record <u>must</u> sign the form or provide signatures on separate forms. Other information required includes:

- Copy of Appraisal Report
- Copy of Boundary Survey
- Wetlands/Uplands Determination or Wetland jurisdictional map
- Copy of Title Policy or other title research verifying willing seller(s)
- Listed Species Survey
- Copy of all land development permits

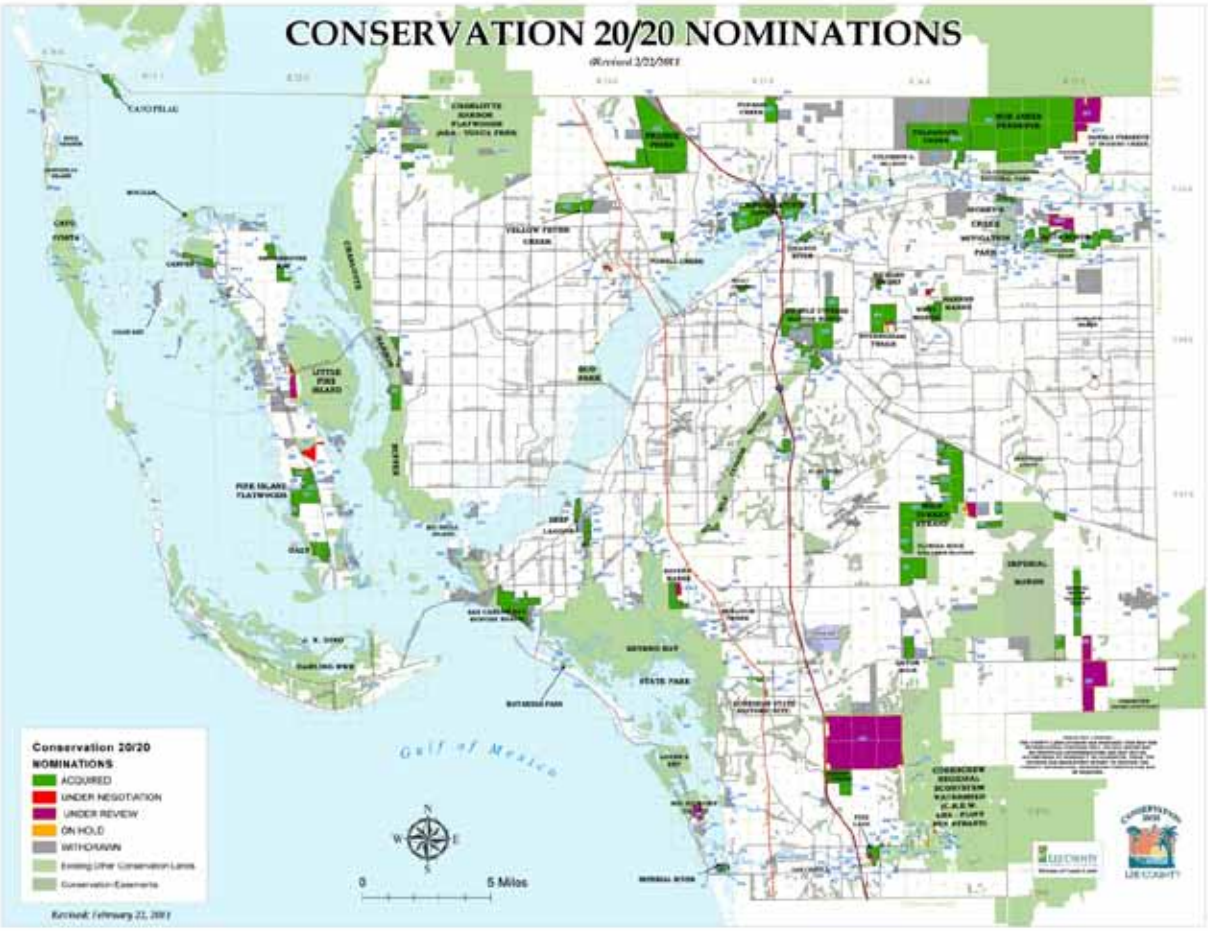
Each property that is submitted to the program will go through a rigorous review by the CLASAC before a decision is made whether or not to pursue it for acquisition. CLASAC conducts a minimum of four meetings in the review process: two full meetings and two sub-committee meetings.

An initial review is conducted to screen out properties that are determined to be inappropriate for the program. This enables the land owner to know in a relatively short period of time if the property is either not going to be considered further or if it will move on to a more detailed review. The initial review asks seven questions. In general, CLASAC will forward to secondary review properties that meet at least four the seven criteria. However, exceptions are sometimes made for properties that can make important connections to existing conservation lands.

Based on the findings of the secondary review, CLASAC will make a recommendation as to whether or not the property should be pursued for acquisition. The secondary review is weighted according to size and contiguity (maximum of 16 points); habitat for plants and animals (maximum of 14 points); significance for water resources (maximum of 14 points); and ease of management, recreation potential, and development status (maximum of 12 points). Although there is no minimum score to be eligible for acquisition, the higher the score, the more likely it is that the property will be selected.

Following the secondary review, the Board of County Commissioners is notified of nominations that CLASAC selects to be pursued for acquisition. If the Board does not raise any objections during a two week review period, the Division of County Lands will commence with the negotiation process. The negotiation period can vary greatly, but can be completed in four months if no issues arise.

Currently the C20/20 program has acquired 9,640 hectares (23,820 acres) of land in the form of 106 separate parcels that comprise 42 separate preserves ranging from mangrove forest to cypress strands to xeric oak scrub (Map 63).



Map 63: Lee County Conservation 20/20 Lands

Sarasota County

Environmentally Sensitive Lands Protection Program

The Environmentally Sensitive Lands Protection Program (ESLPP) of Sarasota County is a voter-approved and taxpayer-funded program designed to acquire and protect natural lands. . In March 1999, voters approved the ESLPP to protect native habitats by collecting a 0.25 mil ad valorem tax to be collected through 2019. In November 2005, voters approved a second referendum extending the program through 2029 and expanding the county's land protection efforts to include neighborhood parkland acquisitions Priority sites within the county are ranked on environmental criteria including connectivity, water quality, habitat rarity, land quality and manageability. Acquired lands are protected and managed. Some preserves have public access for nature-based recreation.

Sarasota County's environmentally sensitive lands provide safe habitat for many threatened and native species including gopher tortoises, Florida scrub-jays, bobcats, eagles and migrant birds. Acquisition and protection of these lands now ensures that their environmentally sensitive nature and habitats will be there for future generations.

The County partners with the Sarasota Conservation Foundation to assist with environmental land acquisitions. A nine-member oversight committee comprised of community representatives oversees the purchase of these lands and ensures the use of the land for the good of the public. The committee has identified 24 diverse and environmentally sensitive sites throughout the county for possible acquisition. Sarasota County also acquires land through other means, including grants, donations, partnerships and conservation easements.

To be considered under the Environmentally Sensitive or Neighborhood Parkland Programs, a property must have a willing seller. The criteria for considering parkland acquisitions include location, broad community access, proximity and connectedness, natural features, cultural features, compatible community needs and water access. The criteria considered for environmental acquisitions are rarity, quality, connectivity, manageability and water quality benefits.

The Environmentally Sensitive Lands Oversight Committee (ESLOC) and the Parks Advisory and Recreation Council (PARC) are the two advisory boards authorized by the Sarasota County Commission to review nominated properties and make recommendations for land protection.

Regional Environmental Mitigation Program

The Sarasota County Regional Environmental Mitigation Program (REMP) oversees the acquisition, design and construction of Regional Offsite Mitigation Areas (ROMAs) throughout the county. The intent of the REMP is to provide meaningful, ecologically sound mitigation for unavoidable environmental impacts associated with county infrastructure projects such as road and sidewalk construction. Since its inception in 2001, the REMP has acquired more than 162 hectares (400 acres) of habitat to be restored and enhanced to provide greater wetland function and improved wildlife habitat. The REMP team works with the SWFWMD and the USACOE to permit and design regional mitigation areas that will enhance critical habitat for wildlife and preserve unique environmental areas for future generations.

The Fox Creek ROMA consists of a 140-acre parcel located in west-central Sarasota County, between Fox Creek and Cow Pen Slough. The Fox Creek ROMA was purchased by Sarasota County Public Works in 2003 to provide regional mitigation for impacts associated with Sarasota County Capital Improvement Projects including roadway and stormwater projects. The multiphase Fox Creek project will include the creation, enhancement and/or restoration of native habitats found on this unique parcel. Additionally, the Fox Creek ROMA project includes potential habitat restoration initiatives to restore the

remnant scrub habitat found on the site that would benefit listed species such as the Florida scrub jay (*Aphelocoma coerulescens*) and gopher tortoise (*Gopherus polyphemus*).

A master land management plan has been developed for the Fox Creek ROMA to ensure ecologically sound management of the site in perpetuity. Upon completion of the restoration and enhancement efforts, it is the intent to open the Fox Creek ROMA to passive recreation including hiking, bird watching and public education and outreach events that showcase the unique habitats found on the Fox Creek site.

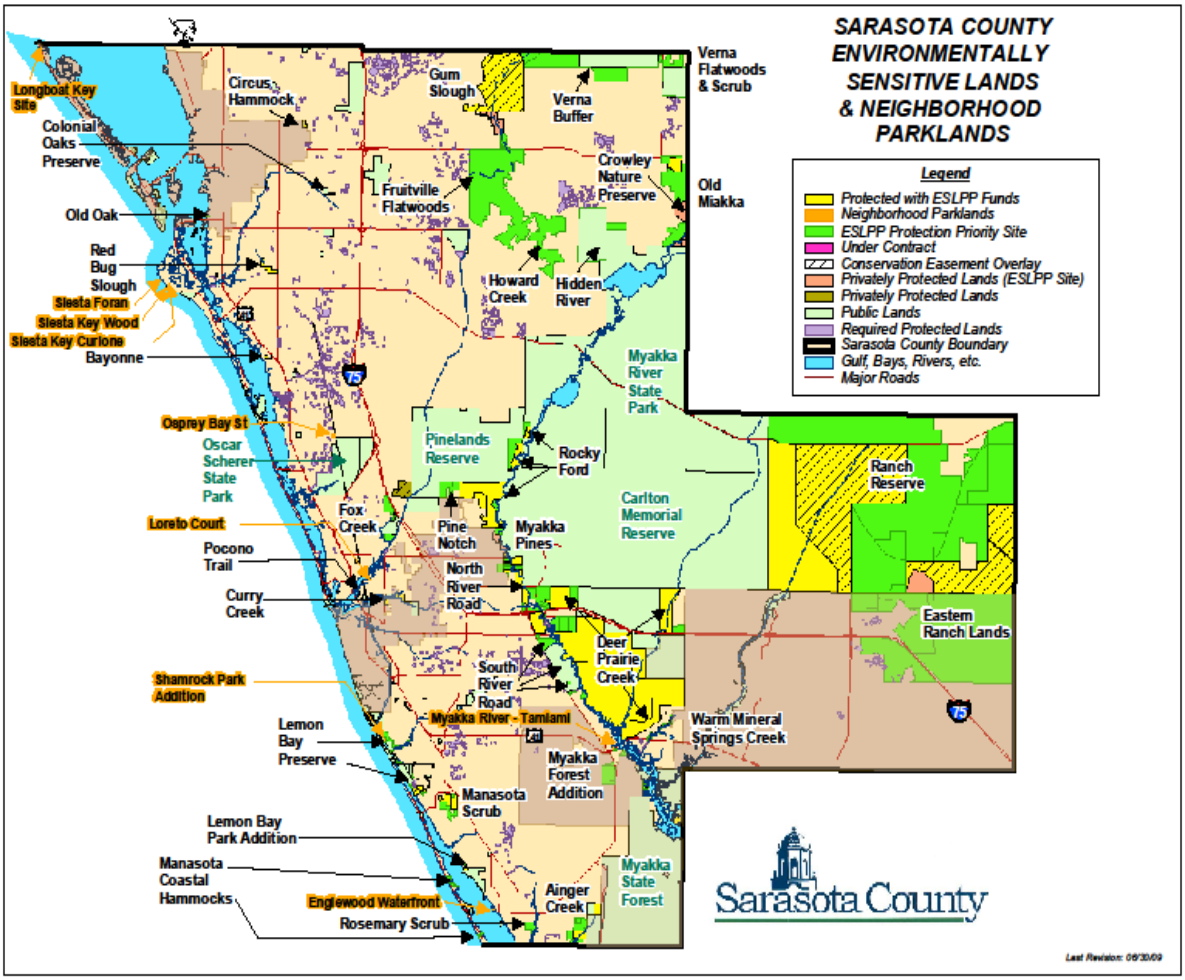
The Curry Creek ROMA includes 8 hectares (20 acres) of preserve located in Nokomis off Albee Farm Road and Colonia Lane. The Curry Creek ROMA features a unique tidal creek restoration area that provides enhanced habitat for wading birds and many important fish species. The site, previously dominated by exotic plant species, has been restored to a lush saltwater marsh and tidal area lined with mangroves, leather fern and native grass and rush species.

The Myakka ROMA, located adjacent to the Jelks Preserve along River Road, comprises 29 hectares (72 acres) of habitat that will be enhanced and preserved to mitigate for future County infrastructure projects. The Myakka ROMA will preserve important riverfront habitat along the Myakka River as well as other habitats critical to wildlife. The Myakka ROMA contains a mosaic of upland and wetland habitats, including mature hardwood hammock, pine flatwoods, wet prairie and forested wetland. Upon completion of wetland restoration activities and enhancement efforts, this parcel will be opened to the public for passive recreation, including hiking and bird watching.

In October 2007, REMP acquired a new ROMA as part of a land exchange. The new parcel is located adjacent to Gottfried Creek in Englewood, and contains habitats critical to listed wildlife species including the Florida scrub jay and the gopher tortoise. The parcel and its unique habitat types will be preserved in perpetuity.

The Regional Mitigation Program has partnered with other county departments and agencies in a cooperative effort to restore and enhance many areas in Sarasota County, including Lemon Bay Preserve and Deer Prairie Creek Restoration.

Sarasota County has almost (16,000 hectares) 40,000 acres in preservation.



Map 64: Sarasota County Environmentally Sensitive Lands

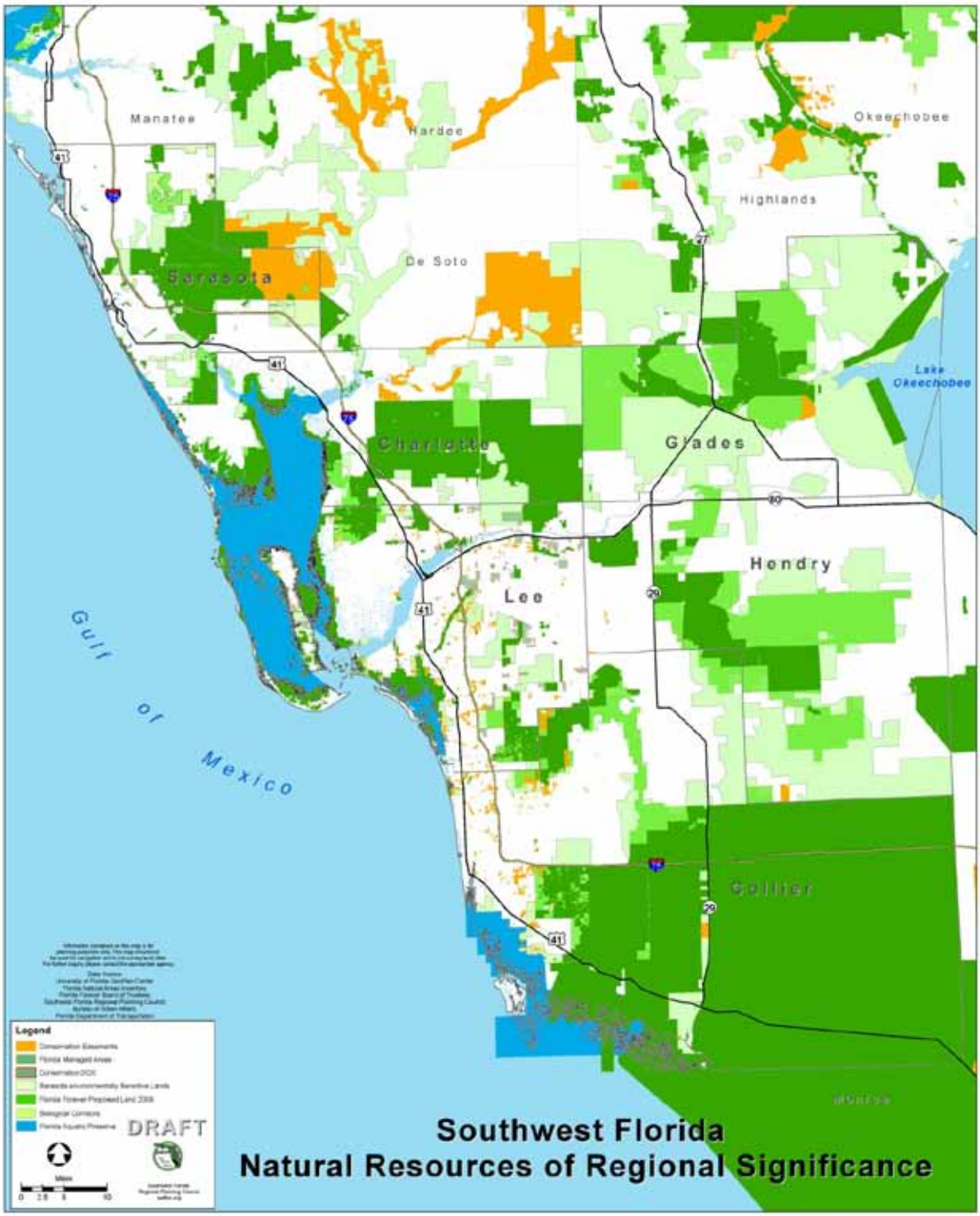
Regional GreenPrint

As part of the strategic regional plan (SRPP), the SWFRPC has developed a "GreenPrint" mapping that reflects the many land conservation efforts at the federal, state, regional, local, and private levels in southwest Florida and connected adjacent lands. This mapping also indicates areas identified by coordinated conservation planning efforts of the 54 partners in the Coastal Conservation Corridor Plan projects as areas of significant regional value, showing them as "core" and "corridor" conservation lands.

The concept for the Southwest Florida Coastal Conservation Corridor Project (SWFCCC) grew out of the Coastal Wetlands Planning Protection and Restoration Act (CWPPRA) passed in 1990, and the Regional Wildlife Habitat Planning efforts of the Florida Game and Freshwater Fish Commission (GFC), now known as the Florida Fish and Wildlife Conservation Commission (FWC) in the Tampa Bay and SWFRPC areas. The CWPPRA authorized the USFWS to provide matching National Coastal Wetlands Conservation grants to coastal states for the acquisition, management, restoration, and enhancement of wetlands.

The definition of a coastal wetland referenced in the administration of CWPPRA is broad and includes multiple, interrelated coastal wetlands, including those located in the drainage basins of estuaries, adjacent freshwater and intermediate wetlands, and additional natural community types integral to the proper functioning of entire ecosystems within a region. It is understood that these various types of ecosystems interact together as an ecological unit and are critical to coastal fish, wildlife, and their habitat.

The SWFCCC coordinates multi-agency efforts and data into a comprehensive coastal conservation and restoration corridor plan, which includes GIS-based maps and narratives, and an analysis with prioritizations of lands deemed critical for species and watershed conservation and restoration in coastal southwest Florida. The Florida Chapter of The Nature Conservancy, on behalf of the FDEP and GFC, undertook the SWFCCC project. Funding from the USFWS was applied for through the Friends of Rookery Bay, a non-profit citizen support organization.



Map 65: GreenPrint Map for the Study Area

An evaluation of the performance of three wetlands functional assessment methods, WRAP, UMAM, and HGM, in the coastal wetlands of the Charlotte Harbor National Estuary Program coastal watersheds

The evaluation period for the functional assessment comparisons of WRAP, UMAM and HGM was the five years from January 1, 2004 through December 31, 2008. During this period, important policy milestones occurred, including the U.S. Supreme Court case known as the SWANNC decision, the Southwest Florida Environmental Impact Statement Record of Decision, and the implementation of the Lee Master Mitigation Plan. It is estimated that there are approximately 15,000 permits, general permits, and exemptions that have been issued within the study area during the five year period of 2002-2007.

A review of electronic files from FDEP, SFWMD, SWFWMD and SWFRPC for the project study period of January 1, 2004 to December 31, 2008 reveals that 10,186 ERP permitting actions occurred within the CHNEP study area (Table 7). The watershed with the most permitting activity is the Peace River in the SWFWMD (25.1% of the total) and the Caloosahatchee River in the SFWMD (28.11%). Charlotte Harbor proper had the least (4.15%).

Watershed	FDEP	SWFWMD	SFWMD	Total for the Watershed	Percent of the Total for CHNEP
Dona & Roberts Bay	70	359	0	429	4.21%
Lemon Bay	279	229	0	508	4.99%
Myakka River	96	476	0	572	5.62%
Peace River	411	2,138	8	2,557	25.10%
Charlotte Harbor	159	247	17	423	4.15%
Pine Island Sound Matlacha Pass	816	0	210	1,026	10.07%
Caloosahatchee River	2,215	2	646	2,863	28.11%
Estero Bay	843	0	965	1,808	17.75%
CHNEP 2004 - 2008 Total	4,889	3,451	1,846	10,186	

Table 7: Total number of ERP permit actions during the study period

18.1% occurred in costal wetland habitats or at the coastline. The most active coastal watersheds were the Caloosahatchee River (26.77% of coastal actions) and the Pine Island Sound Matlacha Pass watershed. The least active watersheds were Myakka River (4.03%) and Dona and Roberts Bays (4.74%).

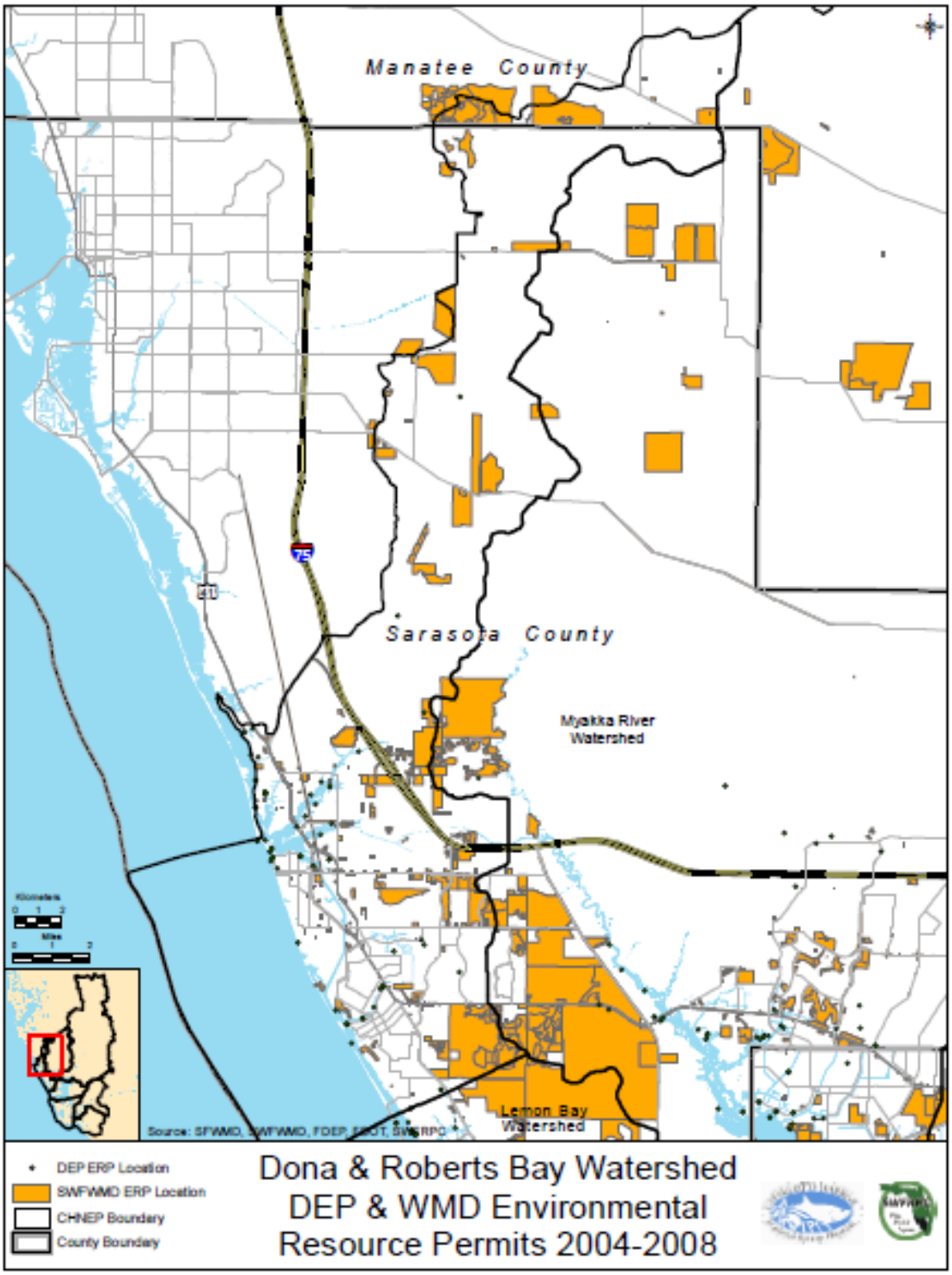
Watershed	FDEP	SWFWMD	SFWMD	Total for the Watershed	Percent of the Total for CHNEP
Dona & Roberts Bay	37	50	0	87	4.74%
Lemon Bay	143	65	0	208	11.34%
Myakka River	38	36	0	74	4.03%
Peace River	104	47	0	151	8.23%
Charlotte Harbor	72	46	3	121	6.60%
Pine Island Sound Matlacha Pass	354	0	57	411	22.41%
Caloosahatchee River	384	0	107	491	26.77%
Estero Bay	244	0	47	291	15.87%
CHNEP 2004 - 2008 Total	1,376	244	214	1,834	

Table 8: Total number of coastal ERP permit actions during the study period

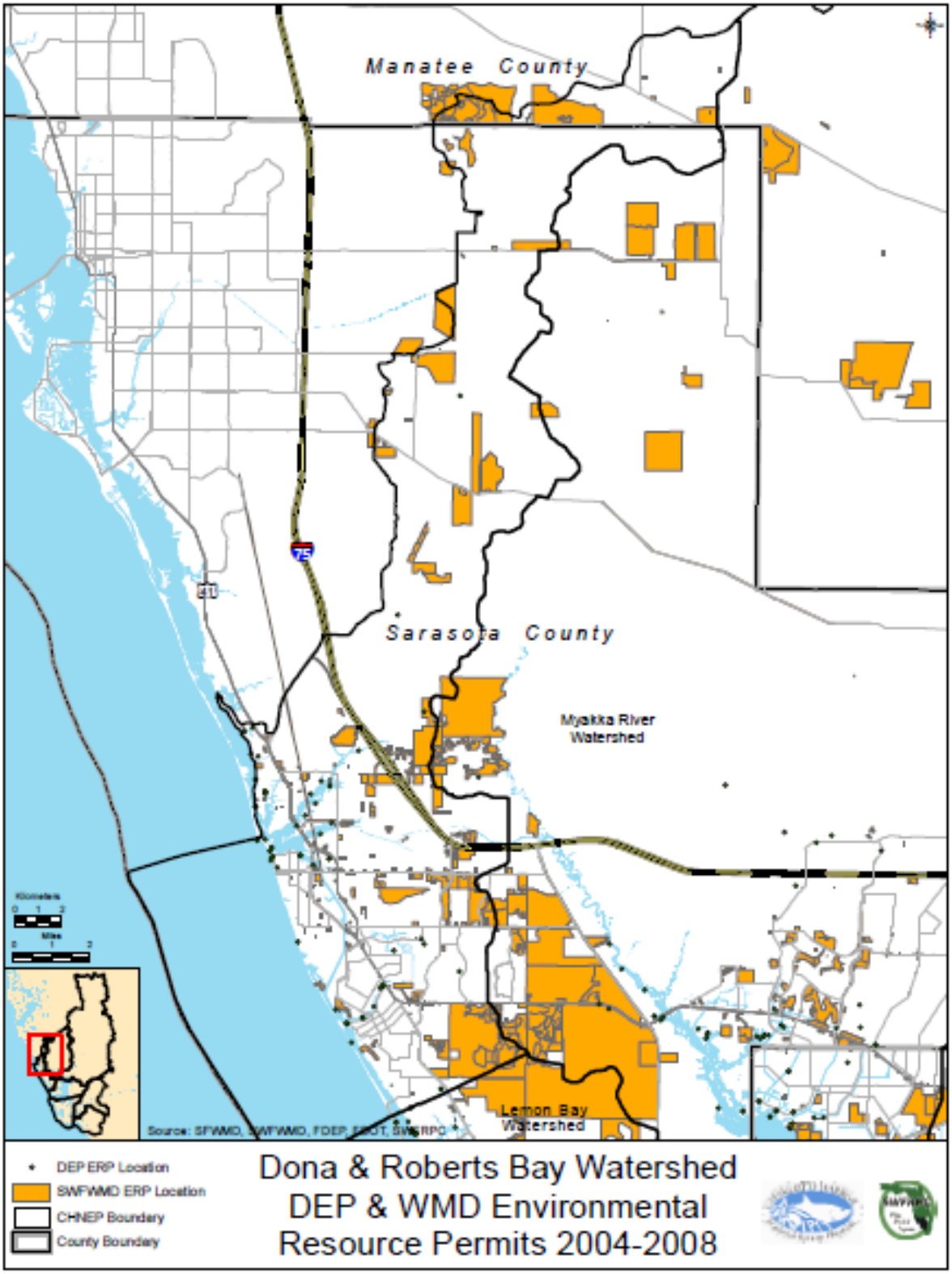
Dona & Roberts Bay ERP Permit Locations

Dona and Roberts Bays had 70 FDEP and 359 SWFWMD ERP permitting actions for a total of 429 ERPs during the study period. This is 4.21 % of all ERP permitting that occurred in the CHNEP during the study period, and represents 1% of the FDEP and 10% of the SWFWMD ERP permitting.

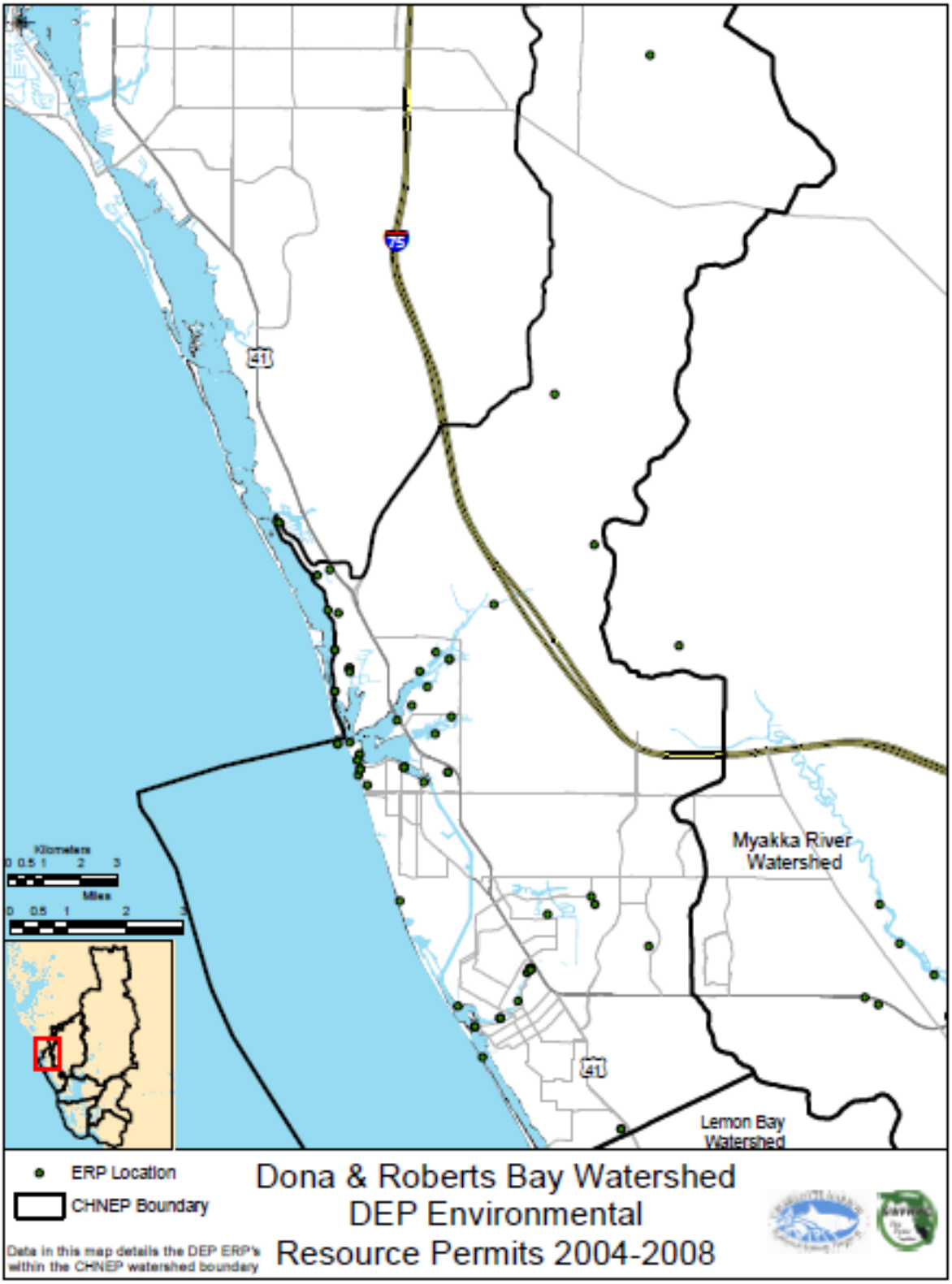
Thirty-seven of the FDEP ERPs and fifty of the SWFWMD ERPs were coastal projects. This is 5% of all the coastal projects that occurred in the Dona and Roberts Bay watersheds during the study period. Coastal ERPs constituted 52.86% of the FDEP, 13.93% of the SWFWMD ERP permitting and 20.28% of all the ERP projects that occurred in Dona and Roberts Bays during the study period.



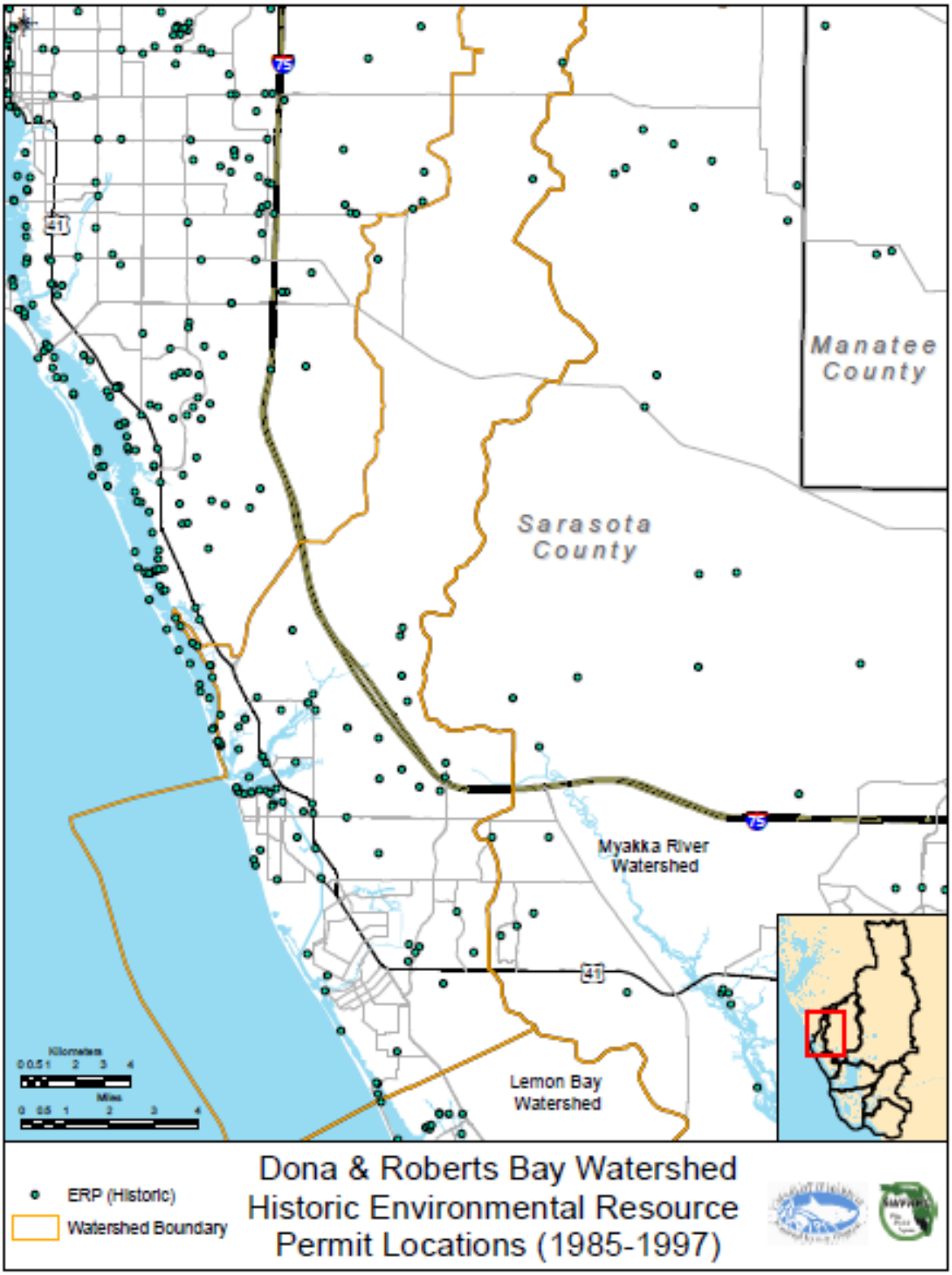
Map 66: Location of FDEP and SWFWMD ERPs issued in the Dona and Roberts Bays Watershed during the study period January 1, 2004 to December 31, 2008



Map 67: Location of SWFWMD ERPs issued in the Dona and Roberts Bays Watershed during the study period January 1, 2004 to December 31, 2008



Map 68: Locations of FDEP ERPs issued in the Dona and Roberts Bays Watershed during the study period January 1, 2004 to December 31, 2008

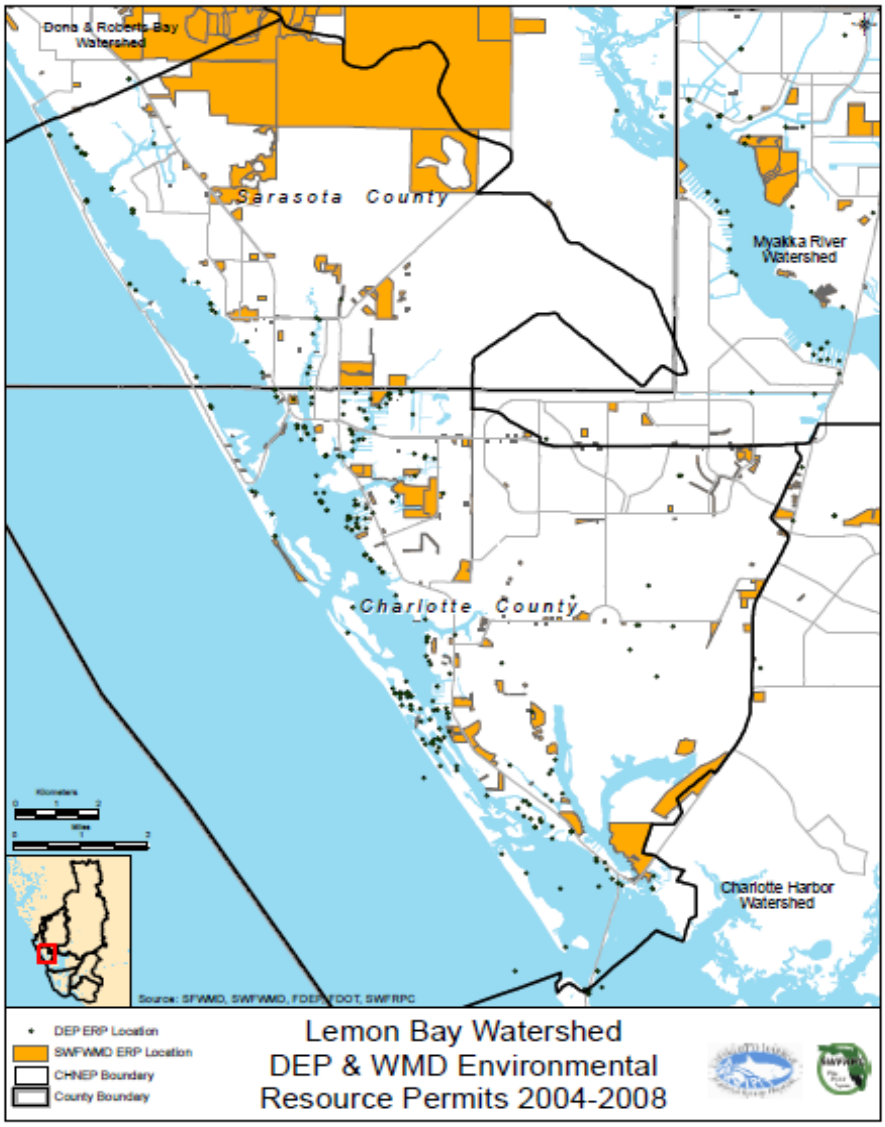


Map 69: Locations of FEDP ERPs issued in the Dona and Roberts Bays Watershed from January 1, 1985 to December 31, 2007

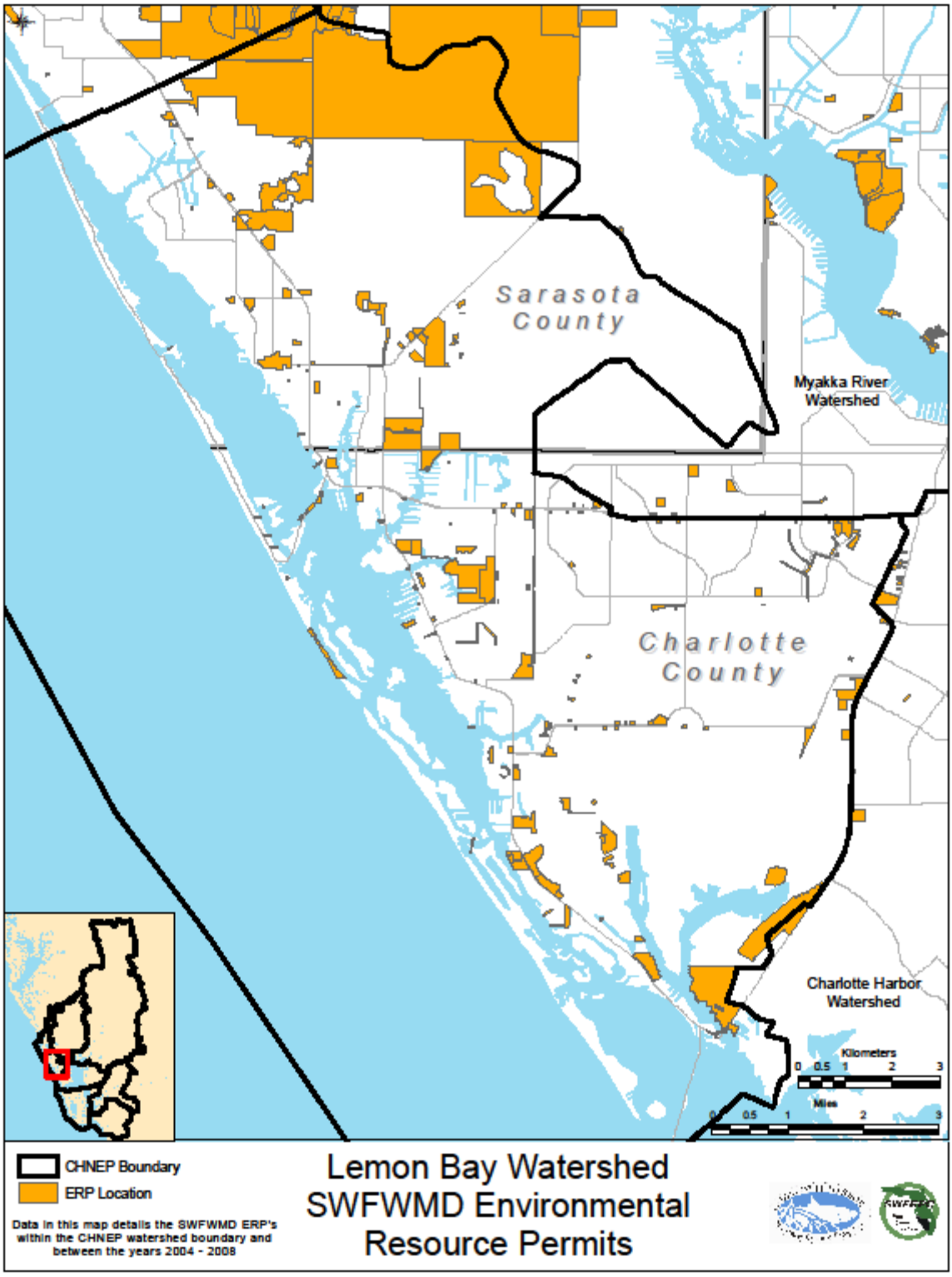
Lemon Bay ERP Permit Locations

Lemon Bay had 279 FDEP and 359 SWFWMD ERP permitting actions for a total of 508 ERPs in the study period. This is 4.99% of all the ERP permitting that occurred in the CHNEP during the study period, including 6% of the FDEP and 7% of the SWFWMD ERP permitting.

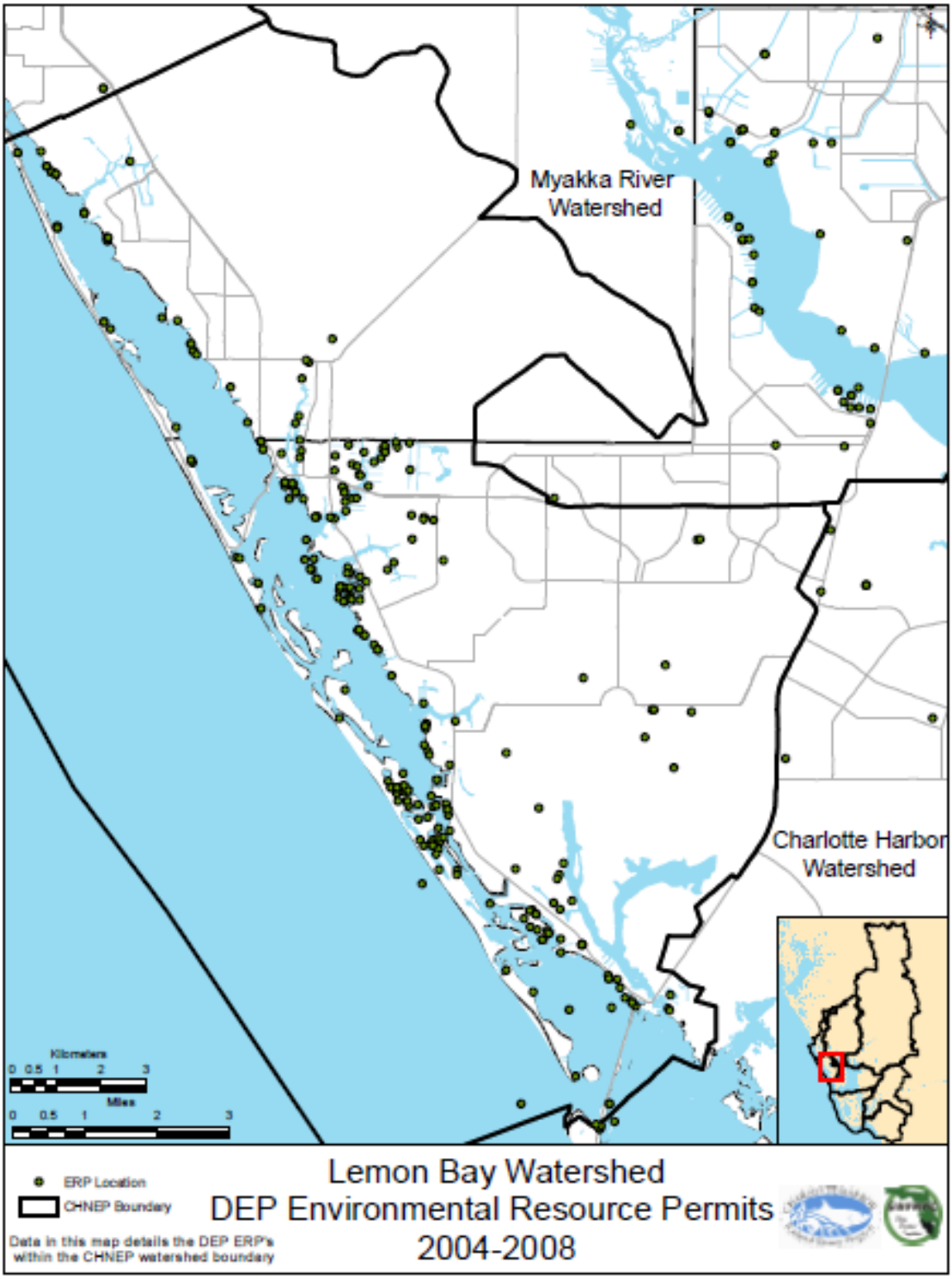
One hundred forty-three of the FDEP ERPs and sixty-five of the SWFWMD ERPs were coastal projects. This is 11.34% of all the coastal projects which occurred in the CHNEP during the study period. Coastal ERPs constituted 51.25% of the FDEP, 28.38% of the SWFWMD ERP permitting and 40.94% of all the ERP projects that occurred in Lemon Bay during the study period



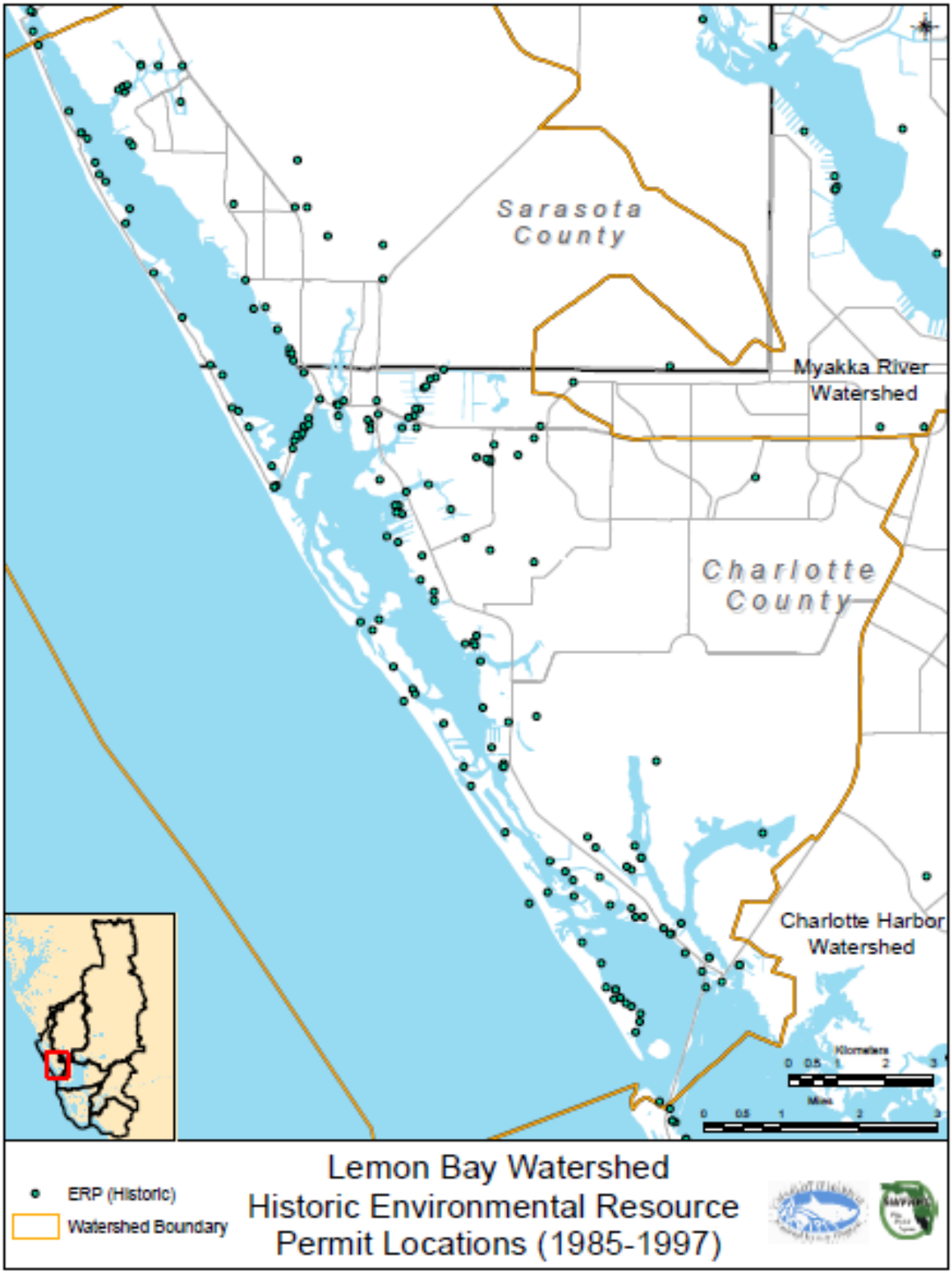
Map 70: Locations of FDEP and SWFWMD ERPs issued in the Lemon Bay Watershed during the study period January 1, 2004 to December 31, 2008



Map 71: Locations of SWFWMD ERPs issued in the Lemon Bay Watershed during the study period January 1, 2004 to December 31, 2008



Map 72: Locations of FDEP ERPs issued in the Lemon Bay Watershed during the study period January 1, 2004 to December 31, 2008

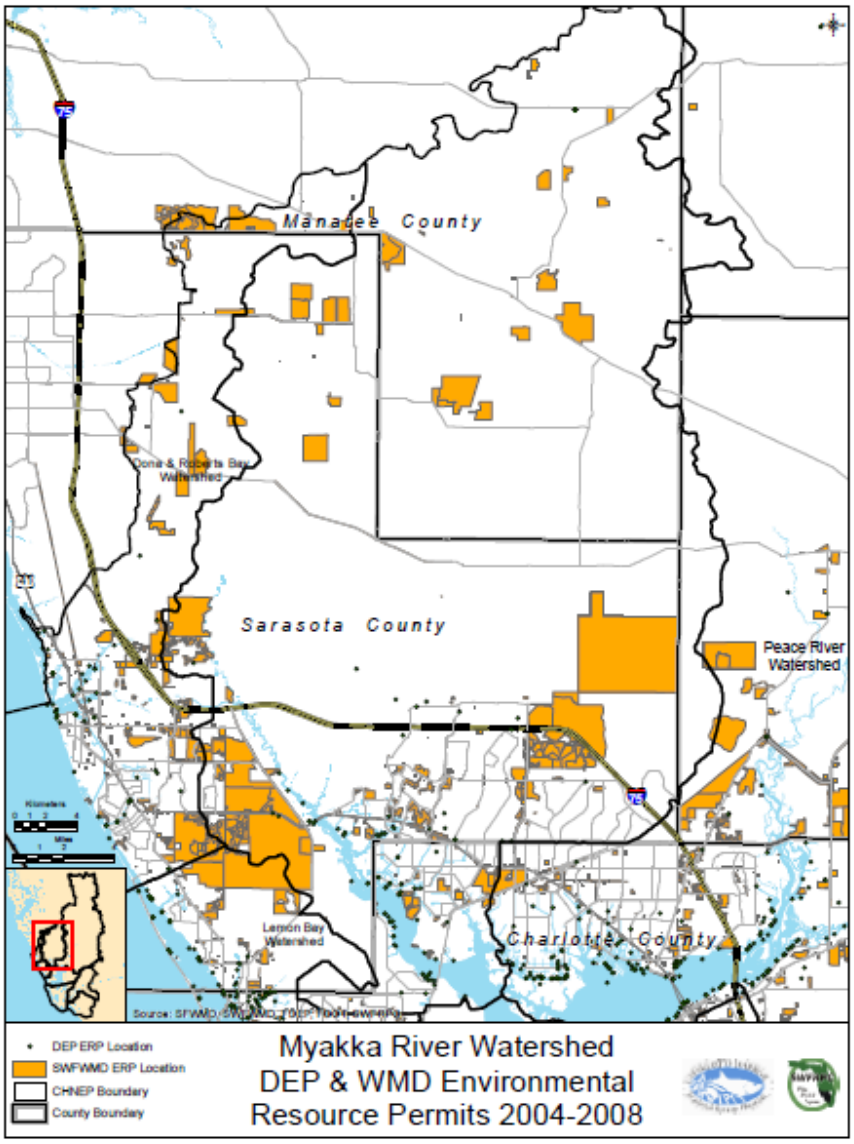


Map 73: Locations of FDEP ERPs issued in the Lemon Bay Watershed from January 1, 1985 to December 31, 2007

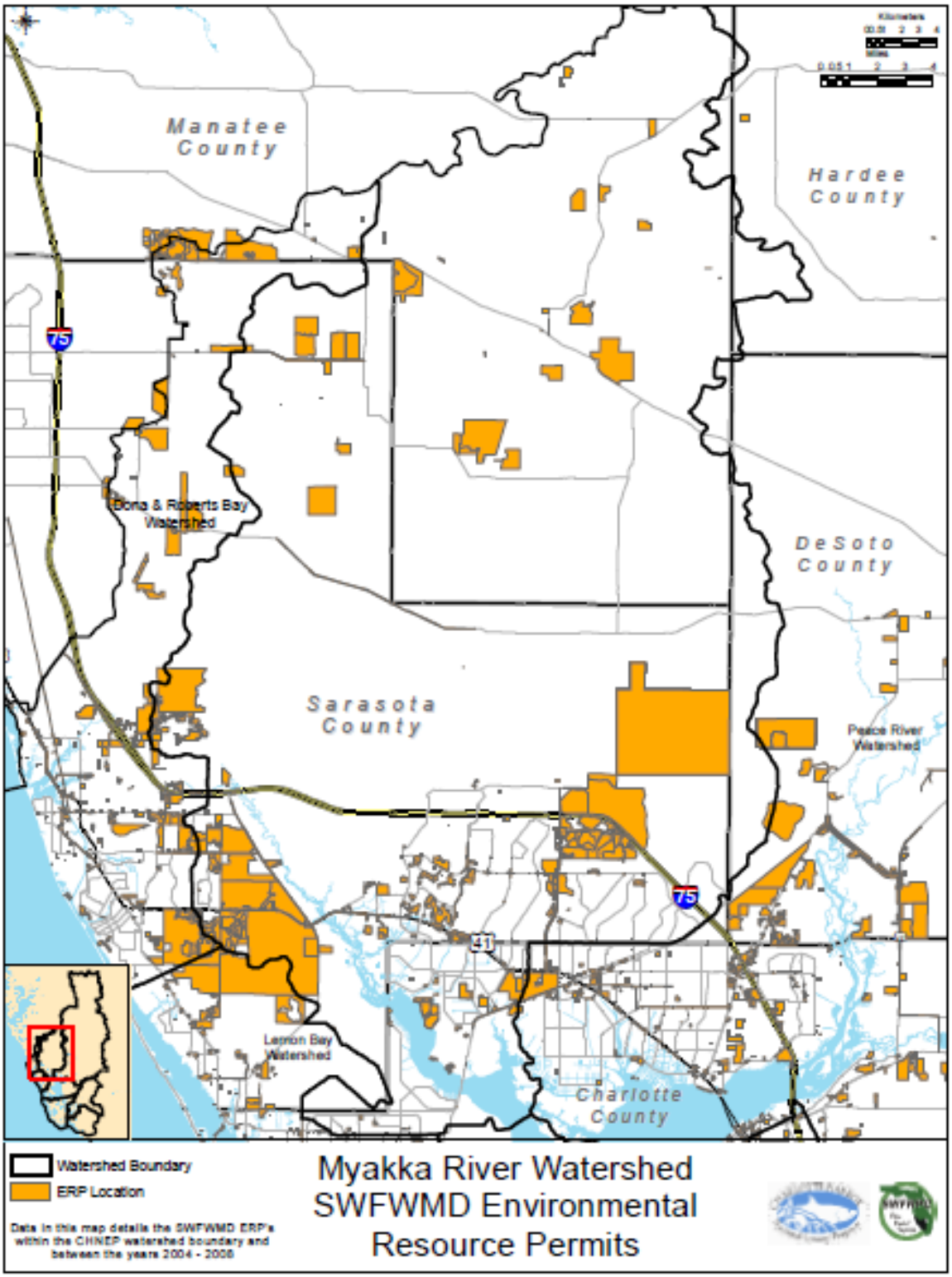
Myakka River ERP Permit Locations

The Myakka River watershed had 96 FDEP and 476 SWFWMD ERP permitting actions for a total of 572 ERPs in the study period. This is 5.62% of all the ERP permitting that occurred in the CHNEP during the study period, including 2% of the FDEP and 14% of the SWFWMD ERP permitting.

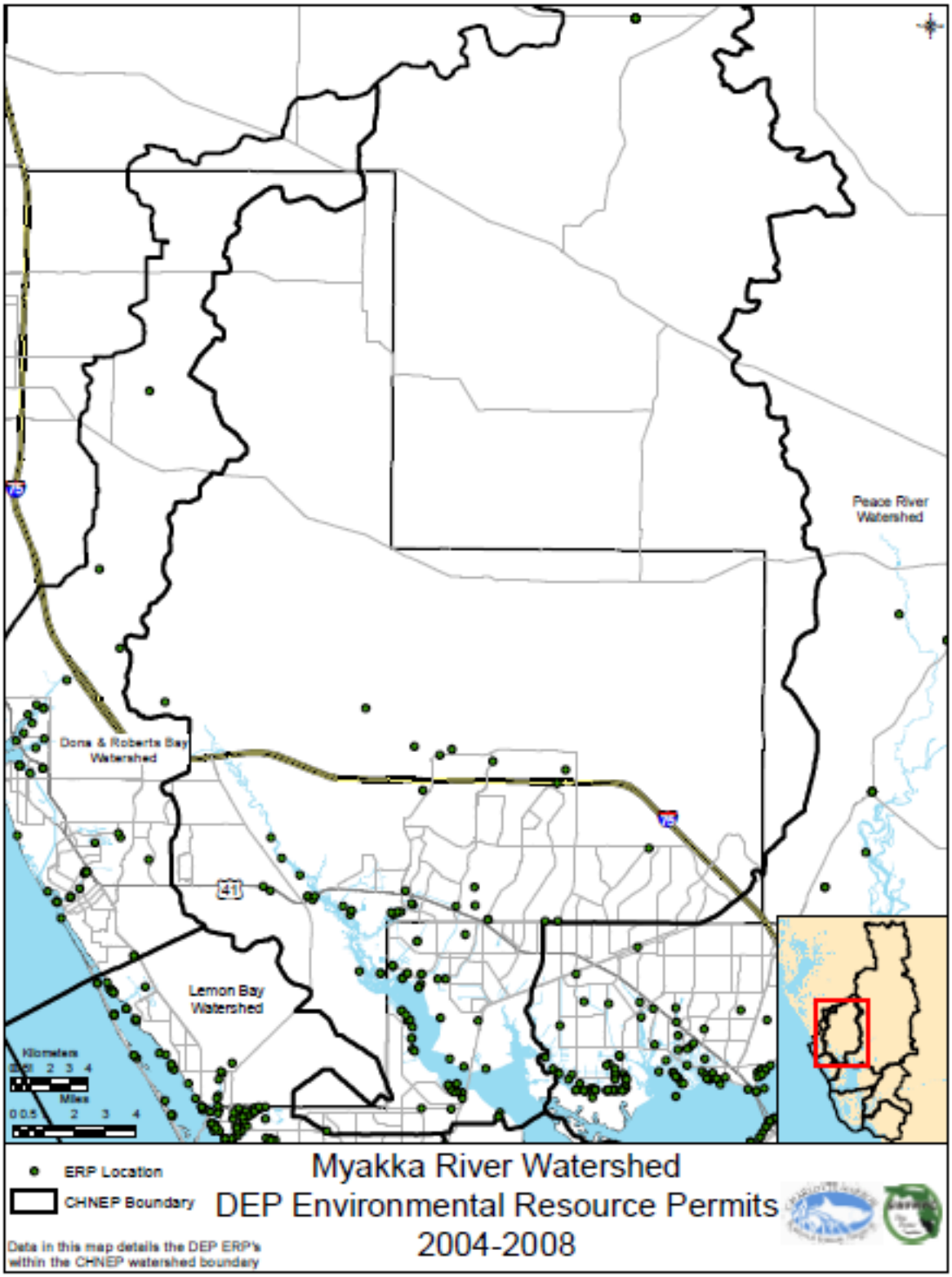
Thirty-eight of the FDEP ERP and thirty-six of the SWFWMD ERP were coastal projects. This is 4.03% of the total ERP projects, and 4.03% of all the coastal ERP projects that occurred in the CHNEP during the study period. Coastal ERPs constituted 39.58% of the FDEP, 7.56% of the SWFWMD ERP, and 12.94% of all ERP permitting that occurred in the Myakka River watershed during the study period.



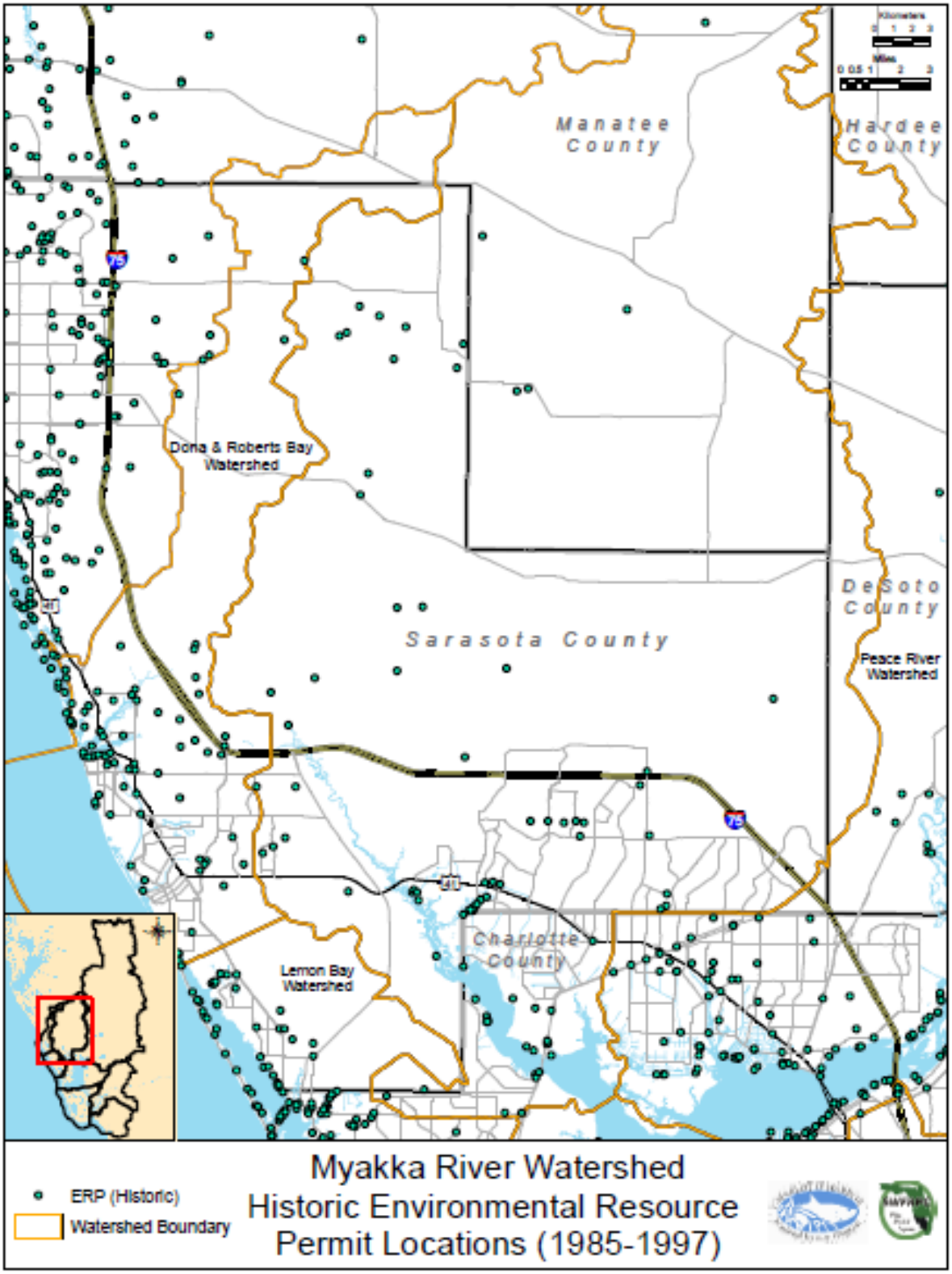
Map 74: Locations of FDEP and SWFWMD ERPs issued in the Myakka River Watershed during the study period January 1, 2004 to December 31, 2008



Map 75: Locations of SWFWMD ERPs issued in the Myakka River Watershed during the study period January 1, 2004 to December 31, 2008



Map 76: Locations of FDEP ERPs issued in the Myakka River Watershed during the study period January 1, 2004 to December 31, 2008

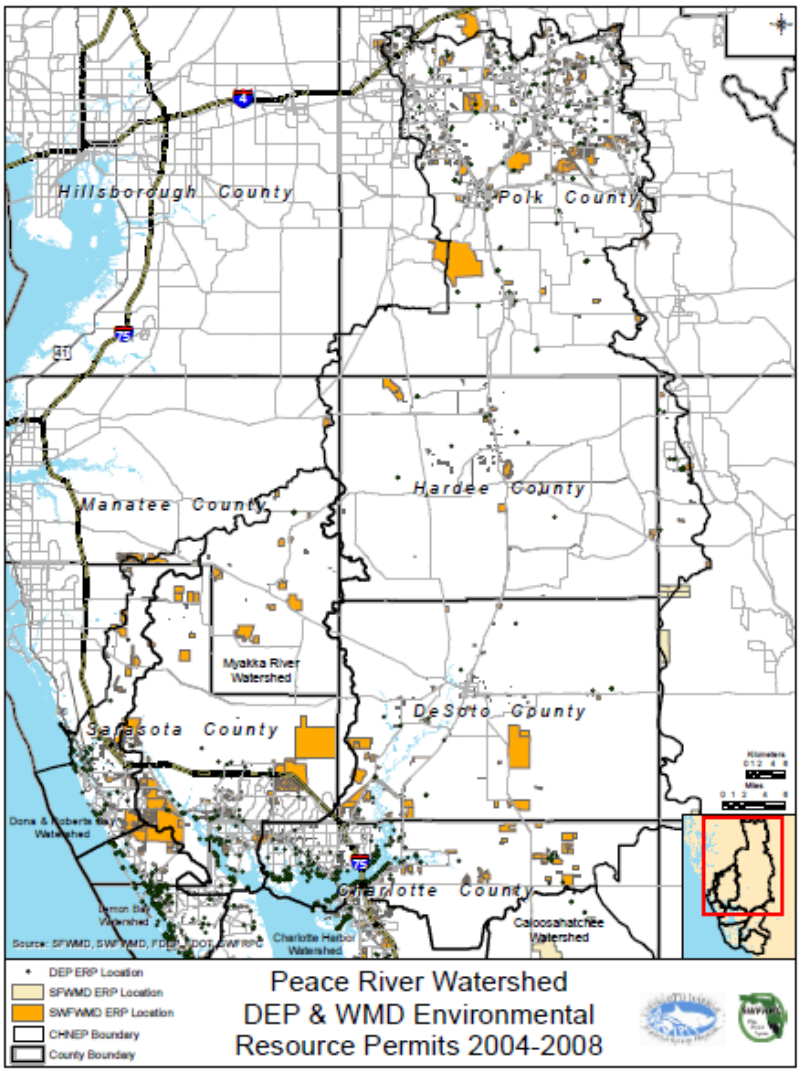


Map 77: Locations of FDEP ERPs issued in the Myakka River Watershed from January 1, 1985 to December 31, 2007

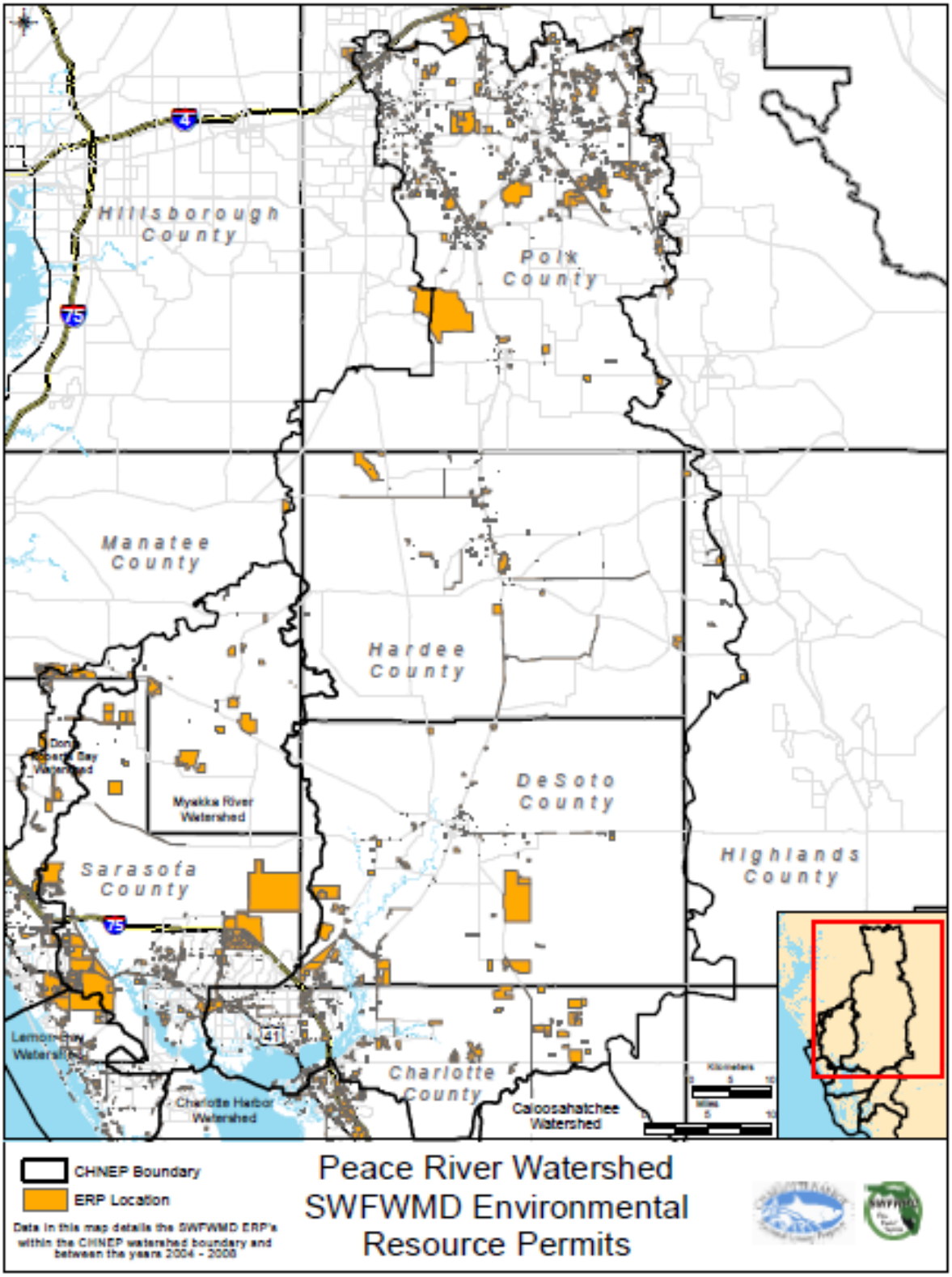
Peace River ERP Permit Locations

The Peace River watershed had 411 FDEP, 2,138 SWFWMD ERP, and 8 SFWMD permitting actions for a total of 2,557 ERPs in the study period. (Both the South and the Southwest Water Management Districts have jurisdiction over parts of the Peace River watershed.) This is 25.1% of all the ERP permitting that occurred in the CHNEP during the study period, including 8% of the FDEP and 62% of the SWFWMD ERP permitting.

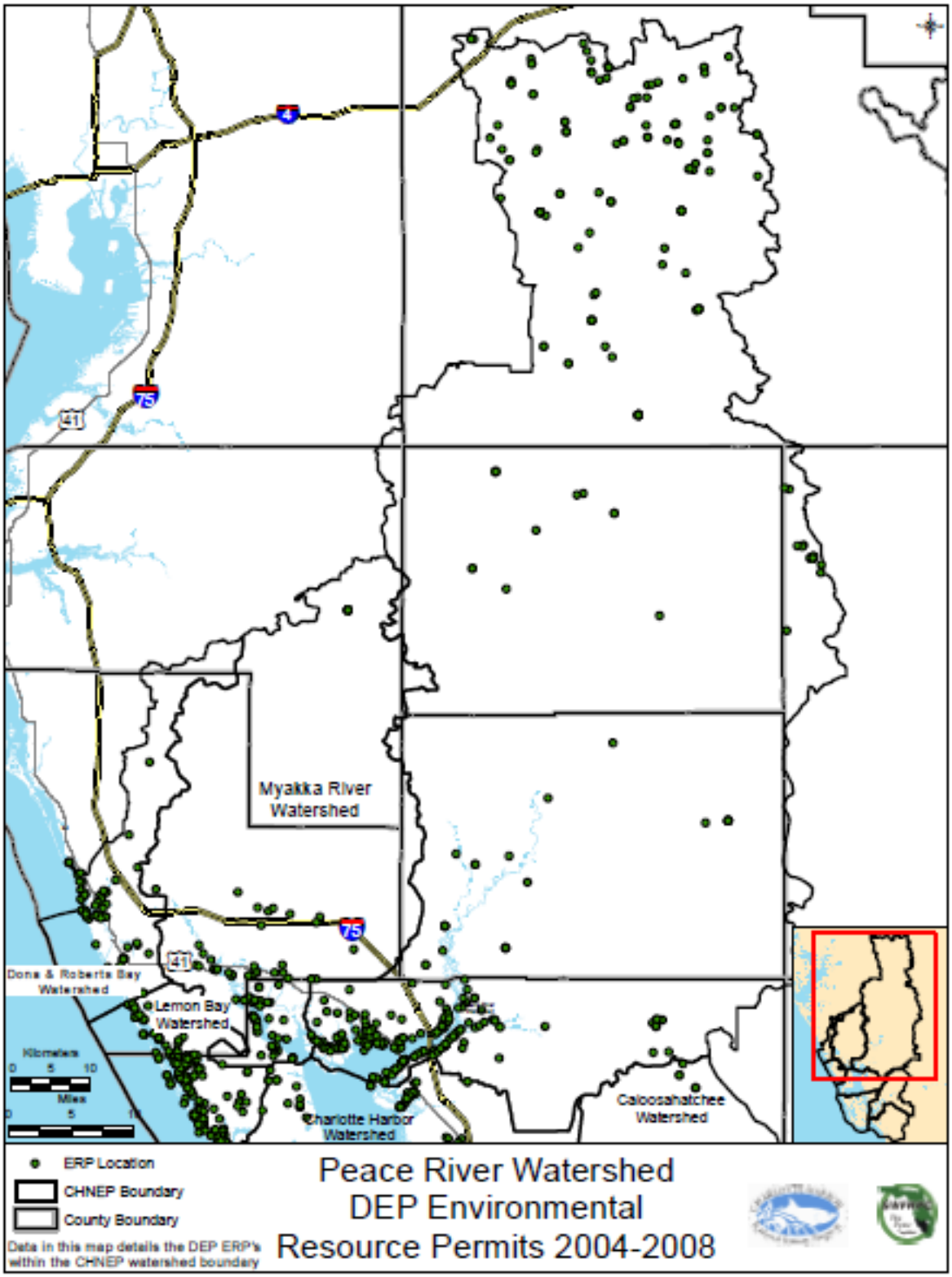
One hundred and four of the FDEP ERPs, forty-seven of the SWFWMD ERPs, and none of the SFWMD ERPs were coastal projects. This is 6% of the total projects, and 8.23% of all the coastal ERP projects that occurred in the CHNEP during the study period. Coastal ERPs constituted 25.3% of the FDEP, 2.2% of the SWFWMD ERP permitting, and 5.91% of the total ERPs that occurred in Peace River watershed during the study period.



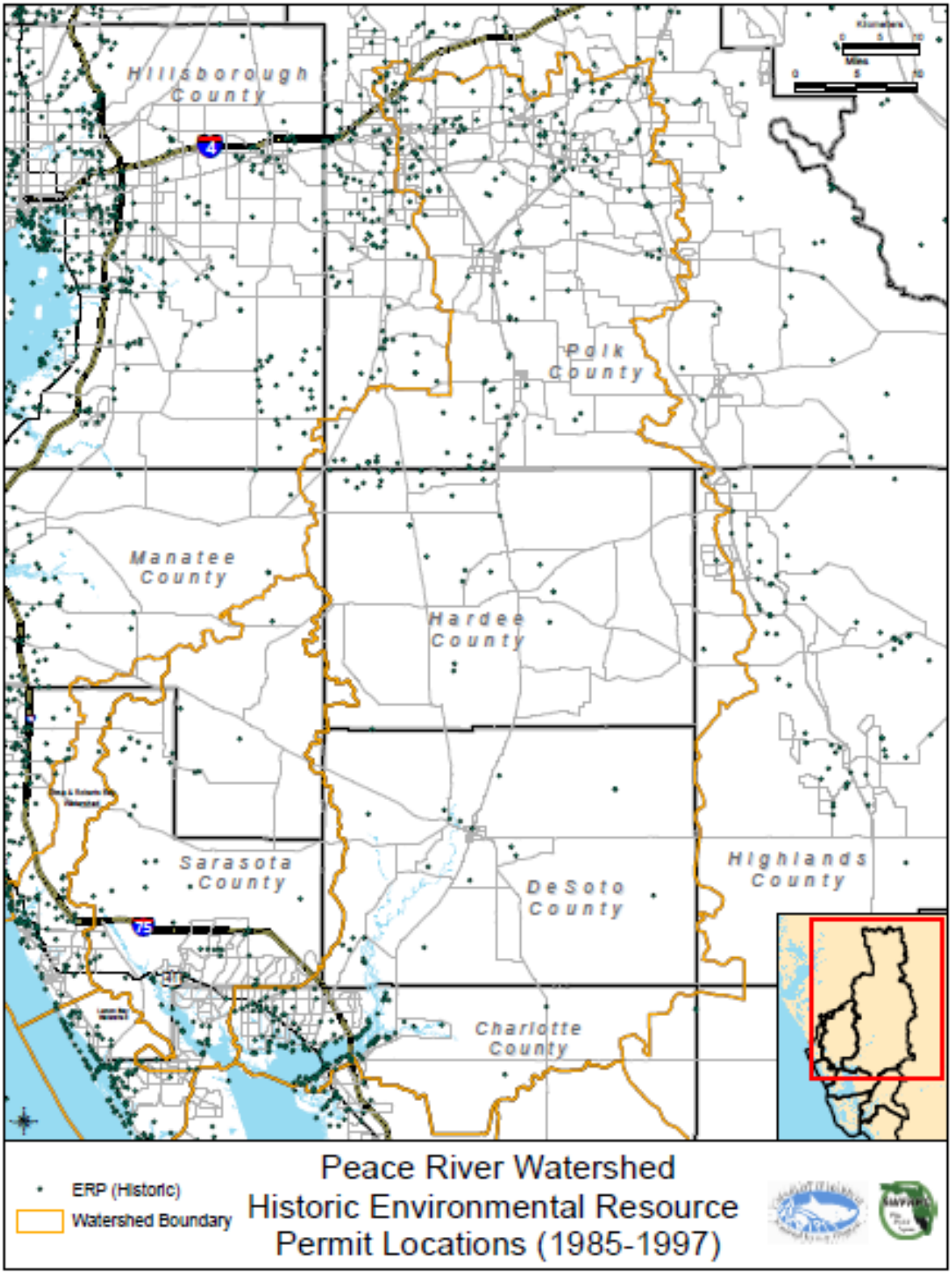
Map 78: Locations of FDEP and SWFWMD ERPs issued in the Peace River Watershed during the study period January 1, 2004 to December 31, 2008



Map 79: Locations of SWFWMD ERPs issued in the Peace River Watershed during the study period January 1, 2004 to December 31, 2008



Map 80: Locations of FEDP ERPs issued in the Peace River Watershed during the study period January 2, 2004 to December 31, 2008

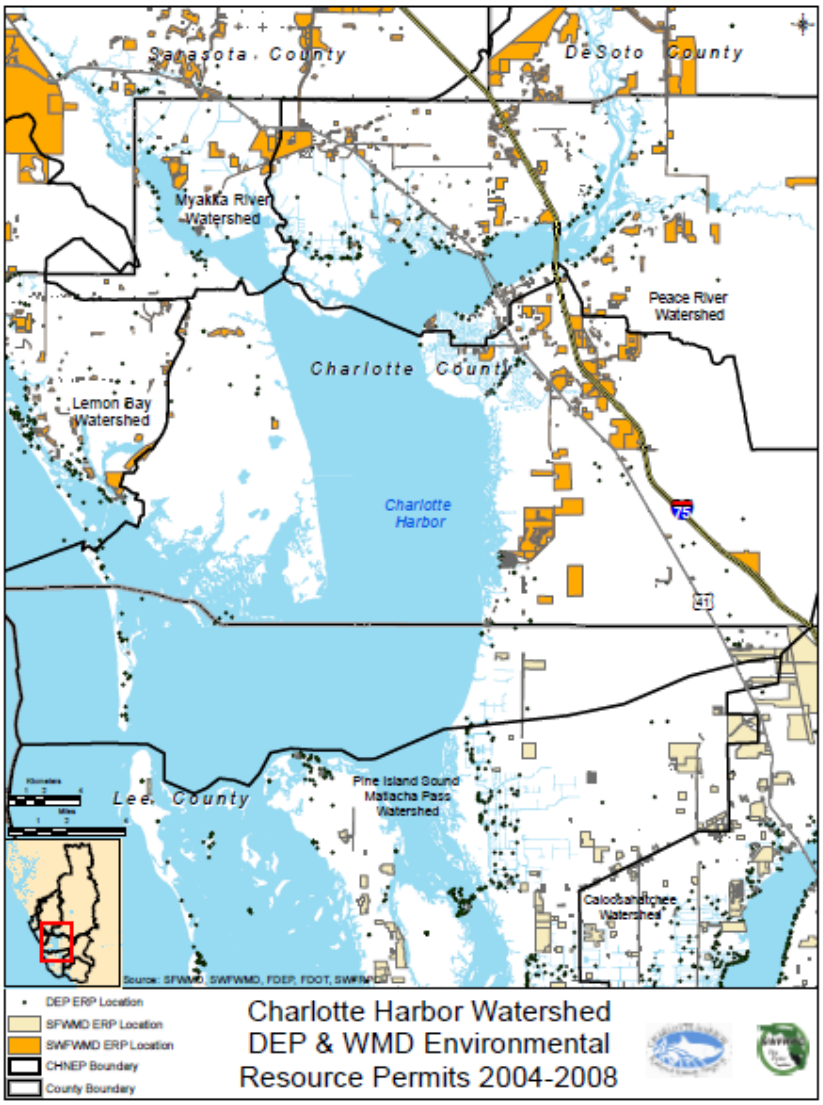


Map 81: Locations of FDEP ERPs issued in the Peace River Watershed from January 1, 1985 to December 31, 2007

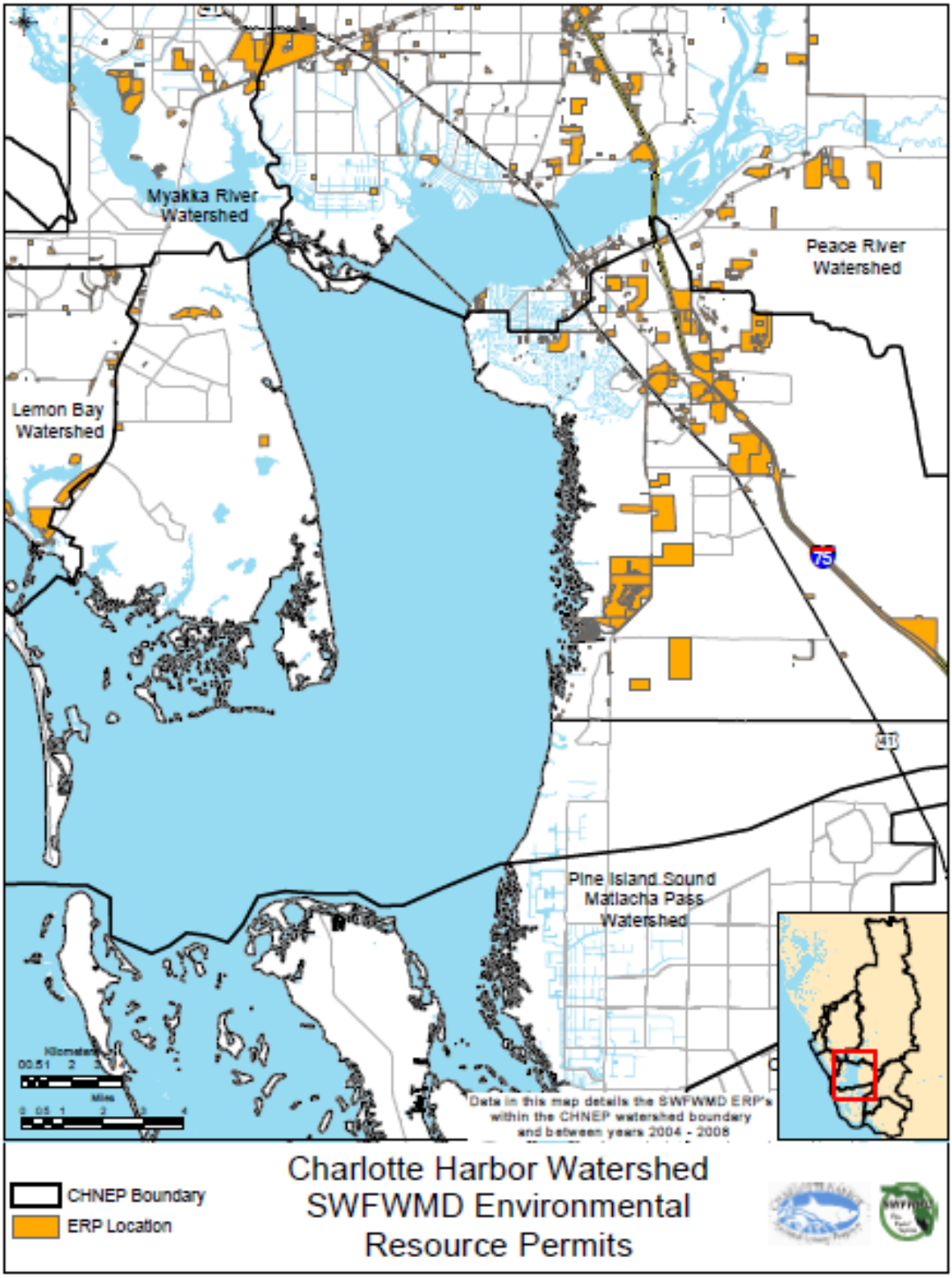
Charlotte Harbor ERP Permit Locations

Charlotte Harbor Proper had 159 FDEP, 247 SWFWMD, and 17 SFWMD ERP permitting actions for a total of 423 ERPs in the study period. This is 4.15% of all the ERP permitting that occurred in the CHNEP during the study period, including 3% of the FDEP, 7% of the SWFWMD, and 1% of the SFWMD ERP permitting.

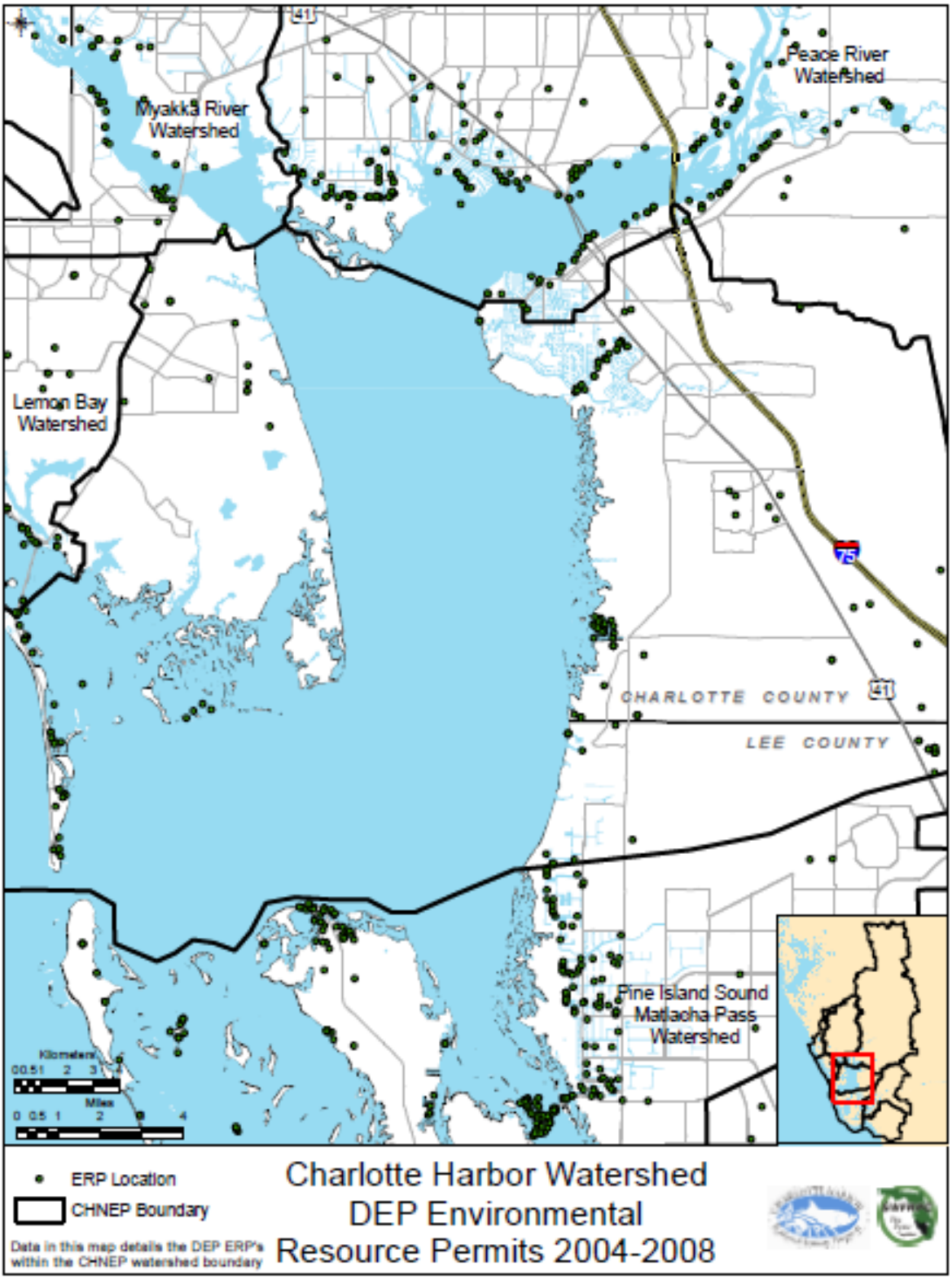
Seventy-two of the FDEP ERPs, forty-six of the SWFWMD, and three of the SFWMD ERPs were coastal projects. This is 4.15% of the total projects, and 6.6% of all the coastal ERP projects that occurred in the CHNEP during the study period. Coastal ERPs constituted 45.28% of the FDEP, 18.62% of the SWFWMD, 17.65% of the SWFWMD and 28.61% of the total ERP permitting that occurred in Charlotte Harbor Proper watershed during the study period.



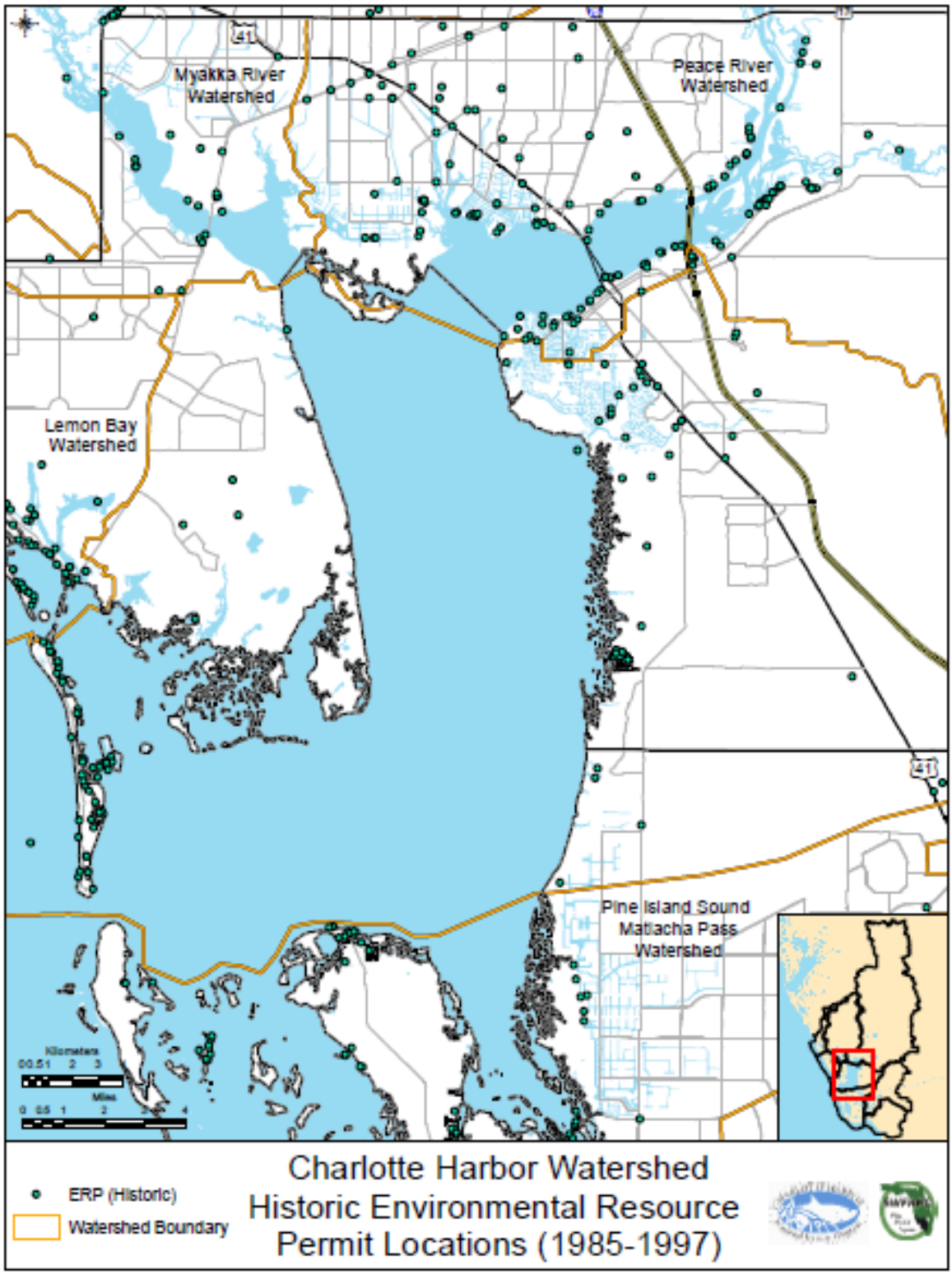
Map 82: Locations of FDEP and SWFWMD ERPs issued in the Charlotte Harbor Watershed during the study period January 1, 2004 to December 31, 2008



Map 83: Locations of SWFWMD ERPs issued in the Charlotte Harbor Watershed during the study period January 1, 2004 to December 31, 2008



Map 84: Locations of FDEP ERPs issued in the Charlotte Harbor Watershed during the study period January 1, 2004 to December 31, 2008

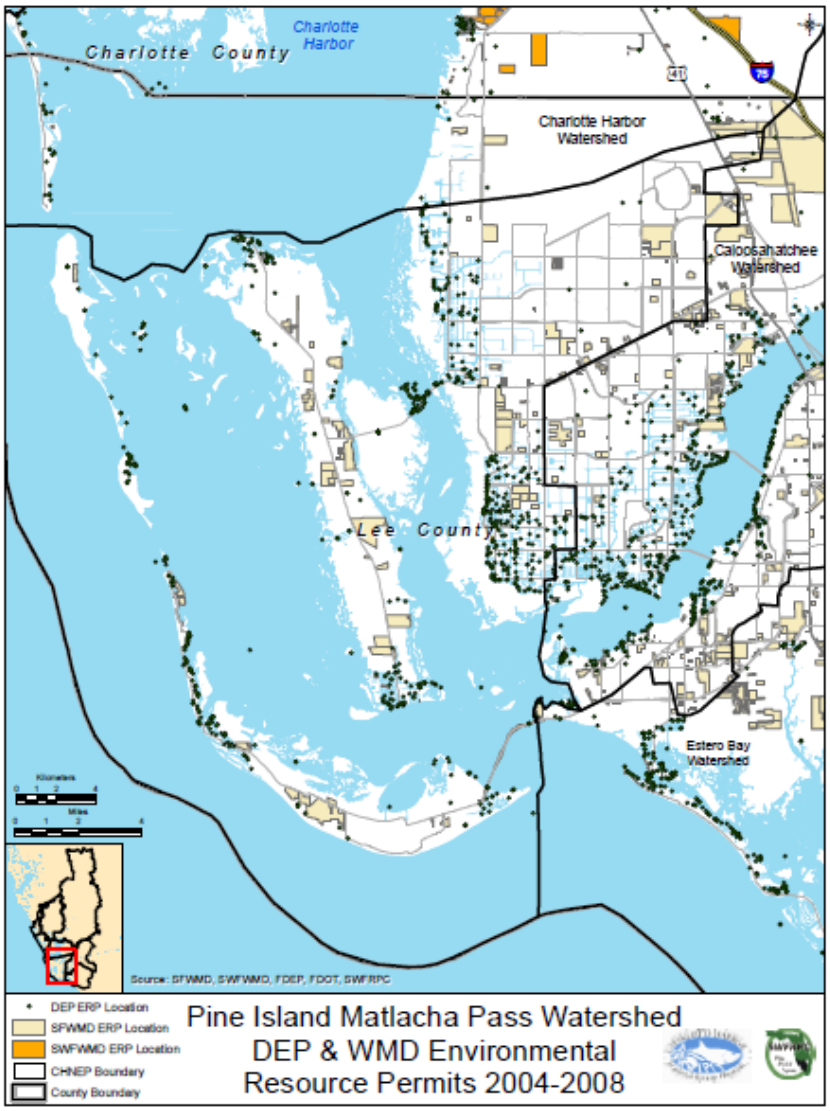


Map 85: Locations of FDEP ERPs issued in the Charlotte Harbor Watershed from January 1, 1985 to December 31, 2007

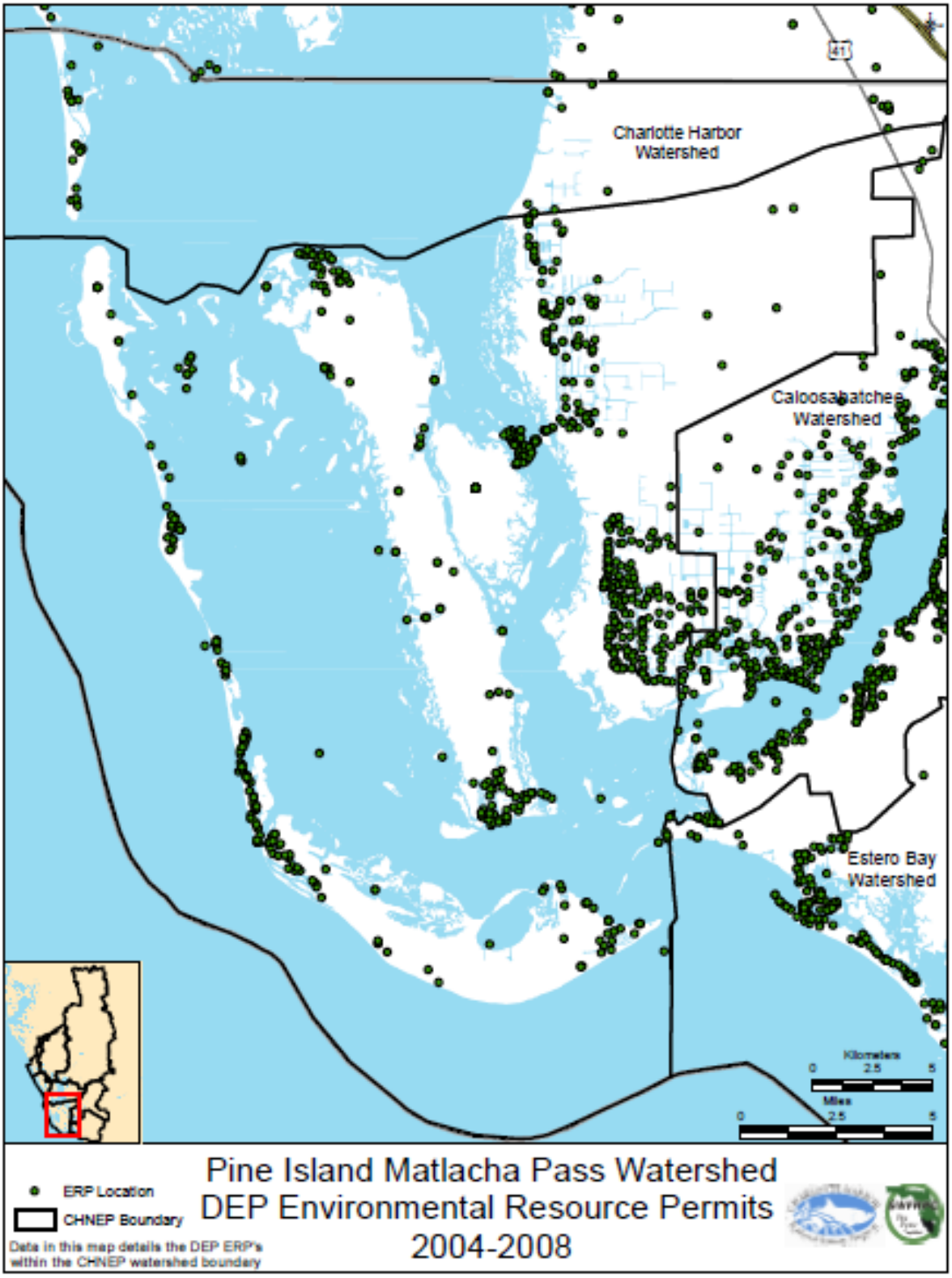
Pine Island and Matlacha Pass ERP Permit Locations

The Pine Island Sound and Matlacha Pass watersheds had 816 FDEP and 210 SFWMD ERP permitting actions for a total of 1,026 ERPs in the study period. This is 10.07% of all the ERP permitting that occurred in the CHNEP during the study period, including 17% of the FDEP and 11% of the SFWMD ERP permitting.

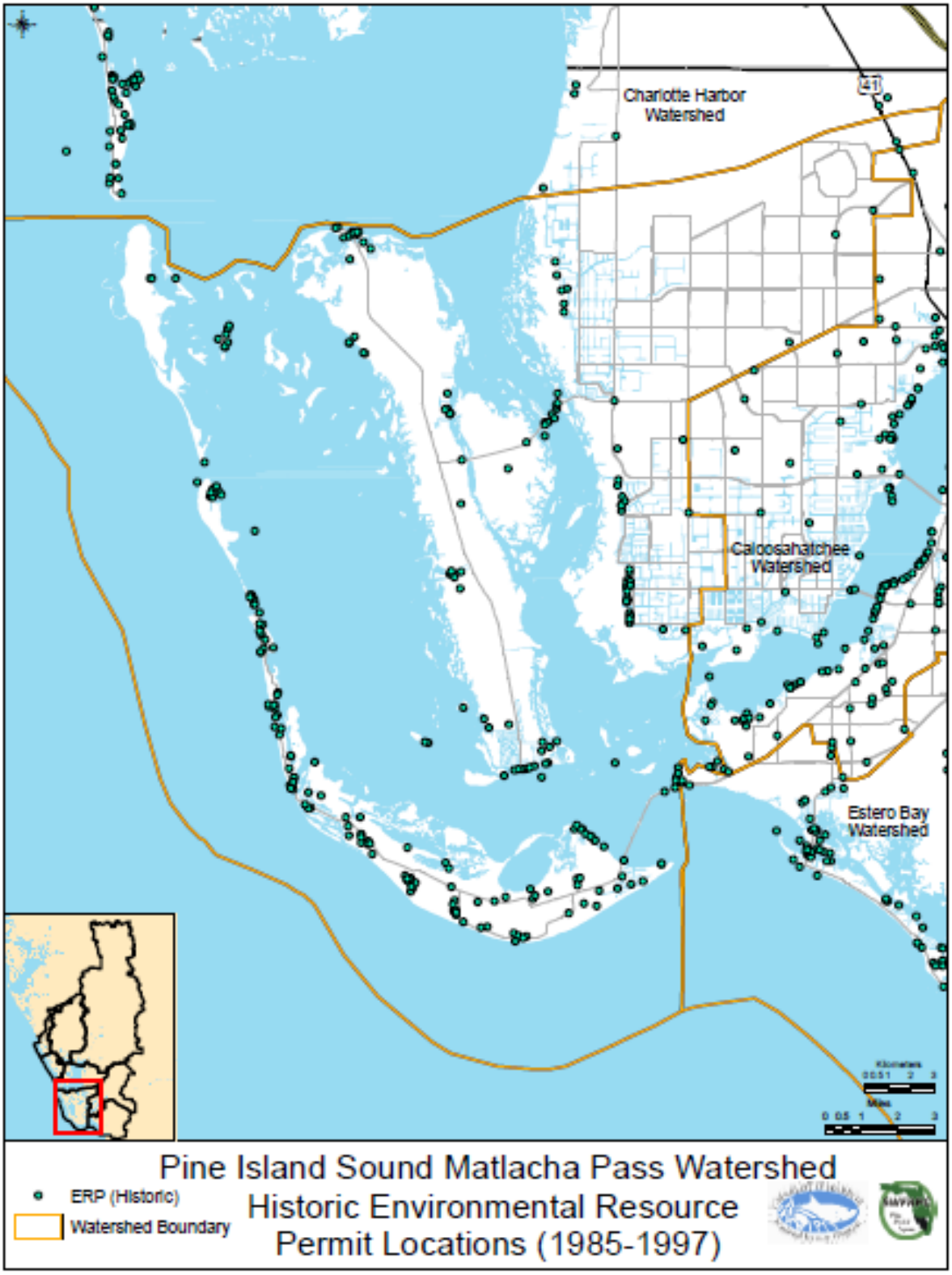
Three hundred fifty-four of the FDEP ERPs and fifty-seven of the SFWMD ERPs were coastal projects. This is 10% of the total projects, and 22% of all the coastal ERP projects that occurred in the CHNEP during the study period. Coastal ERPs constituted 43.38% of the FDEP, 27.14 % of the SFWMD ERP permitting, and 40.06% of the total ERP that occurred in the Pine Island Sound and Matlacha Pass watersheds during the study period.



Map 86: Locations of FDEP and SFWMD ERPs issued in the Pine Island and Matlacha Pass Watershed during the study period January 1, 2004 to December 31, 2008



Map 87: Locations of FDEP ERPs issued in the Pine Island and Matlacha Pass Watershed during the study period January 1, 2004 to December 31, 2008

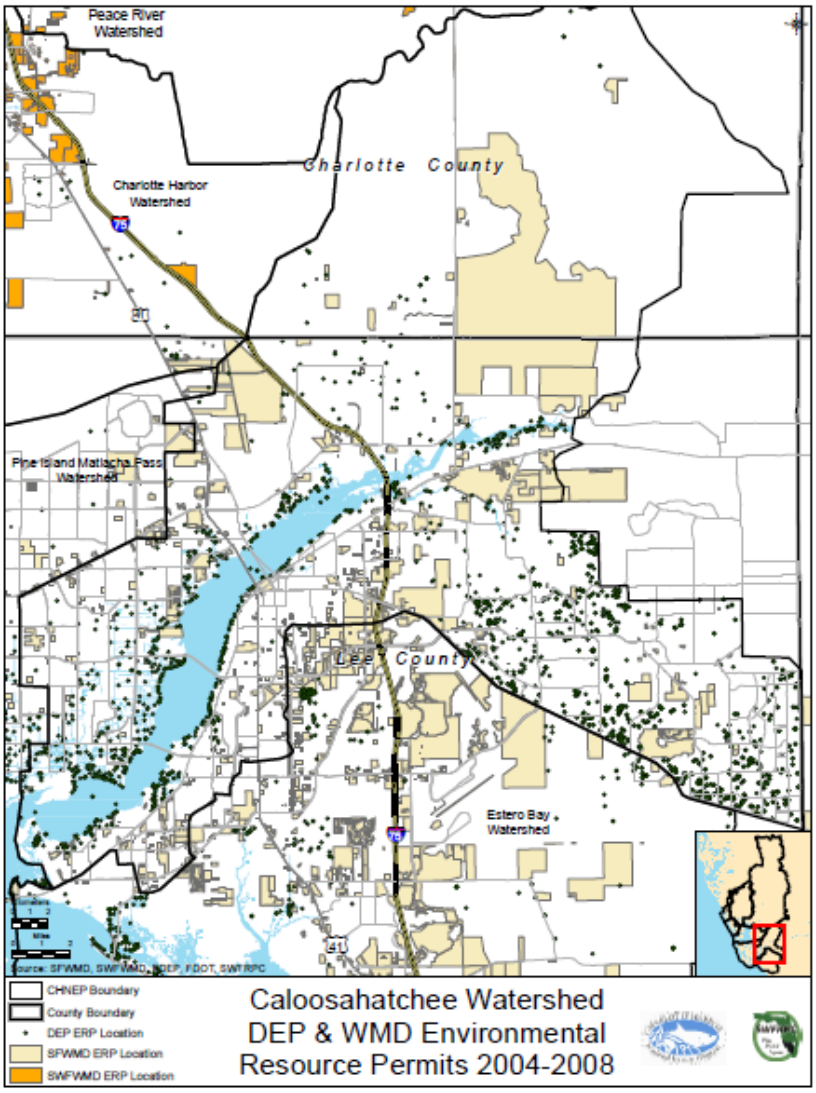


Map 88: Locations of FDEP ERPs issued in the Pine Island and Matlacha Pass Watershed from January 1, 1985 to December 31, 2008

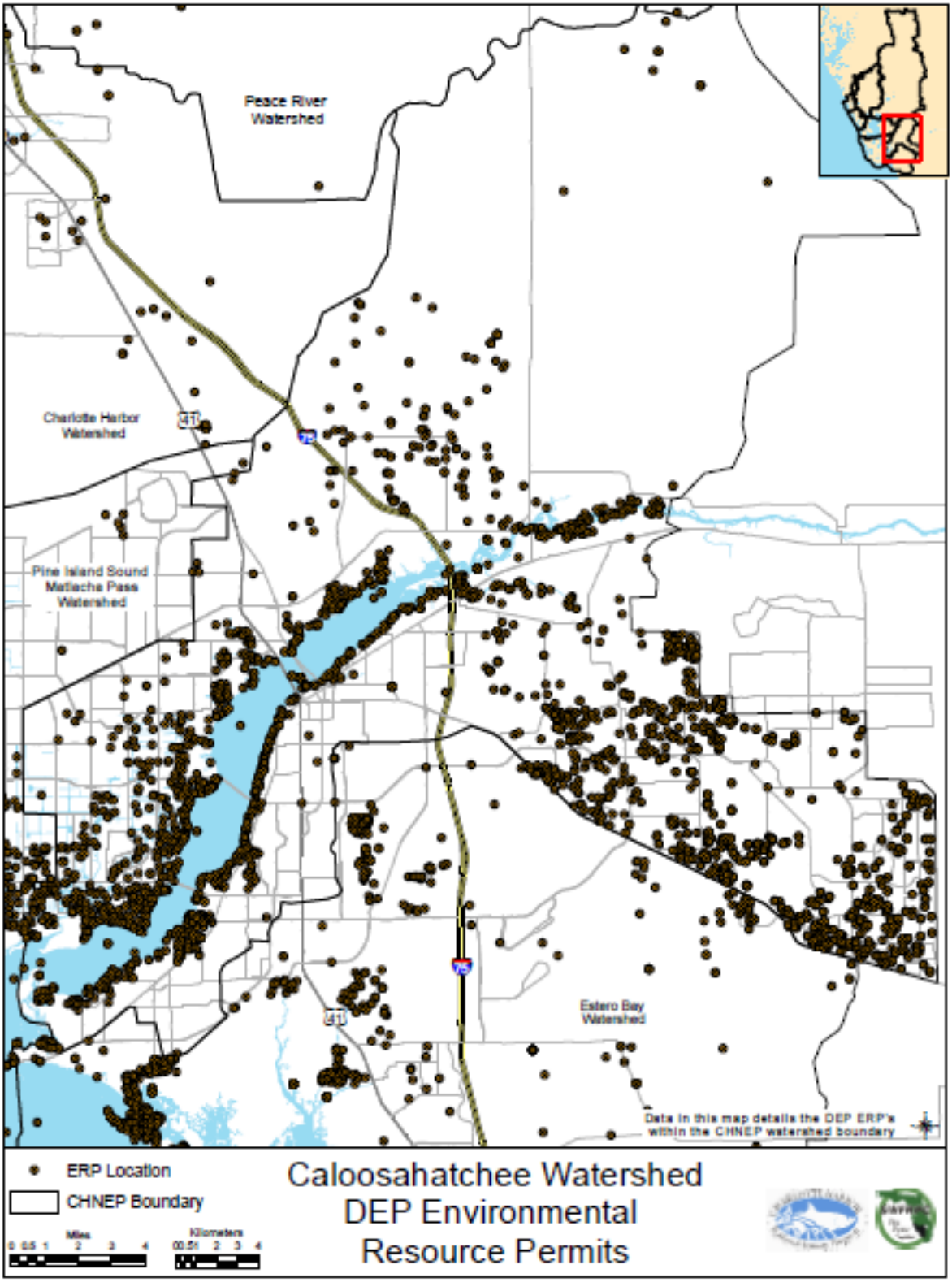
Caloosahatchee River ERP Permit Locations

The Caloosahatchee River watershed had 2,215 FDEP, 2 SWFWMD and 646 SFWMD ERP permitting actions for a total of 2,863 ERPs in the study period. This is 28.11% of all the ERP permitting that occurred in the CHNEP during the study period, including 45% of the FDEP and 35% of the SWFWMD ERP permitting.

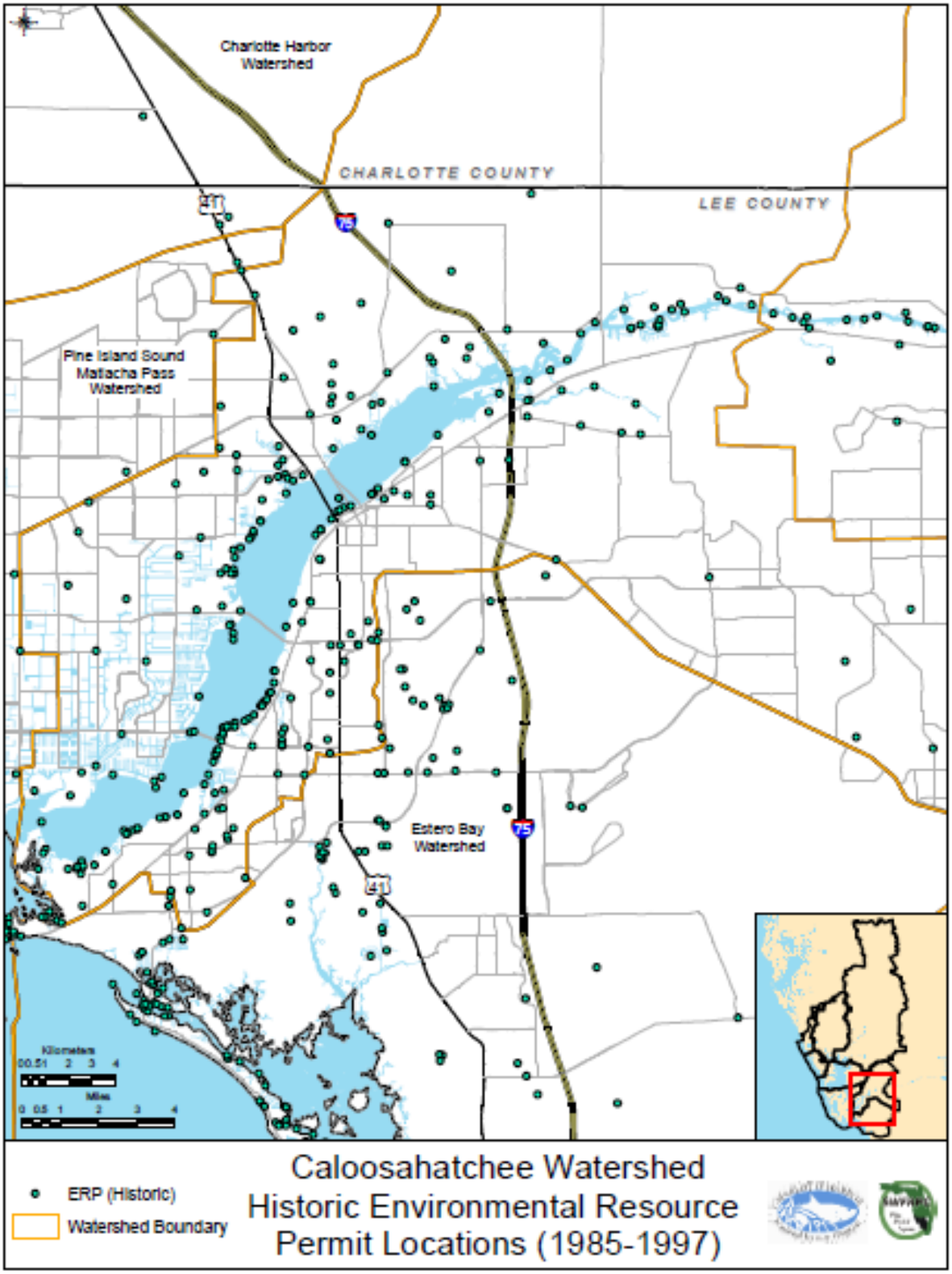
Three hundred eighty-four of the FDEP ERPs and one hundred and seven (107) of the SFWMD ERPs were coastal projects. This is 22% of the total projects, and 27% of all the coastal ERP projects that occurred in the CHNEP during the study period. Coastal ERPs constituted 17.34% of the FDEP, 16.56 % of the SFWMD, and 17.15% of the total ERP permitting that occurred in the Caloosahatchee River watershed during the study period.



Map 89: Locations of FDEP and SFWMD ERPs issued in the Caloosahatchee River Watershed during the study period January 1, 2004 to December 31, 2008



Map 90: Locations of FDEP ERPs issued in the Caloosahatchee River Watershed during the study period January 1, 2004 to December 31, 2008

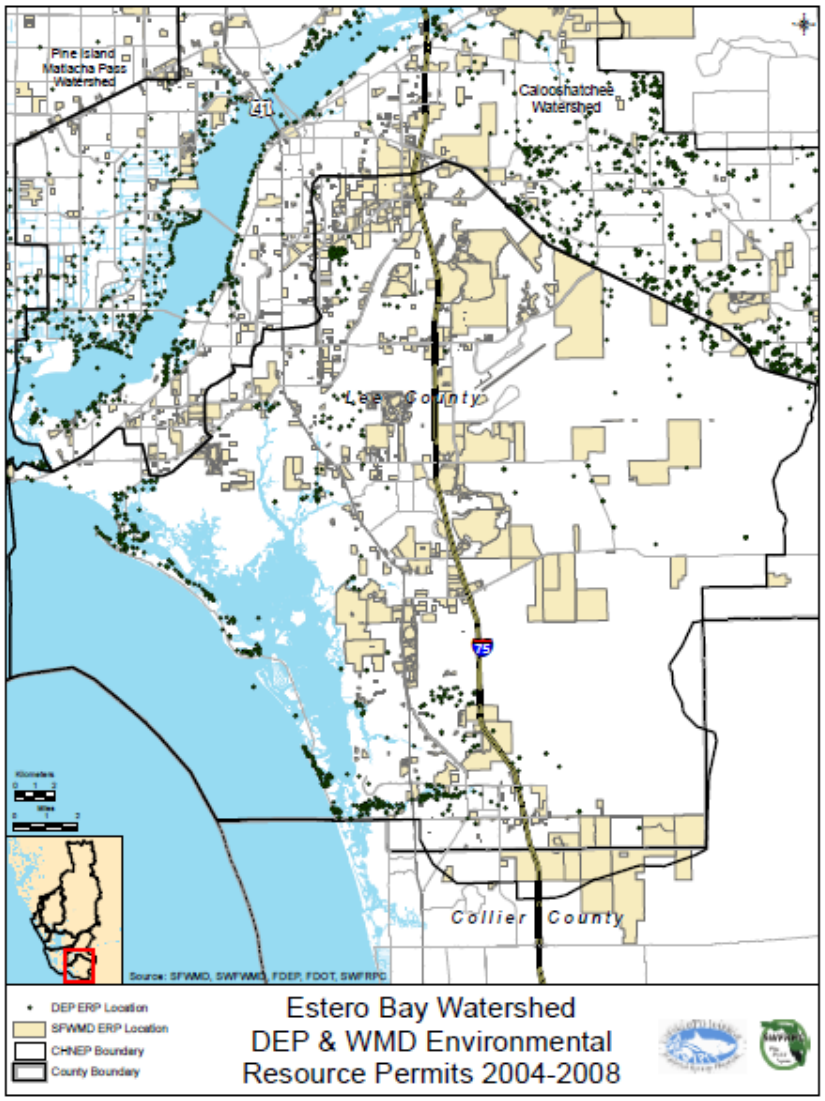


Map 91: Locations of FDEP ERPs issued in the Caloosahatchee River Watershed from January 1, 1985 to December 31, 2007

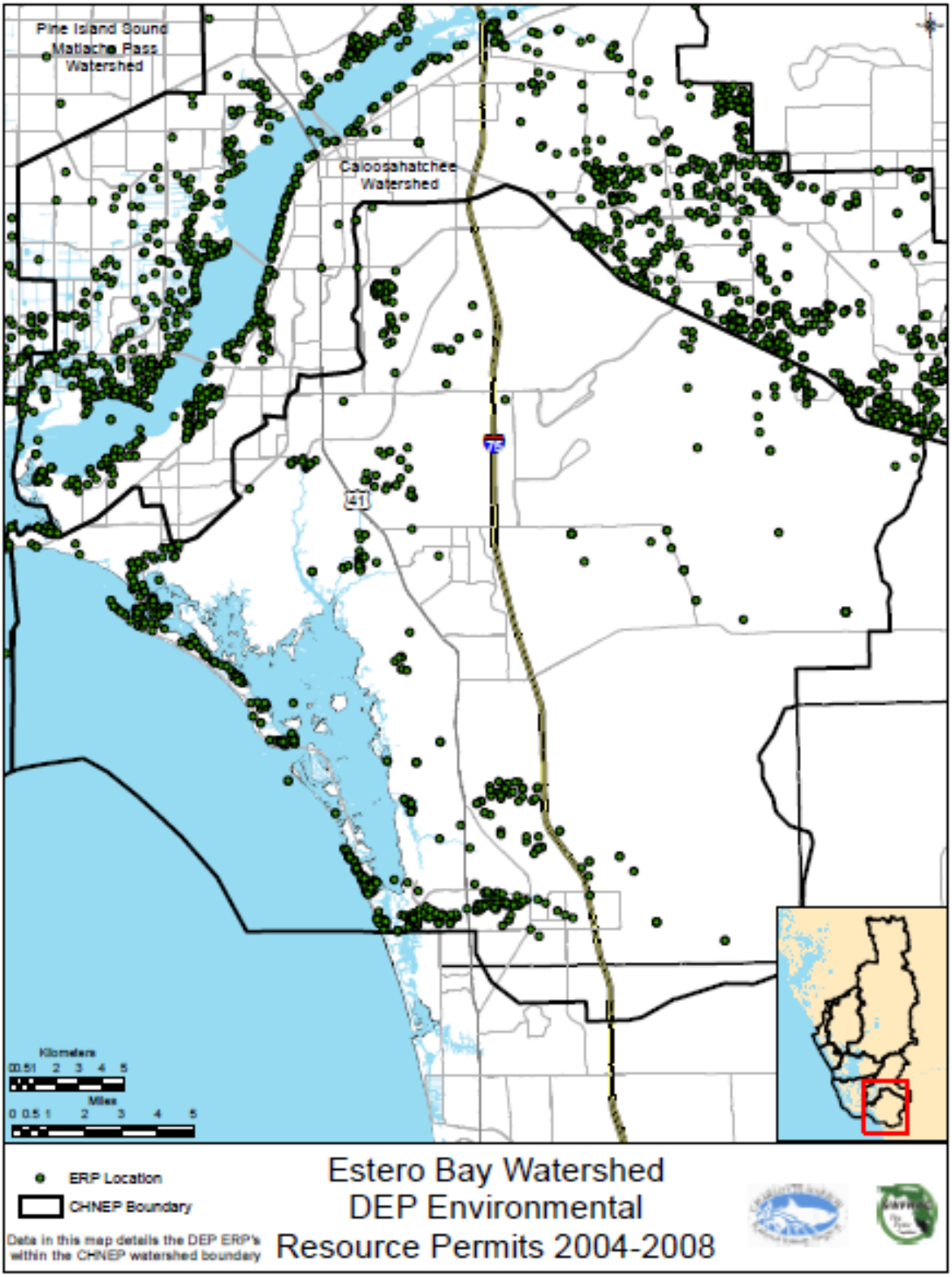
Estero Bay ERP Permit Locations

The Estero Bay watershed had 843 FDEP and 965 SFWMD ERP permitting actions for a total of 1,808 ERPs in the study period. This is 17.75 % of all the ERP permitting that occurred in the CHNEP during the study period, including 17% of the FDEP and 52% of the SWFWMD ERP permitting.

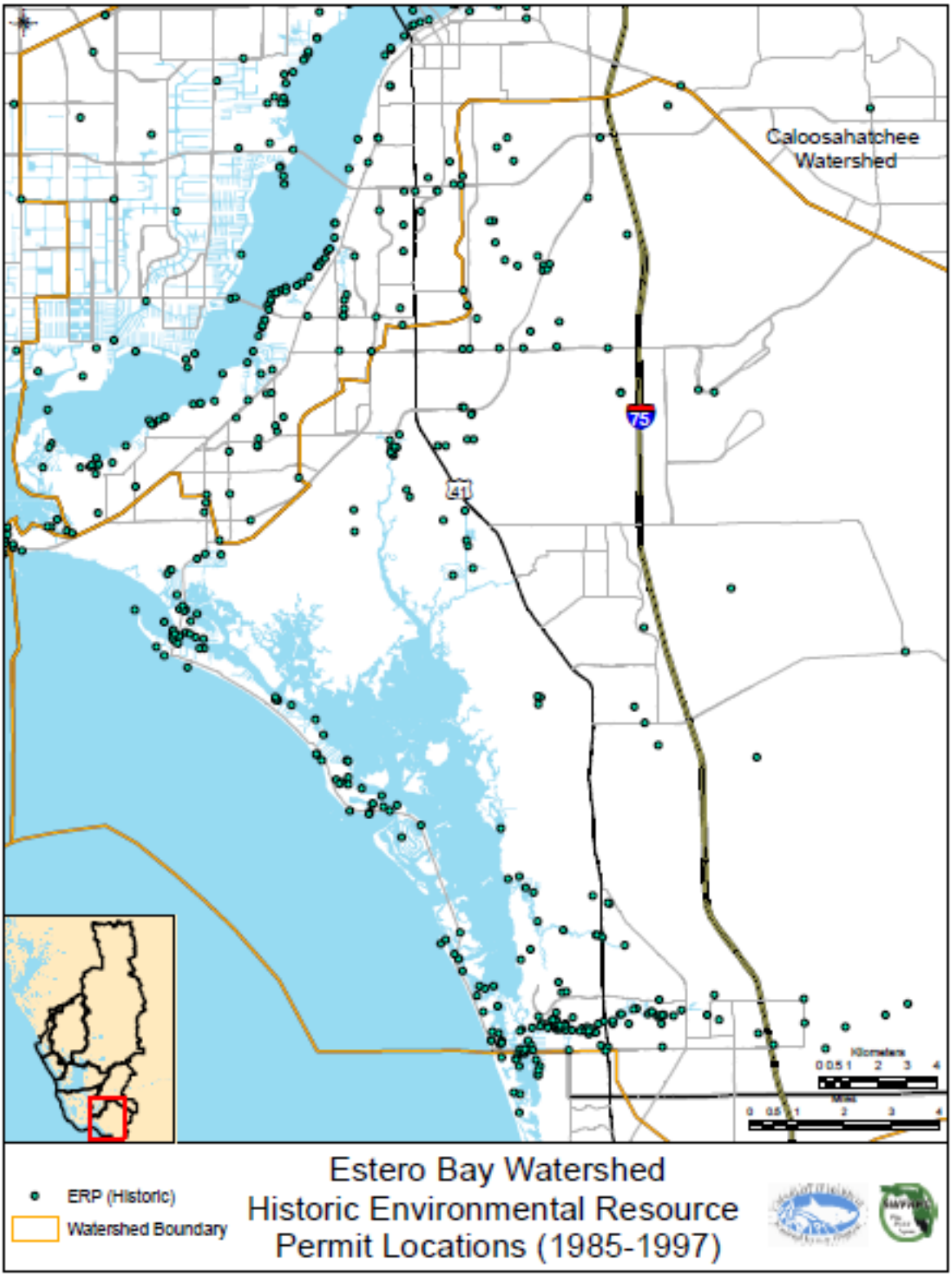
Two hundred forty-four of the FDEP ERPs and forty-seven of the SWFWMD ERPs were coastal projects. This is 18% of the total projects, and 16% of all the coastal ERP projects that occurred in the CHNEP during the study period. Coastal ERPs constituted 28.94% of the FDEP, 4.87% of the SFWMD and 16.1% of the total ERP permitting that occurred in the Estero Bay watershed during the study period.



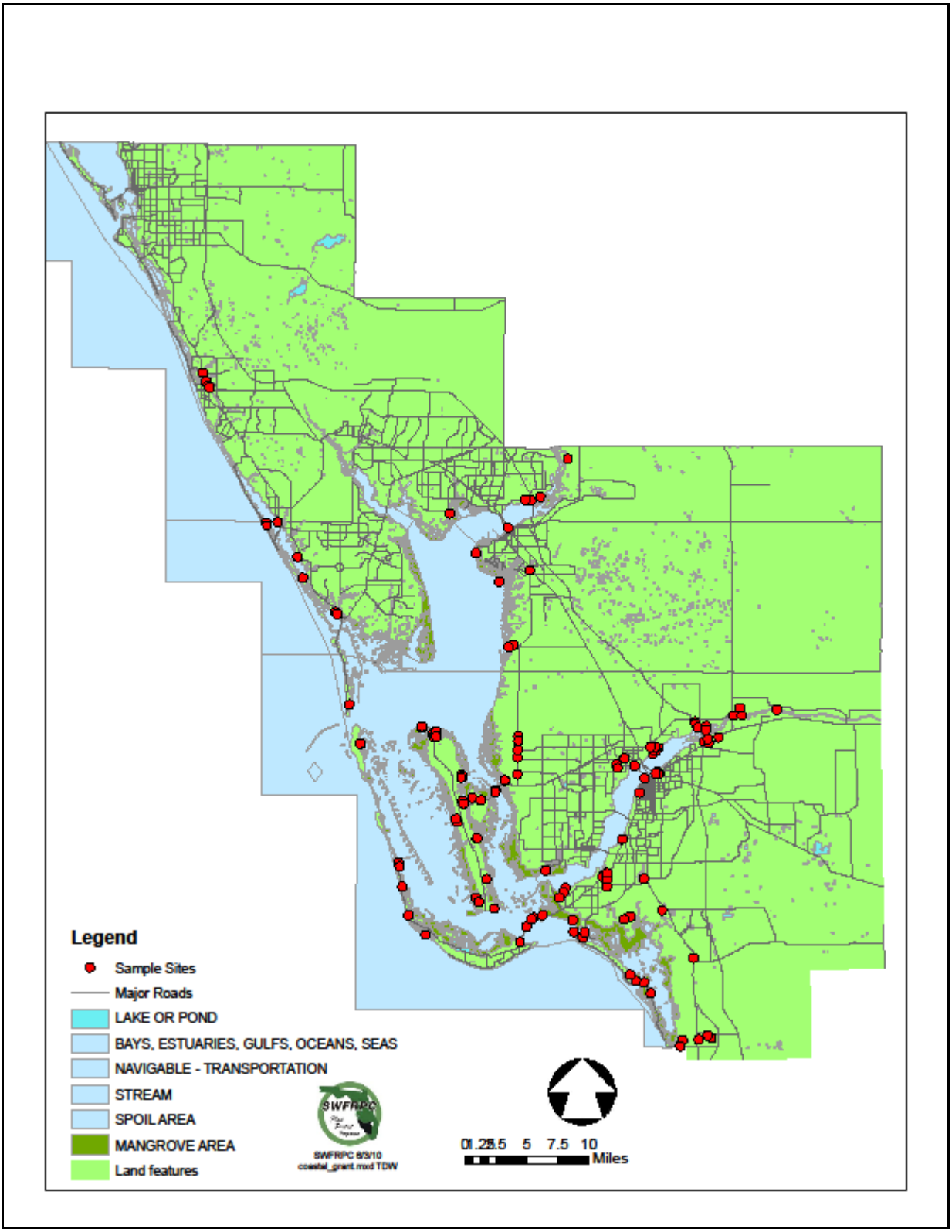
Map 92: Locations of FDEP and SFWMD ERPs issued in the Estero Bay Watershed during the study period January 1, 2004 to December 31, 2008



Map 93: Locations of FDEP ERPs issued in the Estero Bay Watershed during the study period January 1, 2004 to December 31, 2008



Map 94: Locations of FDEP ERPs issued in the Estero Bay Watershed from January 1, 1985 to December 31, 2007



Map 95: Study sites examined, reviewed and evaluated for wetland functional assessments during the study

Overview of Methods for Assessing Wetland Functions and Values

Until 1960 the typical way to assign a functional value to a wetland was to assign it an economic market value as a development site. This was followed by occasional attempts to measure the economic value of recreational services wetlands supported, especially those associated with hunting and fishing (King *et al.* 2000). Wetland assessment procedures began to be developed in the 1970s in an effort to demonstrate that wetlands provide benefits beyond narrowly defined commercial and recreational outcomes (Leonard et al. 1981, U.S. Environmental Protection Agency 1984). It was always the intent in these early efforts to find a suite of wetland values and functions that exceeded, perhaps by several orders of magnitude, the simple accounting of acre for acre values of wetland mitigation replacement.

The Habitat Evaluation Procedure or HEP (developed by the U.S. Fish and Wildlife Service in 1980) is the most noteworthy of these procedures because it was one of the first and most comprehensive. It is still a widely used method for establishing nonmonetary currencies of habitat value (USFWS 1980b). The Habitat Suitability Index (HSI) and habitat units (HUs) developed using HEP provide a means to document professional judgments about the adequacy or equivalency of habitats for various fish and wildlife species. They can be used to evaluate some types of habitat trades and mitigation proposals.

HEP focuses primarily on site characteristics that satisfy the needs and preferences of particular fish and wildlife species (e.g., breeding and feeding conditions), not on site and landscape characteristics that determine how improving habitats for those fish and wildlife is likely to satisfy the needs and preferences of people. A significant amount of conceptual work went into the development of a component of HEP called the Human Use and Economic Evaluation or HUEE (USFWS 1985), which did deal with those habitat values. However, indices related to wetland values were never fully developed or field tested and, unlike the rest of the HEP method, the HUEE module has not been widely used.

The impetus for the development of the HSI series was the Habitat Evaluation Procedures, or HEP (USFWS 1980a), a planning and evaluation technique that focuses on the habitat requirements of fish and wildlife species. Methods in the HSI model series have been formatted according to Standards for the Development of Habitat Suitability Index Models (USFWS 1981).

The HSI series models are similar to other sources of information that address, in general terms, the habitat requirements of fish and wildlife species. Several other efforts to compile species databases have been initiated in recent years (e.g., Mason et al. 1979; USFWS 1980b). These other databases are descriptive in content and contain an array of habitat and population information, while the HSI series is unique in that it is constrained to habitat information only, with an emphasis on quantitative relationships between key environmental variables and habitat suitability. In addition, HSI synthesizes habitat information into explicit habitat models useful in quantitative assessments. The HSI models reference numerous literature sources in an effort to consolidate scientific information on species-habitat relationships.

HSI models provide a numerical index of habitat suitability on a 0.0 to 1.0 scale, based on the assumption that there is a positive relationship between the index and habitat carrying capacity (USFWS 1981). The models vary in generality and precision, due in part to the amount of available quantitative habitat information and the frequently qualitative nature of existing information. When possible, HSI models are derived from site-specific population and habitat data.

The HSI models are usually presented in three basic formats: (1) graphic; (2) word; and (3) mathematical. The graphic format is a representation of the structure of the model and displays the sequential aggregation of variables into an HSI. Following this, the model relationships are discussed and the assumed relationships between variables, components, and HSIs are documented. Finally, the model relationships are described in mathematical language, mimicking as closely and as simply as possible, the preceding word descriptions.

The documentation explains the model's structure and inherent assumptions, and provides the insights necessary to modify the model when the judgments used are inconsistent with local or new knowledge. The models should be viewed as hypotheses of species-habitat relationships rather than statements of proven cause and effect relationships. Their value is to serve as a basis for improved decision-making and increased understanding of habitat relationships because they specify hypotheses of habitat relationships that can be tested and improved. Results of model performance tests, when available, are presented or referenced with each model. However, models that have been reliable in specific studies may be less reliable in other situations. For this reason, feedback is encouraged from model users concerning improvements to models, the availability of other habitat models, results of model tests, and suggestions that may increase the effective use of habitat information for fish and wildlife planning.

The appendices to the HSI model series contain supplementary information for model applications. This information is general in nature although certain appendices may apply to only part of the model series. For example, Appendix A provides specific guidance and model application information for inland aquatic fish species and contains sample field data sheets for collecting aquatic field data and converting those data into habitat variable values. Measurement techniques for terrestrial variables are summarized in Hays et al. (1981).

Numerous assessment procedures specific to wetlands have been developed since HEP. Some of them attempt to address wetland values by measuring functions and then identifying significant risks or exceptional values associated with each function using "red flags" or "noteworthiness" rankings (e.g., Habitat Assessment Technique (Cable, Brack, and Holmes 1989), Evaluation for Planned Wetlands (EPW) (Bartoldus, Garbisch, and Kraus 1994), New England Freshwater Wetlands Invertebrate Biomonitoring Protocol (NEFWIBP) (Hicks 1997)).

These simple add-on approaches are based on the presence or absence of notable features, such as endangered species or designated historic or archeological areas. They do not attempt to make links between functions, services, and values. A few procedures include simplified models or questions that are used to assign scores to wetlands based on social categories such as recreation, aesthetics, agricultural potential, and educational values (e.g., New Hampshire Method (Ammann and Stone 1991), the Connecticut Method (Ammann, Frazen, and Johnson 1986),

Hollands-Magee Method (Hollands and Magee 1985), Minnesota Routine Assessment Method for Evaluating Wetland Functions (MNRAM) (Minnesota Board of Water and Soil Resources 1998), Oregon Freshwater Wetland Assessment Methodology (OFWAM) (Roth et al. 1996)). Some of them also weave concepts of function and value into a measure called "functional value" (e.g., Ammann, Frazen, and Johnson 1986; Ammann and Stone 1991). However, the criteria used in those methods to assign relative values to different wetlands or to distinguish between levels of function and associated values are not clearly defined.

The Wetland Evaluation Technique (WET) (Adamus *et al.* 1987) is exceptional in that it provides a basis for estimating separate ratings of social significance for most functions. However, in the WET approach, site evaluators are asked to "value" a function as low, medium, or high based on the *likelihood* of its being "socially significant," not on the *level* of social significance. Because these ratings relied on only a few easily recognized factors, the social significance component of the WET approach was used fairly often and yielded predictable and consistent results when applied by different wetland assessors. However, the advantage of having an approach that was easy to use and consistent came at a cost. WET indices did not address many important differences between wetlands that influence the links between wetland functions, services, and values and yielded empirical rankings that were difficult to interpret or defend. Because of these technical limitations, the valuation component of the WET method is rarely used today.

Overall, wetland assessment procedures that have attempted to link individual functions with services and values have done so in a very limited way, were not fully developed or field tested, and have not been widely used. They were also developed before it was possible to take advantage of advances in valuation theory and modern data storage and retrieval systems. The current trend in wetland assessment has been to improve procedures for evaluating functions (e.g., HGM Approach (Smith *et al.* 1995), Index of Biological Integrity (IBI) (Karr 1981, 1998), WEThings (Whitlock, Jarmon, and Larson 1994;Whitlock *et al.* 1994) and to leave the assessment of all related socioeconomic trade-offs to be worked out through the political process. This limits the usefulness of wetland assessment procedures and makes it difficult for wetland managers and regulators to defend using the results. It also leaves them with very little technical justification for protecting "valuable" wetlands or preventing mitigation trades that result in the replacement of "valuable" wetlands with less "valuable" wetlands.

For this study we evaluated the apparent success of assigned mitigation actions by the use of the dominant existing mitigation functional assessment techniques. The current prevalent methods utilized in southwest Florida and the CHNEP study area are the federal Hydrogeomorphic Methodology (HGM), the State of Florida's Uniform Mitigation Assessment Method (UMAM), and the South Florida Water Management District's Wetland Rapid Assessment Procedure (WRAP), which was also employed by the USACOE for a time period ranging from January 1, 2002 to December 31, 2008.

The original Rapid Procedure for Assessing Wetland Functional Capacity or Rapid Assessment Procedure (RAP) was developed to provide a procedure for assessing functional capacity of wetlands in the glaciated northeast and Midwest of the United States of America. It also served as the original template and provided a step by step process for developing rapid assessment

procedures for other regions of the continental United States, including Florida. The original RAP required a two person team of experienced wetland scientists, one with a soils/hydrology background and the other competent in plant identification and ecology. It was applicable to depressional, slope, lacustrine fringe, extensive peatland, flat and riverine HGM class wetlands in the glaciated northeast and Midwest. The procedure template was designed to be applicable to all wetland types in the continental United States. Approximately eight wetland functions were evaluated: modification of ground water discharge; modification of ground water recharge; storm and flood water storage; modification of stream flow; modification of water quality; export of detritus; contribution to abundance and diversity of wetland vegetation; and contribution to abundance and diversity of wetland fauna.

To implement the method, the user(s) distinguished the wetland assessment areas (WAAs) based on hydrogeomorphic wetland class (Brinson 1993) and physical separation criteria. The user then visited the wetland assessment area and completed the inventory sheet by selecting conditions that best described various landscape, hydrologic, soils, vegetation variables. Vegetation types/species and pre-emptive status were also identified. Information from the inventory sheet was applied to the models which (a) contain variables, (b) list conditions for each variable, (c) assign a weight (scale 0-3) to conditions for each variable, and (d) provide space for calculating the functional capacity index (FCI). Functional Capacity Units (FCUs) may also have been calculated. The output of RAP is a measure of functional capacity of a site relative to the range of possible scores for a given model.

Wetland Rapid Assessment Procedure (WRAP)

The Wetland Rapid Assessment Procedure (WRAP) was designed to provide a consistent, timely regulatory tool for evaluating freshwater wetlands that have been created, enhanced, preserved, or restored through the regulatory programs of the South Florida Water Management District and the Environmental Resource Permit process. M-WRAP is a modified version of WRAP designed for use in reviewing mitigation banks and to aid in determining the number of credits. E-WRAP is a modified version of WRAP designed for use in the assessing estuarine systems and contains different descriptors in the models for the estuarine environment and policy guidance for the assessment of sites in mosquito impoundments.

Professional understanding of functions in Florida freshwater wetland ecosystems and familiarity with flora and fauna with respect to specific ecosystems are required to effectively utilize WRAP. Over 200 sites were visited during the development of WRAP.

The categories assessed include **s**ix variables: wildlife utilization; overstory/shrub canopy of desirable species; wetland vegetative ground cover of desirable species; adjacent upland/wetland buffer; field indicators of wetland hydrology; and water quality input and treatment.
The user(s) review(s) existing information (e.g., identify land uses adjacent to the site and on-site hydrology), visits the wetland area, and completes the data sheet. The data sheet (a) identifies the variables, (b) lists three or more calibration descriptors for each variable, and (c)

assigns a score (range 0 to 3) to each description. Scores for each variable are summed and divided by the maximum possible score to derive a WRAP score (scale 0.0-1.0) for the wetland.

The output of WRAP is a measure of functionality based on anthropogenic activities for a site. The estimated time for use of the method is *1 hour per acre of site* for in-office evaluation (step 1), which includes identifying the project site and adjacent land uses; and *1 hour* for field evaluation (step 2) and to score the wetland (step 3).

A particular system is evaluated on its own attributes and is not to be compared to a different type of system (i.e., marsh not be compared to a mangrove swamp). Also, WRAP is not intended to be used as a guide to design wetland mitigations or restorations.

WRAP has been used for mitigation bank reviews and by the USACOE for the review of permit actions (e.g., highways, residential, agriculture, and commercial projects). The current status report is the 15th version in five years. WRAP is supposed to be updated every five years. Statistical analysis of the data indicates that WRAP is highly repeatable and that there is no multicollinearity or correlation among variables (Pers. comm.: R. Miller and B. Gunsalus, SFWMD, May 28, 1998). To date, E-WRAP has not been field tested (Pers. comm.: D. Ferrell, USFWS, August 17, 1998).

Uniform Mitigation Assessment Method (UMAM)

The Florida Department of Environmental Protection (FDEP) and water management districts (WMDs), in cooperation with local governments and the relevant federal agencies, developed the Uniform Mitigation Assessment Method (UMAM) in Chapter 62-345, Florida Statutes (F.S.), in order fulfill the mandate of subsection 373.414(18), F.S., which required the establishment of a state-wide uniform mitigation assessment method to determine the amount of mitigation required for regulatory permits to offset adverse impacts to wetlands and other surface waters and to award and deduct mitigation bank credits.

Although the state of Florida directive did not include the US Army Corps of Engineers (USACOE) and other federal agencies, the USACOE Jacksonville office conducted a study of the method and recommended UMAM to be used for federal wetland regulatory purposes in Florida starting August 1, 2005. (However, the USACOE continues to use its own time lag table rather than the state's time lag table.)

UMAM applies to all wetland impacts subject to review under Section 373.414, F.S., excluding subparagraphs 373.414(1)(a) 1, 3, 5, and 6 and paragraph 373.414(1)(b) 3, F.S. UMAM provides a standardized procedure for assessing the functions provided by wetlands and other surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss. It does not assess whether the adverse impact meets other criteria for issuance of a permit, nor the extent to which such impacts may be approved.

The UMAM rule superseded existing ratio guidelines and other state of Florida requirements concerning the amount of mitigation required to offset an impact to wetlands or other surface waters. Upon a determination by a State agency that mitigation is required to offset a proposed impact, UMAM must be used to quantify the acreage of mitigation or the number of credits from a mitigation bank or regional offsite mitigation area required to offset the impact. UMAM is also used to determine the degree of improvement in ecological value of proposed mitigation bank activities. The rule state that when applying UMAM, reasonable scientific judgment must be used.

UMAM is not applicable to activities for which mitigation is not required; activities authorized under general permits under Part IV of Chapter 373, F.S., for which special forms of mitigation are specified in the rule establishing the general permit; activities in North Trail Basin and Bird Drive Basin in Miami-Dade County for which mitigation is specified in FDEP Permit Number 132416479, issued February 15, 1995 to Everglades National Park for a mitigation bank in the Hole in the Donut; activities for which mitigation is determined under Section 373.41492, F.S.; Florida Department of Transportation permit applications where mitigation is provided under a plan developed by a water management district and approved by FDEP final order pursuant to Section 373.4137, F.S.; activities for which mitigation is determined under Section 338.250, F.S. (Central Florida Beltway); impacts that are offset under the net improvement provision of subparagraph 373.414(1)(b)3, F.S.; fishing or recreational values, pursuant to subparagraph 373.414(1)(a)4, F.S.; or mitigation for mangrove trimming and alteration as required and implemented in accordance with Section 403.9332, F.S.

UMAM was not intended to supersede or replace existing rules regarding cumulative impacts, the prevention of secondary impacts, reduction and elimination of impacts, or to determine the appropriateness of the type of mitigation proposed.

An entity that has received a mitigation bank permit issued by the FDEP or a water management district prior to the adoption of the UMAM rule, or any mitigation bank with an application pending and permitted under the applicable rules, ordinances and special acts in effect prior to the adoption of this rule, must have impact sites assessed for the purpose of deducting bank credits using the credit assessment method, including any functional assessment methodology, that was in place when the bank was permitted. A permitted mitigation bank has the option to modify the mitigation bank permit to have its credits re-assessed under UMAM, and thereafter have its credits deducted using UMAM. In accordance with Section 373.4136, F.S., the number of credits awarded must be based on the degree of improvement in ecological value expected to result from the establishment and operation of the mitigation bank, as determined using UMAM.

Any application for a permit or other authorization involving mitigation, including mitigation banks, that is pending on or before the effective date of UMAM is to be reviewed under the applicable rules, ordinances, and special acts in effect before the effective date of UMAM, unless the applicant elects to amend the application to be reviewed under UMAM.

Applications to modify a conceptual, conceptual approval, standard, standard general or individual permit that was either issued prior to the effective date of UMAM or reviewed under

the applicable rules, ordinances and special acts in effect prior to the adoption of UMAM is evaluated under the mitigation assessment criteria used in the review of the permit, unless the applicant elects to have the application reviewed under UMAM or unless the proposed modification is reasonably expected to lead to substantially different or substantially increased water resource impacts.

An application for a permit under part IV of Chapter 373, F.S., for an activity associated with mining operations that qualifies for the exemption in subsection 373.414(15), F.S., is reviewed under the applicable rules identified in subsection 373.414(15), F.S.
There are many definitions specific to the UMAM process. These include:

(1) “Assessment area” means all or part of a wetland or surface water impact site, or a mitigation site, that is sufficiently homogeneous in character, impact, or mitigation benefits to be assessed as a single unit.

(2) “Reviewing agency” means the Florida Department of Environmental Protection, or any water management district, local government or other governmental agency required by subsection 373.414(18), F.S., to use this methodology.

(3) "Ecological value" means the value of functions performed by uplands, wetlands, and other surface waters to the abundance, diversity, and habitats of fish, wildlife, and listed species. Included are functions such as providing cover and refuge; breeding, nesting, denning, and nursery areas; corridors for wildlife movement; food chain support; natural water storage, natural flow attenuation, and water quality improvement which enhances fish, wildlife, and listed species utilization.

(4) “Impact site” means wetlands and other surface waters as delineated pursuant to Chapter 62-340, F.A.C. that would be impacted by the project. Uplands shall not be included as part of the impact site.

(5) “Indicators” means physical, chemical, or biological indications of wetland or other surface waters function.

(6) “Invasive Exotic” for purposes of this rule means animal species that are outside of their natural range or zone of dispersal and have or are able to form self-sustaining and expanding populations in communities in which they did not previously occur, and those plant species listed in the Florida Exotic Pest Plant Council’s 2001 List of Invasive Species Category I and II, which is incorporated by reference herein, and may be found on the Internet at www.fleppc.org or by writing to the Bureau of Beaches and Wetland Resources, Department of Environmental Protection, 2600 Blair Stone Road, MS 2500, Tallahassee, FL 32399-2400.

(7) “Listed species” means those animal species that are endangered, threatened or of special concern and are listed in Sections 68A-27.003, 68A-27.004, and 68A-27.005, F.A.C., and those plant species listed in 50 Code of Federal Regulations 17.12, when such plants are located in a wetland or other surface water.

(8) “Mitigation credit” or “credit” means a standard unit of measure which represents the increase in ecological value resulting from restoration, enhancement, preservation, or creation activities.

(9) "Mitigation site" means wetlands and other surface waters as delineated pursuant to Chapter 62-340, F.A.C., or uplands, that are proposed to be created, restored, enhanced, or preserved by the mitigation project.

(10) "With impact assessment" means the reasonably anticipated outcome at an assessment area assuming the proposed impact is conducted.

(11) "With mitigation assessment" means the outcome at an assessment area assuming the proposed mitigation is successfully conducted.

(12) "Without preservation assessment" means the reasonably anticipated outcome at an assessment area assuming the area is not preserved.

When an applicant proposes mitigation for impacts to wetlands and surface waters as part of an environmental resource permit or wetland resource permit application, the applicant is responsible for submitting the necessary supporting information for the application UMAM. The reviewing agency is then responsible for verifying this information and applying the UMAM assessment method to determine the amount of mitigation necessary to offset the proposed impacts. The same applies when the application is for a mitigation bank or regional mitigation permit.

UMAM is designed to be used in any type of impact site or mitigation site in any geographic region of the state of Florida. The inherent flexibility required for such a method is accomplished in a multi-part approach that consists of a qualitative characterization of both the impact and mitigation assessment areas (Part I) that describes the assessment area, identifies its native community type, and the functions provided to fish and wildlife and their habitat; and a quantitative assessment (Part II) of the impact and mitigation sites and the use of numerical scores to compare the reduction of ecological value due to proposed impacts to the gain in ecological value due to proposed mitigation; and to determine whether a sufficient amount of mitigation is proposed.

The purpose of the qualitative characterization (Part I) is to provide a framework for comparison of the assessment area to the optimal condition and location of that native community type. It provides a descriptive framework to characterize the assessment area and the functions provided by that area. Another purpose is to note any relevant factors of the assessment area that are discovered by site inspectors, including use by listed species.

Part II of this method provides indicators of wetland and other surface water function, which are scored based on the framework developed in Part I. Part I must be completed and referenced when scoring the assessment area in Part II. An impact or mitigation site may contain more than one assessment area, each of which is independently evaluated under this method.

The functional gain or loss for mitigation and impact assessment areas, respectively, is determined by applying the formulas in subsection 62-345.600(3), F.A.C., to ascertain the number of mitigation bank credits to be awarded and debited and the amount of mitigation needed to offset the impacts to wetlands and other surface waters.

The degree of ecological change on a site is determined for both the impact and mitigation assessment areas by the mathematical difference in the Part II scores between the current condition and a future condition. The future condition may be the "with-impact" condition, the future condition without preservation or the condition with (successful) mitigation. This difference is termed the "delta." This formula is applied to all assessment areas within proposed impact sites and mitigation sites (including mitigation banks and regional offsite mitigation areas when applicable).

In the Qualitative Characterization (Part I), an impact or mitigation assessment area is described with sufficient detail to provide a frame of reference for the type of community being evaluated and to identify the functions that will be evaluated. When an assessment area is an upland proposed as mitigation, functions are related to the benefits provided by that upland to fish and wildlife of associated wetlands or other surface waters. Information for each assessment area must be sufficient to identify the functions beneficial to fish and wildlife and their habitat that are characteristic of the assessment area's native community type, based on currently available information, such as aerial photographs, topographic maps, geographic information system data and maps, site visits, scientific articles, journals, other professional reports, field verification when needed, and reasonable scientific judgment. For artificial systems, such as borrow pits, ditches and canals, and for altered systems, reference is made to the native community type it most closely resembles. The information provided by the applicant for each assessment area must address the following, as applicable:

a) Special water classifications, such as whether the area is in an Outstanding Florida Water, an Aquatic Preserve, a Class II water approved, restricted, conditionally approved, conditionally restricted for shellfish harvesting, or an Area of Critical State Concern;

b) Significant nearby features that might affect the values of the functions provided by the assessment area, such as areas with regionally significant ecological resources or habitats (national or state parks, forests, or reserves; Outstanding National Resource Waters and associated watershed; Outstanding Florida Waters and associated watershed; other conservation areas), major industry, or commercial airport;

c) Assessment area size;

d) Geographic relationship and hydrologic connection between the assessment area and any contiguous wetland or other surface waters, or uplands, as applicable;

e) Classification of the assessment area's native community type, considering past alterations that affect the classification. Classification is based on Florida Land Use, Cover and Form Classification System (1999) (FLUCCS) codes. In addition, the applicant can further classify the assessment area using the 26 Communities of Florida (Soils Conservation Service February 1981), A Hydrogeomorphic Classification for Wetlands (Wetland Research Program Technical Report WRP-DE-4, Mark M. Brinson August 1993), or other sources that, based on reasonable scientific judgment, describe the natural communities in Florida;

f) Uniqueness when considering the relative rarity of the wetland or other surface water and floral and faunal components, including listed species, on the assessment area in relation to the surrounding regional landscape;

g) Functions performed by the assessment area's native community type. Functions to be considered are: providing cover, substrate, and refuge; breeding, nesting, denning, and nursery areas; corridors for wildlife movement; food chain support; and natural water storage, natural flow attenuation, and water quality improvement, which enhances fish, wildlife, and listed species utilization;

h) Anticipated wildlife utilization and type of use (feeding, breeding, nesting, resting, or denning), and applicable listing classifications (threatened, endangered, or species of special concern as defined by Rules 68A-27.003, 68A-27.004 and 68A-27.005, F.A.C.). The list developed for the assessment area need not include all species which use the area, but must include all listed species in addition to those species that are characteristic of the native community type, considering the size and geographic location of the assessment area. Generally, wildlife surveys will not be required. The need for a wildlife survey will be determined by the likelihood that the site is used by listed species, considering site characteristics and the range and habitat needs of such species, and whether the proposed system will impact that use;

i) Whether any portion of the assessment area has been previously used as mitigation for a prior issued permit; and

j) Any additional information that is needed to accurately characterize the ecological values of the assessment area and functions provided.

The Assessment and Scoring (Part II) utilizes the frame of reference established in Part I. The information obtained under Part II is used to determine the degree to which the assessment area provides the functions identified in Part I and the amount of function lost or gained by the project. Each impact assessment area and each mitigation assessment area is assessed under two conditions:

(a) The current pre-project condition or, in the case of preservation mitigation, without preservation – For assessment areas where previous impacts that affect the current condition are temporary in nature, consideration is given to the inherent functions of these areas relative to seasonal hydrologic changes, and expected vegetation regeneration and projected habitat functions if the use of the area were to remain unchanged. When evaluating impacts to a previously permitted mitigation site that has not achieved its intended function, the reviewing agency considers the functions the mitigation site was intended to offset and any delay or reduction in offsetting those functions that may be caused by the project. Previous construction or alteration undertaken in violation of Part IV, Chapter 373, F.S., or Sections 403.91-.929, F.S. (1984 Supp.), as amended, or rule, order or permit adopted or issued thereunder, will not be considered as having diminished the condition and relative value of a wetland or surface water, when assigning a score under this part. When evaluating wetlands or other surface waters that are within an area that is subject to a recovery strategy pursuant to Chapter 40D-80, F.A.C., impacts from water withdrawals will not be considered when assigning a score under this part.

And (b) "With mitigation" or "with impact" post project– The "with mitigation" and "with impact" assessments are based on the reasonably expected outcome, which may

represent an increase, decrease, or no change in value relative to current conditions. For the "with impact" and "with mitigation" assessments, the evaluator will assume that all other necessary regulatory authorizations required for the proposed project have been obtained and that construction will be consistent with such authorizations. The "with mitigation" assessment will be scored only when reasonable assurance has been provided that the proposed plan can be conducted.

When the "with impact" outcome is upland, the "with impact" scores for each of the wetland indicators of function shall be zero (0).

Upland mitigation assessment areas are scored using the location and community structure indicators listed in subsection 62-345.500(6), F.A.C. Scoring of these indicators for the upland assessment areas are based on benefits provided to the fish and wildlife of the associated wetlands or other surface waters, considering the current or anticipated ecological value of those wetlands and other surface waters.

For upland preservation, the gain in ecological value is determined by the mathematical difference between the score of the upland assessment area with the proposed preservation measure and the upland assessment area without the proposed preservation measure. When the community structure is scored as "zero", then the location and landscape support shall also be "zero". The resulting delta is then multiplied by the preservation adjustment factor contained in subsection 62-345.500(3), F.A.C.

For upland enhancement or restoration, the value provided is determined by the mathematical difference between the score of the upland assessment area with the proposed restoration or enhancement measure and the current condition of the upland assessment area.

For uplands proposed to be converted to wetlands or other surface waters through creation or restoration measures, the upland areas are scored as "zero" in their current condition. Only the "with mitigation" assessment shall be scored in accordance with the indicators listed in subsection 62-345.500(6), F.A.C.

When preservation is assessed, the "with mitigation" assessment s considers the potential of the assessment area to perform current functions in the long term, considering the protection mechanism proposed, and the "without preservation" assessment shall evaluate the assessment area's functions considering the extent and likelihood of what activities would occur if it were not preserved, the temporary or permanent effects of those activities, and the protection provided by existing easements, restrictive covenants, or state, federal, and local rules, ordinances and regulations. The gain in ecological value is determined by the mathematical difference between the Part II scores for the "with mitigation" and "without preservation" (the delta) multiplied by a preservation adjustment factor. The preservation adjustment factor is scored on a scale from 0 (no preservation value) to 1 (optimal preservation value), in one-tenth increments. The score is assigned based on the applicability and relative significance of the following considerations:

1. The extent to which proposed management activities within the preserve area promote natural ecological conditions such as fire patterns or the exclusion of invasive exotic species;
2. The ecological and hydrological relationship between wetlands, other surface waters, and uplands to be preserved;
3. The scarcity of the habitat provided by the proposed preservation area and the degree to which listed species use the area;
4. The proximity of the area to be preserved to areas of national, state, or regional ecological significance, such as national or state parks, Outstanding Florida Waters, and other regionally significant ecological resources or habitats, such as lands acquired or to be acquired through governmental or non-profit land acquisition programs for environmental conservation, and whether the areas to be preserved include corridors between these habitats.; and
5. The extent and likelihood of potential adverse impacts if the assessment area were not preserved.

The preservation adjustment factor is multiplied by the mitigation delta assigned to the preservation proposal to yield an adjusted mitigation delta for preservation.

The functional evaluation is based on currently available information, such as aerial photographs, topographic maps, geographic information system data and maps, site visits, scientific articles, journals, other professional reports, and reasonable scientific judgment.

Indicators of wetland and other surface water function listed in Part II are scored on a relative scale of zero to ten, based on the level of function that benefits fish and wildlife. For the purpose of providing guidance, descriptions are given for four general categories of scores: optimal (10), moderate (7), minimal (4), and not present (0). Any whole number score between 0-10 may be used that is a best fit to a single or combination of descriptions and in relation to the optimal level of function of that community type or habitat.

Three categories of indicators of wetland function (location and landscape support, water environment and community structure) listed below are scored to the extent that they affect the ecological value of the assessment area. Upland mitigation assessment areas shall be scored for location and community structure only.

1) Location and Landscape Support – The value of functions provided by an assessment area to fish and wildlife are influenced by the landscape position of the assessment area and its relationship with surrounding areas. While the geographic location of the assessment area does not change, the ecological relationship between the assessment area and surrounding landscape may vary from the current condition to the “with impact” and “with mitigation” conditions. Many species that nest, feed or find cover in a specific habitat or habitat type are also dependent in varying degrees upon other habitats, including upland, wetland and other surface waters, that are present in the regional landscape. For example, many amphibian species require small isolated wetlands for

breeding pools and for juvenile life stages, but may spend the remainder of their adult lives in uplands or other wetland habitats. If these habitats are unavailable or poorly connected in the landscape or are degraded, then the value of functions provided by the assessment area to the fish and wildlife identified in Part I is reduced. The location of the assessment area shall be considered to the extent that fish and wildlife utilizing the area have the opportunity to access other habitats necessary to fulfill their life history requirements. The availability, connectivity, and quality of offsite habitats, and offsite land uses which might adversely impact fish and wildlife utilizing these habitats, are factors to be considered in assessing the location of the assessment area. The location of the assessment area shall be considered relative to offsite and upstream hydrologic contributing areas and to downstream and other connected waters to the extent that the diversity and abundance of fish and wildlife and their habitats is affected in these areas. The opportunity for the assessment area to provide offsite water quantity and quality benefits to fish and wildlife and their habitats downstream and in connected waters is assessed based on the degree of hydrologic connectivity between these habitats and the extent to which offsite habitats are affected by discharges from the assessment area. It is recognized that isolated wetlands lack surface water connections to downstream waters and as a result, do not perform certain functions (e.g., detrital transport) to benefit downstream fish and wildlife; for such wetlands, this consideration does not apply.

a. A score of (10) means the assessment area is ideally located and the surrounding landscape provides full opportunity for the assessment area to perform beneficial functions at an optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    i. Habitats outside the assessment area represent the full range of habitats needed to fulfill the life history requirements of all wildlife listed in Part I and are available in sufficient quantity to provide optimal support for these wildlife.
    ii. Invasive exotic or other invasive plant species are not present in the proximity of the assessment area.
    iii. Wildlife access to and from habitats outside the assessment area is not limited by distance to these habitats and is unobstructed by landscape barriers.
    iv. Functions of the assessment area that benefit downstream fish and wildlife are not limited by distance or barriers that reduce the opportunity for the assessment area to provide these benefits.
    v. Land uses outside the assessment area have no adverse impacts on wildlife in the assessment area as listed in Part I.
    vi. The opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas is not limited by hydrologic impediments or flow restrictions.
    vii. Downstream or other hydrologically connected habitats are critically or solely dependent on discharges from the assessment area and could suffer severe adverse impacts if the quality or quantity of these discharges were altered.
    viii. For upland mitigation assessment areas, the uplands are located so as to provide optimal protection of wetland functions.

b. A score of (7) means that, compared to the ideal location, the location of the assessment area limits its opportunity to perform beneficial functions to 70% of the optimal ecological value. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    i. Habitats outside the assessment area are available in sufficient quantity and variety to provide optimal support for most, but not all, of the wildlife listed in Part I, or certain wildlife populations may be limited due to the reduced availability of habitats needed to fulfill their life history requirements.
    ii. Some of the plant community composition in the proximity of the assessment area consists of invasive exotic or other invasive plant species, but cover is minimal and has minimal adverse effect on the functions provided by the assessment area.
    iii. Wildlife access to and from habitats outside the assessment area is partially limited, either by distance or by the presence of barriers that impede wildlife movement.
    iv. Functions of the assessment area that benefit fish and wildlife downstream are somewhat limited by distance or barriers that reduce the opportunity for the assessment area to provide these benefits.
    v. Land uses outside the assessment area have minimal adverse impacts on fish and wildlife identified in Part I.
    vi. The opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas is limited by hydrologic impediments or flow restrictions such that these benefits are provided with lesser frequency or lesser magnitude than would occur under optimal conditions.
    vii. Downstream or other hydrologically connected habitats derive significant benefits from discharges from the assessment area and could suffer substantial adverse impacts if the quality or quantity of these discharges were altered.
    viii. For upland mitigation assessment areas, the uplands are located so as to provide significant, but suboptimal, protection of wetland functions.

c. A score of (4) means that, compared to the ideal location, the assessment area location limits its opportunity to perform beneficial functions to 40% of the optimal ecological value. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    i. Availability of habitats outside the assessment area is fair, but fails to provide support for some species of wildlife listed in Part I, or provides minimal support for many of the species listed in Part I.
    ii. The majority of the plant community composition in the proximity of the assessment area consists of invasive exotic or other invasive plant species that adversely affect the functions provided by the assessment area.
    iii. Wildlife access to and from habitats outside the assessment area is substantially limited, either by distance or by the presence of barriers which impede wildlife movement.

iv. Functions of the assessment area that benefit fish and wildlife downstream are limited by distance or barriers which substantially reduce the opportunity for the assessment area to provide these benefits.
v. Land uses outside the assessment area have significant adverse impacts on fish and wildlife identified in Part I.
vi. The opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas is limited by hydrologic impediments or flow restrictions, such that these benefits are rarely provided or are provided at greatly reduced levels compared to optimal conditions.
vii. Downstream or other hydrologically connected habitats derive minimal benefits from discharges from the assessment area but could be adversely impacted if the quality or quantity of these discharges were altered.
viii. For upland mitigation assessment areas, the uplands are located so as to provide minimal protection of wetland functions.

d. A score of (0) means that the location of the assessment area provides no habitat support for wildlife utilizing the assessment area and no opportunity for the assessment area to provide benefits to fish and wildlife outside the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    i. No habitats are available outside the assessment area to provide any support for the species of wildlife listed in Part I.
    ii. The plant community composition in the proximity of the assessment area consists predominantly of invasive exotic or other invasive plant species such that little or no function is provided by the assessment area.
    iii. Wildlife access to and from habitats outside the assessment area is precluded by barriers or distance.
    iv. Functions of the assessment area that would be expected to benefit fish and wildlife downstream are not present.
    v. Land uses outside the assessment area have a severe adverse impact on wildlife in the assessment area as listed in Part I.
    vi. There is negligible or no opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas due to hydrologic impediments or flow restrictions that preclude provision of these benefits.
    vii. Discharges from the assessment area provide negligible or no benefits to downstream or hydrologically connected areas and these areas would likely be unaffected if the quantity or quality of these discharges were altered.
    viii. For upland mitigation assessment areas, the uplands are located so as to provide no protection of wetland functions.

2) Water Environment – The quantity of water in an assessment area, including the timing, frequency, depth and duration of inundation or saturation, flow characteristics, and the quality of that water, may facilitate or preclude its ability to perform certain functions and may benefit or adversely impact its capacity to support certain wildlife. Hydrologic requirements and tolerance to hydrologic alterations and water quality variations vary by

ecosystem type and the wildlife utilizing the ecosystem. Hydrologic conditions within an assessment area, including water quantity and quality, must be evaluated to determine the effect of these conditions on the functions performed by area and the extent to which these conditions benefit or adversely affect wildlife. Water quality within wetlands and other surface waters is affected by inputs from surrounding and upstream areas and the ability of the wetland or surface water system to assimilate those inputs. Water quality within the assessment area can be directly observed or can be inferred based on available water quality data, on-site indicators, adjacent land uses and estimated pollutant removal efficiencies of contributing surface water management systems. Hydrologic conditions in the assessment area are a result of external hydrologic inputs and the water storage and discharge characteristics of the assessment area. Landscape features outside the assessment area, such as impervious surfaces, borrow pits, levees, berms, swales, ditches, canals, culverts, or control structures, may affect hydrologic conditions in the assessment area. Surrounding land uses may also affect hydrologic conditions in the assessment area if these land uses increase discharges to the assessment area, such as agricultural discharges of irrigation water, or decrease discharges, such as wellfields or mined areas.

a. A score of (10) means that the hydrology and water quality fully supports the functions and provides benefits to fish and wildlife at optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    i. Water levels and flows appear appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.
    ii. Water level indicators are distinct and consistent with expected hydrologic conditions for the type of system being evaluated.
    iii. Soil moisture is appropriate for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects. No evidence of soil desiccation, oxidation or subsidence is observed.
    iv. Soil erosion or deposition patterns are not atypical or indicative of altered flow rates or points of discharge.
    v. Evidence of fire history does not indicate atypical fire frequency or severity due to excessive dryness.
    vi. Vegetation or benthic community zonation in all strata are appropriate for the type of system being evaluated and does not indicate atypical hydrologic conditions.
    vii. Vegetation shows no signs of hydrologic stress such as excessive mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with hydrologic stress.
    viii. Presence or evidence of use by animal species with specific hydrologic requirements is consistent with expected hydrologic conditions for the system being evaluated.
    ix. Plant community composition is not characterized by species tolerant of and associated with water quality degradation or alterations in frequency, depth, and duration in inundation or saturation.
    x. Direct observation of standing water indicates no water quality degradation such as discoloration, turbidity, or oil sheen.

xi. Existing water quality data indicates conditions are optimal for the type of community and would fully support the ecological values of the area.
xii. Water depth, wave energy, currents and light penetration are optimal for the type of community being evaluated.

b. A score of (7) means that the hydrology and water quality supports the functions and provides benefits to fish and wildlife at 70% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    i. Water levels and flows are slightly higher or lower than appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.
    ii. Water level indicators are not as distinct or as consistent as expected for hydrologic conditions for the type of system being evaluated.
    iii. Although soil oxidation or subsidence is minimal, soils are drier than expected for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.
    iv. Soil erosion or deposition patterns indicate minor alterations in flow rates or points of discharge.
    v. Fire history evidence indicates that fire frequency or severity may be more than expected for the type of system being evaluated, possibly due to dryness.
    vi. Vegetation or benthic community zonation in some strata is inappropriate for the type of system being evaluated, indicating atypical hydrologic conditions.
    vii. Vegetation has slightly greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with some hydrologic stress.
    viii. Presence or evidence of use by animal species with specific hydrologic requirements is less than expected or species present have more generalized hydrologic requirements.
    ix. Some of the plant community composition consists of species tolerant of and associated with moderate water quality degradation or alterations in frequency, depth, and duration in inundation or saturation.
    x. Direct observation of standing water indicates slight water quality degradation such as discoloration, turbidity, or oil sheen.
    xi. Existing water quality data indicates slight deviation from what is normal, but these variations in parameters, such as salinity or nutrient loading, are not expected to cause more than minimal ecological effects.
    xii. Water depth, wave energy, currents and light penetration are generally sufficient for the type of community being evaluated but are expected to cause some changes in species, age classes and densities.

c. A score of (4) means that the hydrology and water quality supports the functions and provides benefits to fish and wildlife at 40% of the optimal capacity for the assessment area. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

i. Water levels and flows are moderately higher or lower than appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.
ii. Water level indicators are not distinct and are not consistent with the expected hydrologic conditions for the type of system being evaluated.
iii. Soil moisture has deviated from what is appropriate for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects. Strong evidence of soil desiccation, oxidation or subsidence is observed.
iv. Soil erosion or deposition patterns are strongly atypical and indicative of alterations in flow rates or points of discharge.
v. Fire history evidence indicates that fire frequency or severity may be much more than expected for the type of system being evaluated, possibly due to dryness.
vi. Vegetation or benthic community zonation in most strata is inappropriate for the type of system being evaluated, indicating atypical hydrologic conditions.
vii. Vegetation has strong evidence of greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease associated with hydrologic stress.
viii. Presence or evidence of use by animal species with specific hydrologic requirements is greatly reduced from expected or those species present have more generalized hydrologic requirements.
ix. Much of the plant community composition consists of species tolerant of and associated with moderate water quality degradation or alterations in frequency, depth, and duration in inundation or saturation.
x. Direct observation of standing water indicates moderate water quality degradation such as discoloration, turbidity, or oil sheen.
xi. Existing water quality data indicates moderate deviation from normal for parameters such as salinity or nutrient loading, so that ecological effects would be expected.
xii. Water depth, wave energy, currents and light penetration are not well suited for the type of community being evaluated and are expected to cause significant changes in species, age classes and densities.

d. A score of (0) means that the hydrology and water quality does not support the functions and provides no benefits to fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    i. Water levels and flows exhibit an extreme degree of deviation from what is appropriate, considering seasonal variation, tidal cycle, antecedent weather and other climatic effects.
    ii. Water level indicators are not present or are greatly inconsistent with expected hydrologic conditions for the type of system being evaluated.
    iii. Soil moisture has deviated from what is appropriate for the type of system being evaluated, considering seasonal variation, tidal cycle, antecedent

weather and other climatic effects. Strong evidence of substantial soil desiccation, oxidation or subsidence is observed.

iv. Soil erosion or deposition patterns are greatly atypical or indicative of greatly altered flow rates or points of discharge.

v. Fire history indicates great deviation from typical fire frequency or severity, due to extreme dryness.

vi. Vegetation or benthic community zonation in all strata is inappropriate for the type of system being evaluated, indicating atypical hydrologic conditions.

vii. Vegetation has strong evidence of much greater than normal mortality, leaning or fallen trees, thinning canopy or signs of insect damage or disease which may be associated with hydrologic stress.

viii. Presence or evidence of use by animal species with specific hydrologic requirements is lacking and those species present have generalized hydrologic requirements.

ix. The plant community composition consists predominantly of species tolerant of and associated with highly degraded water or alterations in frequency, depth, and duration in inundation or saturation.

x. Direct observation of standing water indicates significant water quality degradation such as obvious discoloration, turbidity, or oil sheen.

xi. Existing water quality data indicates large deviation from normal for parameters such as salinity or nutrient loading, so that adverse ecological effects would be expected.

xii. Water depth, wave energy, currents and light penetration are inappropriate for the type of community (species, age classes and densities) being evaluated.

3) Community Structure – Each impact and mitigation assessment area is evaluated with regard to its characteristic community structure. In general, a wetland or other surface water is characterized either by plant cover or by open water with a submerged benthic community. Wetlands and surface waters characterized by plant cover will be scored according to subparagraph 62-345.500(6) (c) 1., F.A.C., while benthic communities will be assessed in accordance with subparagraph 62-345.500(6)(c)2., F.A.C. If the assessment area is a mosaic of relatively equal parts of submerged plant cover and a submerged benthic community, then both of these indicators will be scored and those scores averaged to obtain a single community structure score.

a. Vegetation and structural habitat – The presence, abundance, health, condition, appropriateness, and distribution of plant communities in surface waters, wetlands, and uplands can be used as indicators to determine the degree to which the functions of the community type identified are provided. Vegetation is the base of the food web in any community and provides many additional structural habitat benefits to fish and wildlife. In forested systems, for example, the vertical structure of trees, tree cavities, standing dead snag, and fallen logs provide forage, nesting, and cover habitat for wildlife. Topographic features, such as flats, deeper depressions, hummocks, or tidal creeks also provide important structure for fish and wildlife habitat. Overall condition of a plant community can often be evaluated by observing indicators such as dead or dying vegetation, regeneration

and recruitment, size and age distribution of trees and shrubs, fruit production, chlorotic or spindly plant growth, structure of the vegetation strata, and the presence, coverage and distribution of inappropriate plant species. Human activities such as mowing, grazing, off-road vehicle activity, boat traffic, and fire suppression constitute more direct and easily observable impacts affecting the condition of plant communities. Although short-term environmental factors such as excessive rainfall, drought, and fire can have temporary impacts, human activities such as flooding, drainage via groundwater withdrawal and conveyance canals, or construction of permanent structures such as seawalls in an aquatic system can permanently damage these systems. The plant community should be evaluated to consider whether natural successional patterns for the community type are permanently altered. Inappropriate plants, including invasive exotic species, other invasive species, or other species atypical of the community type being evaluated, do not support the functions attributable to that community type and can out-compete and replace native species. Native upland and wetland vegetation, such as wax myrtle, pines and willow, which are not typically considered as invasive, can occur in numbers and coverage not appropriate for the community type and can serve as indicators of disturbance. The relative degree of coverage by inappropriate species, inappropriate vegetation strata, condition of vegetation, and both biotic and abiotic structure all provide an indication of the degree to which the functions anticipated for the community type identified are being provided.

i. A score of (10) means that the vegetation community and physical structure provide conditions which support an optimal level of function to benefit fish and wildlife utilizing the assessment area as listed in Part I. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:
    - I. All or nearly all of the plant cover is by appropriate and desirable plant species in the canopy, shrub, or ground stratum.
    - II. Invasive exotic or other invasive plant species are not present.
    - III. There is strong evidence of normal regeneration and natural recruitment.
    - IV. Age and size distribution is typical of the system, with no indication of deviation from normal successional or mortality pattern.
    - V. The density and quality of coarse woody debris, snag, den, and cavity provide optimal structural habitat for that type of system.
    - VI. Plants are in good condition, with very little to no evidence of chlorotic or spindly growth or insect damage.
    - VII. Land management practices are optimal for long term viability of the plant community.
    - VIII. Topographic features, such as refugia ponds, creek channels, flats or hummocks, are present and normal for the area being assessed.

IX. If submerged aquatic plant communities are present, there is no evidence of siltation or algal growth that would impede normal aquatic plant growth.

X. If an upland mitigation assessment area, the plant community and physical structure provide an optimal level of habitat and life history support for fish and wildlife in the associated wetlands or other surface waters.

ii. A score of (7) means that the level of function provided by plant community and physical structure is limited to 70% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

XI. Majority of plant cover is by appropriate and desirable plant species in the canopy, shrub, or ground stratum.

XII. Invasive exotic or other invasive plant species are present, but cover is minimal.

XIII. There is evidence of near-normal regeneration or natural recruitment.

XIV. Age and size distribution approximates conditions typical of that type of system, with no indication of permanent deviation from normal successional or mortality pattern, although there may have been temporary deviations or impacts to age and size distribution.

XV. Coarse woody debris, snags, dens, and cavities have either slightly lower than or slightly greater than normal quantity due to deviation from expected age structure or land management.

XVI. Plant condition is generally good condition, with little evidence of chlorotic or spindly growth or insect damage.

XVII. Land management practices are generally appropriate, but there may be some fire suppression or water control features that have caused a shift in the plant community.

XVIII. Topographic features, such as refugia ponds, creek channels, flats or hummocks, are slightly less than optimal for the area being assessed.

XIX. In submerged aquatic plant communities, there is a minor degree of siltation or algal growth that would impede normal aquatic plant growth.

XX. If an upland mitigation assessment area, the plant community and physical structure provide high, but less than optimal, level of habitat and life history support for fish and wildlife in the associated wetlands or other surface waters.

iii. A score of (4) means that the level of function provided by the plant community and physical structure is limited to 40% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

XXI. Majority of plant cover is by inappropriate or undesirable plant species in the canopy, shrub, or ground stratum.

XXII. Majority of the plant cover and presence is comprised of invasive exotic or other invasive plant species.

XXIII. There is minimal evidence of regeneration or natural recruitment.

XXIV. Age and size distribution is atypical of the system and indicative of permanent deviation from normal successional pattern, with greater than expected amount of dead or dying vegetation.

XXV. Coarse woody debris, snags, dens, and cavities are either not present or greater than normal because the native vegetation is dead or dying.

XXVI. Generally poor plant condition, such as chlorotic or spindly growth or insect damage.

XXVII. Land management practices have resulted in partial removal or alteration of natural structures or introduction of some artificial features, such as furrows or ditches.

XXVIII. Reduction in extent of topographic features, such as refugia ponds, creek channels, flats or hummocks, from what is normal for the area being assessed.

XXIX. In submerged aquatic plant communities, there is a moderate degree of siltation or algal growth.

XXX. If an upland mitigation assessment area, the plant community and physical structure provide moderate level of habitat and life history support for fish and wildlife in the associated wetlands or other surface waters.

iv. A score of (0) means that the vegetation communities and structural habitat do not provide functions to benefit fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

XXXI. No appropriate or desirable plant species in the canopy, shrub, or ground stratum.

XXXII. High presence and cover by invasive exotic or other invasive plant species.

XXXIII. There is no evidence of regeneration or natural recruitment.

XXXIV. High percentage of dead or dying vegetation, with no typical age and size distribution.

XXXV. Coarse woody debris, snags, dens, and cavities are either not present or exist only because the native vegetation is dead or dying.

XXXVI. Overall very poor plant condition, such as highly chlorotic or spindly growth or extensive insect damage.

XXXVII. Land management practices have resulted in removal or alteration of natural structure or introduction of artificial features, such as furrows or ditches.

XXXVIII. Lack of topographic features such as refugia ponds, creek channels, flats or hummocks that are normal for the area being assessed.

XXXIX. In submerged aquatic plant communities, there is a high degree of siltation or algal growth.

XL. If an upland mitigation assessment area, the plant community and physical structure provide little or no habitat and life history support for fish and wildlife in the associated wetland or other surface waters.

b. Benthic Communities – This indicator is intended to be used in marine or freshwater aquatic systems that are not characterized by a plant community, and is not intended to be used in wetlands that are characterized by a plant community. The benthic communities within nearshore, inshore, marine and freshwater aquatic systems are analogous to the vascular plant communities of terrestrial wetland systems in that they provide food and habitat for other biotic components of the system and function in the maintenance of water quality. For example, oyster bars and beds in nearshore habitats and estuaries filter large amounts of particulate matter and provide food and habitat for a variety of species, such as boring sponges, mollusks, and polychaete worms. Live hardbottom community composition varies with water depths and substratum, but this community type contributes to the food web, as well as providing three-dimensional structure through the action of reef-building organisms and rock-boring organisms and water quality benefits from filter-feeding organisms. The distribution and quality of coral reefs reflect a balance of water temperature, salinity, nutrients, water quality, and presence of nearby productive mangrove and seagrass communities. Coral reefs contribute to primary productivity of the marine environment as well as creating structure and habitat for a large number of organisms. Even benthic infauna of soft-bottom systems stabilize the substrate, provide a food source, and serve as useful indicators of water quality. All of these communities are susceptible to human disturbance through direct physical damage, such as dredging, filling, or boating impacts, and indirect damage through changes in water quality, currents, and sedimentation.

i. A score of (10) means that the benthic communities are indicative of conditions that provide optimal support for all of the functions typical of the assessment area and provide optimal benefit to fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

XLI. The appropriate species number and diversity of benthic organisms are optimal for the type of system.

XLII. Non-native or inappropriate species are not present and the site is not near an area with such species.

XLIII. Natural regeneration, recruitment, and age distribution are optimal.

XLIV. Appropriate species are in good condition, with typical biomass.

XLV. Structural features are typical of the system with no evidence of past physical damage.

XLVI. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, are typical of that type of habitat and optimal for the benthic community being evaluated.

XLVII. Spawning or nesting habitats, such as rocky or sandy bottoms, are optimal for the community type.

ii. A score of (7) means that, relative to ideal habitat, the benthic communities of the assessment area provide functions at 70% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

XLVIII. Majority of the community is composed of appropriate species; the number and diversity of benthic organisms slightly less than typical.

XLIX. Any non-native or inappropriate species present represent a minority of the community or the site is immediately adjacent to an area with such species.

L. Natural regeneration or recruitment is slightly less than expected.

LI. Appropriate species are in generally good condition, with little reduction in biomass from what is optimal.

LII. Structural features are close to that typical of the system, or little evidence of past physical damage.

LIII. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, indicate slight deviation from what is expected and is less than optimal for the benthic community being evaluated.

LIV. Spawning or nesting habitats, such as rocky or sandy bottoms, are less than expected.

iii. A score of (4) means that, relative to ideal habitat, the benthic communities of the assessment area provide functions to 40% of the optimal level. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

LV. Appropriate species number or diversity of benthic organisms is greatly decreased from typical.

LVI. Majority of species present is non-native or inappropriate species or the site is immediately adjacent to an area heavily infested by such species.

LVII. Natural regeneration or recruitment is minimal.

LVIII. Substantial number of appropriate species are dying or in poor condition, resulting in much lower than normal biomass.

LIX. Structural features are atypical of the system, or there is evidence of great or long term physical damage.

LX. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, are greatly reduced from what is expected and is not appropriate for the benthic community being evaluated.

LXI. Few spawning or nesting habitats, such as rocky or sandy bottoms, are available.

iv. A score of (0) means that the benthic communities do not support the functions identified and do not provide benefits to fish and wildlife. The score is based on reasonable scientific judgment and characterized by a predominance of the following, as applicable:

LXII. Lack of appropriate species and diversity of those species; any appropriate species present are in poor condition.

LXIII. Non-native or inappropriate species are dominant.

LXIV. There is no indication of natural regeneration or recruitment.

LXV. Structural integrity is very low or non-existent, or there is evidence of serious physical damage.

LXVI. Topographic features, such as relief, stability, and interstitial spaces for hardbottom and reef communities or snags and coarse woody debris in riverine systems, are lacking.

LXVII. No spawning or nesting habitats, such as rocky or sandy bottoms, are present.

The Part II score for an impact, wetland, or surface water mitigation assessment area is determined by summing the scores for each of the indicators and dividing that value by 30 to yield a number between 0 and 1. For upland mitigation assessment areas, the Part II score is determined by summing the scores for the location and community structure indicators and dividing that value by 20 to yield a number between 0 and 1.

Time lag is incorporated into the gain in ecological value of the proposed mitigation as follows:

(a) The time lag associated with mitigation means the period of time between the loss of functions at an impact site and the achievement of the outcome that was scored in Part II. In general, the time lag varies by the type and timing of mitigation in relation to the impacts. Wetland creation generally requires a greater time lag than most enhancement activities in order to establish certain wetland functions. Forested systems typically require more time than most herbaceous systems to establish characteristic structure and function. Factors to consider when assigning time lag include biological, physical, and chemical processes associated with nutrient cycling, hydric soil development, and community development and succession. There is no time lag if the mitigation fully offsets the anticipated impacts prior to or at the time of impact.

(b) The time lag factor under this section shall be scored as 1 when evaluating mitigation for proposed phosphate and heavy mineral mining activities in accordance with this rule to determine compliance with section 373.414(6)(b), F.S.

(c) For the purposes of this rule, the time lag, in years, is related to a factor (T-factor) as established in Table 9 below, to reflect the additional mitigation needed to account for the deferred replacement of wetland or surface water functions.

(d) The "Year" column in Table 9 represents the number of years between the time the wetland impacts are anticipated to occur and the time when the mitigation is anticipated to fully offset the impacts, based on reasonable scientific judgment of the proposed mitigation activities and the site specific conditions.

Year	T-factor
≤1	1
2	1.03
3	1.07
4	1.10
5	1.14
6 – 10	1.25
11 – 15	1.46
16 – 20	1.68
21 – 25	1.92
26 – 30	2.18
31 – 35	2.45
36 – 40	2.73
41 – 45	3.03
46 – 50	3.34
51 – 55	3.65
>55	3.91

Table 9: UMAM time lag (T) factors

Mitigation risk is to be evaluated to account for the degree of uncertainty that the proposed conditions will be achieved, resulting in a reduction in the ecological value of the mitigation assessment area. In general, mitigation projects which require longer periods of time to replace lost functions or to recover from potential perturbations will be considered to have higher risk that those which require shorter periods of time. The assessment area shall be scored on a scale from 1 (for no or de minimus risk) to 3 (high risk), on quarter-point (0.25) increments. A score of one would most often be applied to mitigation conducted in an ecologically viable landscape and

deemed successful or clearly trending towards success prior to impacts, whereas a score of three would indicate an extremely low likelihood of success based on the ecological factors below. A single risk score shall be assigned, considering the applicability and relative significance of the factors below, based upon consideration of the likelihood and the potential severity of reduction in ecological value due to these factors:

(a) The vulnerability of the mitigation to and the extent of the effect of hydrologic conditions different than those proposed, considering the degree of dependence on mechanical or artificial means to achieve proposed hydrologic conditions, such as pumps or adjustable weirs, effects of water withdrawals, diversion or drainage features, reliability of the hydrologic data, modeling, and design, unstable conditions due to waves, wind, or currents, and the hydrologic complexity of the proposed community. Systems with relatively simple and predictable hydrology, such as tidal wetlands, would entail less risk than complex hydrological systems such as seepage slopes or perched wetlands;

(b) The vulnerability of the mitigation to the establishment and long-term viability of plant communities other than that proposed, and the potential reduction in ecological value which might result, considering the compatibility of the site soils and hydrologic conditions with the proposed plant community, planting plans, and track record for community or plant establishment method;

(c) The vulnerability of the mitigation to colonization by invasive exotic or other invasive species, considering the location of recruitment sources, the suitability of the site for establishment of these species, the degree to which the functions provided by plant community would be affected;

(d) The vulnerability of the mitigation to degraded water quality, considering factors such as current and future adjacent land use, and construction, operation, and maintenance of surface water treatment systems, to the extent that ecological value is affected by these changes;

(e) The vulnerability of the mitigation to secondary impacts due to its location, considering potential land use changes in surrounding area, existing protection provided to surrounding areas by easements, restrictive covenants, or federal, state, or local regulations, and the extent to which these factors influence the long term viability of functions provided by the mitigation site; and

(f) The vulnerability of the mitigation to direct impacts, considering its location and existing and proposed protection provided to the mitigation site by easements, restrictive covenants, or federal, state, or local regulations, and the extent to which these measures influence the long term viability of the mitigation site.

The relative gain of functions provided by a mitigation assessment area is then adjusted for time lag and risk using the following formula: Relative functional gain (RFG) = Mitigation Delta (or adjusted mitigation delta for preservation)/ (risk x t-factor). The loss of functions provided by impact assessment areas is determined using the following formula: Functional loss (FL) = Impact Delta x Impact Acres. When the acres of a proposed mitigation assessment area is

known, the gain in functions provided by that mitigation assessment area is determined using the following formula: Functional gain (FG) = RFG x Mitigation Acres.

(a) To determine the number of potential mitigation bank credits a bank or regional offsite mitigation area can provide, multiply the relative functional gain (RFG) times the acres of the mitigation bank or regional offsite mitigation assessment area scored. The total amount of credits is the summation of the potential RFG for each assessment area.

(b) To determine the number of mitigation bank credits or amount of regional offsite mitigation needed to offset impacts, when the bank or regional offsite mitigation area is assessed in accordance with this rule, calculate the functional loss (FL) of each impact assessment area. The total number of credits required is the summation of the calculated functional loss for each impact assessment area. Neither time lag nor risk is applied to determining the number of mitigation bank credits or amount of mitigation necessary to offset impacts when the bank or regional offsite mitigation area has been assessed under this rule.

(c) To determine the acres of one mitigation area needed to offset impacts to one assessment area when not using a bank or a regional offsite mitigation area as mitigation, divide functional loss (FL) by relative functional gain (RFG). If the acreage of proposed mitigation is known, then functional gain (FG) must be equal to or greater than the functional loss (FL).

(d) If there are multiple impact assessment areas and/or multiple mitigation assessment areas with known acreages to offset those impacts, then the summation of the appropriate functional gains (FG) must be equal to or greater than the summation of the respective functional loss (FL).

The forms used for the Uniform Mitigation Assessment Method are adopted and incorporated by reference in the rule. The forms are listed by rule number, which is also the form number, and with the subject title and effective date.

(1) Part I – Qualitative Description, 2-2-04.
(2) Part II – Quantification of Assessment Area (impact or mitigation), 2-2-04.
(3) Mitigation Determination Formulas, 9-12-07.

Hydrogeomorphic Approach (HGM)

The primary purpose of the hydrogeomorphic (HGM) approach is to assess wetland functions in the federal 404 Regulatory Program as well as other regulatory, planning, and management situations.

An interdisciplinary team of experts are required during development phase. The application phase should be done by individual(s) who have personal knowledge and field experience with the regional wetland subclass under consideration and review.

HGM is applicable to all wetland habitats types in the United States. However, not all wetland types in the United States have fully developed and USACOE approved assessment models.

A wide variety of wetland functions are assessed in HGM. The list of which functions are evaluated depends upon the wetland regional subclass model. These can include functions related to hydrologic processes, biogeochemical processes, and habitat.

There are two main phases in the specific HGM model for a specific wetland habitat type: development and application. During the development phase, an interdisciplinary team of experts (known in-house as the A-team) develops a guidebook with models for assessing functions of the wetlands in a regional subclass. The application phase consists of applying the models to an actual project following three steps: characterization; assessment; and analysis. The user(s) visits a wetland assessment area (WAA), and/or reviews plans for predicted future conditions, and completes data sheets that (a) identify the individual model variables, (b) list direct or indirect measures of model variables, (c) assign a subindex (scale 0.0-1.0) to conditions for each variable, and (d) include the equation for calculating the functional capacity index (FCI). The functional capacity units (FCUs) are also calculated for each function and all results are analyzed.

The output of HGM is a measure of the functional capacity of a wetland site relative to wetlands from the same regional wetland subclass.

The designers of HGM estimated that the time needed to assess a 1-acre site is a total of 1 to 2 hours per wetland assessment area (WAA) (if models are available) for characterization (step 1), assessment (step 2), and analysis (step 3). If models must be developed, the USACOE estimates that 320 hours (2 months of work) are needed for the development phase.

HGM can directly compare wetlands within the same regional subclass (e.g., emergent tidal wetlands of the eastern Gulf of Mexico). It cannot be utilized to directly compare wetlands from different subclasses (e.g., closed depression wetland and upper riverine wetland within same region) or from different regions. However, results from assessing different regional subclasses utilizing the separate subclass models can be used to aid in regulatory and conservation decisions.

The HGM assessment models can be used as a guide to project design. Users can refer to the model variables to determine which conditions increase or decrease wetland functional capacity. For example the functional capacity for the "retain particulates" function is increased when the wetland is designed to have an overbank flood recurrence interval of 1 year (variable V_{FREQ}). Each variable provides information on conditions that should be avoided. For example, to have a capacity to retain particulates, the ratio of floodplain width to channel width must be greater than one (variable V_{STORE}). Also, the information in the HGM models is useful because it provides design criteria with explicit measurements (e.g., ratio of floodplain width to channel width >55). Finally, not all of the models or variables may be useful. For example, a variable that measures presence or diversity of invertebrate fauna (e.g., distribution and abundance of invertebrates) cannot be incorporated into the design because the presence of most fauna usually cannot be controlled.

There are modified versions of HGM being used which have not been accepted by the USACOE. Most of these are "project specific" and do not include complete data sets as required for USACOE approval (Pers. comm.: C. Charles and E. Clairain, USCOE, July 14, 1998). The Natural Resources Conservation Service (NRCS) developed Interim HGM models for use pursuant to the 1996 Farm Bill. The Interim HGM models are based on HGM principles, but contain little reference data. NRCS has agreed to collect data for model verification and validation, and to complete development of regional guidebooks. The following methods are distinct from the HGM Approach, but include HGM Approach concepts and/or terminology in varying degrees: WAFAM (Hruby et al. 1998), MNRAM (MBWSR 1997), EPW (Bartoldus et al. 1995), the MDE Method (Fugro East Inc. 1995), and the Rapid Assessment Procedure (Magee 1998).

To date, draft regional guidebooks that are approved by the USACOE have been completed for 25 major wetland habitat types. National Guidebooks have been completed for riverine wetlands, (Brinson et al. 1995) and tidal fringe wetlands (Shafer and Yozzo1998). Regional HGM guidebooks have been completed for

- low gradient riverine wetlands in western Kentucky (Ainslie et al. 1999);
- the Yazoo Basin in the lower Mississippi River alluvial valley (Smith and Klimas 2002);
- the northwest Gulf of Mexico tidal fringe wetlands (Shafer, D. J., et al. 2002);
- low-gradient riverine wetlands in western Tennessee (Wilder and Roberts 2002);
- intermontane prairie pothole wetlands in the northern Rocky Mountains (Hauer et al. 2002);
- wet pine flats on mineral soils in the Atlantic and Gulf coastal plains (Rheinhardt, et al. 2002);
- flats wetlands in the Everglades (Noble, C. V., et al. 2002);
- riverine floodplains in the northern Rocky Mountains (Hauer et al. 2002);
- low-gradient, blackwater riverine wetlands in peninsular Florida (Uranowski et al. 2003);
- depressional wetlands in peninsular Florida (Noble, et al. 2004);
- rainwater basin depressional wetlands in Nebraska (Stutheit, R., et al. 2004);
- forested wetlands in the delta region of Arkansas, lower Mississippi River alluvial valley (Klimas et al. 2004);
- forested wetlands in the west Gulf coastal plain region of Arkansas(Klimas et al. 2005);
- depressional wetlands in the upper Des Plaines River basin (Lin2006);
- prairie potholes (Gilbert et al. 2006);
- wetland and riparian forests in the Ouachita Mountains and Crowley's Ridge regions of Arkansas Klimas et al. 2006);
- tidal fringe wetlands along the Mississippi and Alabama Gulf coast (Shafer et al. 2007);
- headwater slope wetlands on the Mississippi and Alabama Coastal Plains (Noble et al. 2007);
- forested wetlands in the Arkansas Valley region of Arkansas (Klimas et al. 2008); and
- forested wetlands and riparian areas in the Ozark Mountains region of Arkansas (Klimas et al. 2008)

There are no plans to revise the concept of the HGM Approach. Models for individual regional wetland subclasses are being prepared and will continue to be prepared as dictated by needs and funding. Models are first published in draft regional guidebooks and released for a two year period during which time end-users are invited to comment. Thereafter, the final regional guidebook is published and reviewed every five years.

WRAP **6 Variables**	**UMAM** **3 Variables**	**HGM** **14 Variables**
Wildlife Utilization	Location & Landscape Support	Degree of marsh dissection
Wetland Canopy	Water Environment	Proportion of tidally connected edge to total edge
Wetland Ground Cover	Community Structure (Vegetation and/or Benthic Community)	Total Effective Patch Size
Habitat Support/Buffer		Hydrologic Regime
Field Hydrology		Percent cover by typical plant species
Water Quality Input & Treatment		Nekton Habitat Complexity (# different habitat types)
		Wildlife Habitat Complexity (total # different habitat types)
		Surface roughness (Manning's) (3 sub-components)
		Mean Total Percent Vegetative Cover
		Mean Vegetative Structure Index
		Mean width of marsh
		Relative Exposure Index (Fetch)
		Distance to navigation channel or 2m depth
		Soil texture

Table 10: Comparison of the variables evaluated by the three functional assessment methods

Site Visit Protocols

Office Preparation

The assessment process begins with the selection of a permit. Environmental Resource Permits (ERPs) from the South Florida Water Management District (SFWMD) and other agencies were chosen for the project on the basis of the proximity of the project site to tidally influenced wetlands, whether or not wetland impacts were anticipated in the permit. Suitable permits were scanned into a database of permits sorted according to watershed. General data from the permit was entered into spreadsheets that summarize all the permit activity for the watershed. Aerial photos for the project site were found on the county websites. Aerials going back to 1998 for Lee County, and 2002 for Charlotte and Sarasota Counties were downloaded and saved as part of the project file for each site and the most current photos were printed for field reference.

Access to the site was then determined. Some sites were located on public lands, where no special permission was needed to gain access to the site. Many sites were located on private property. In these cases, the property owner was contacted to secure permission to access the site. In other cases, especially when the property owner could not be determined or contacted, the sites were assessed from the nearest public access: a road, a right-of-way, or a waterway. A route to the site was determined, or, if the site was to be assessed from the water, a charter boat was arranged for.

The UMAM data sheet Part 1 was also completed prior to the field visit. A hard copy file was established for each project site.

Field procedures

Equipment used in the field included:

- Trimble GPS unit with Arc Pad ArcGIS software
- Digital camera
- Functional assessment field data sheets
- Functional assessment “cheat sheets”
- Clipboard
- Field guides
- Binoculars
- Aerial photos
- YSI water quality sensor (this equipment was added toward the end of the study period as it became available due to another study)

Field personnel included the Senior Planner and the Environmental Scientist. All field personnel wore protective clothing appropriate for the conditions anticipated, including hats and sunscreen to protect from prolonged exposure to the sun.

On reaching the site, the Trimble unit was booted up. Some time was required for this device to acquire contact with satellites and triangulate a GPS position. Once the position was acquired, longitude and latitude were recorded on the data sheets.

A site ID was given to each site based on the date of assessment and the number of sites assessed that day. Thus, 101022-3 would be the ID for the third site assessed on October 22, 2010. The disposition of the project that was the subject of the permit was determined and indicated on the data sheets as pre- or post-project. A "Best Professional Judgment" score was noted before any formal assessment began. Usually, one member of the team would note their BPJ score, but not reveal that to the other team member doing the formal assessment, in order not to color the assessment.

The data sheets for each assessment method were filled out simultaneous with entering the same information into the tables set up on the Trimble unit. Flora and fauna observed at the site were recorded. Photographs of the site were taken, with special emphasis on the project area, any wetland vegetation, any alterations of vegetation, and any wildlife observed. Surrounding conditions were recorded to put the project site into context spatially.

Towards the end of the study period, water quality sensing equipment was procured for another study. We brought this equipment along to take measurements of water temperature, dissolved oxygen, pH, and salinity.

The total time utilized at each site doing the wetland assessments utilizing all three functional assessment methods was approximately one hour.

Post-visit office procedures

Following the field visit, several processes were required to gather and store all the data recorded. Photos were downloaded and stored digitally in files. These photos were analyzed to properly record any flora or fauna that could not be identified in the field. The data recorded on the Trimble unit, digital versions of the functional assessments, were downloaded into a database and added to the Arc Map file established for the project. Water quality data were downloaded into databases and the equipment rinsed and maintained according to the manufacturer's recommendations.

Since some information on the functional assessment data sheets was better determined from the desktop, the data sheets were completed. If the site being assessed was in the pre-project state, then data sheets were also completed for the post-project state as predicted by the conditions of the permit. If the site was assessed post-project, then data sheets were also completed for a pre-project condition based on historical aerial photos and staff reports from the permit file. Local knowledge was sometimes helpful in this process as well. Scores from the functional assessments were then entered into databases that summarized wetland impacts and mitigation.

Finally, a narrative in a standard format was written for each site. The narrative summarized the conditions at the time of assessment; the nature of the project being permitted; the wildlife, wetland canopy, and wetland groundcover observed at the site; the habitat support around the site; and the hydrology of the site. The conditions predicted for the post- or pre-project state, depending on the existing state, were recorded. Finally, tables showing comparisons of the pre- and post-project assessment scores were provided.

Functional Assessment Method Utilization Notes from the Field

Three methods of assessing wetland function were compared in the course of the study: Wetland Rapid Assessment Procedure (WRAP), Uniform Mitigation Assessment Method (UMAM), and Hydrogeomorphic Method (HGM). Each method had strengths and weaknesses as practiced in the field, and facility of use changed over time as the practitioner gained experience and training. This was planned as a part of the study, in order to simulate the use of these methods by the typical field personnel working for environmental consultants or agencies. The following report is meant to convey the observations of one practitioner with minimal experience at the beginning of the study period and lasting more than two years. The practitioner's prior experience included wetland delineation training and basic training in each of the methods.

WRAP in Practice

The Wetland Rapid Assessment Procedure (WRAP) seemed at first to be the easiest and best method to use for functional assessment, but after experience with all three methods being tested, it took a moderate amount of time and was balanced between measuring objectively and subjectively.

The FLUCCS code for assessment area is the designation of the wetland being assessed, at the time of assessment. Page four of the Technical Publication, 2.1 Methodology for Using WRAP, Office Evaluation, (3) (c) states "…Determine Florida Land Use, Cover and Forms Classification System – FLUCCS codes for wetland types (Appendix G)." This is in contrast to the other methods. In UMAM, it is the **native** community type of the assessment area, which is interpreted differently. See the rule, 62-345.400 F.S. Qualitative Characterization – Part 1 (1) (e) "Classification of the assessment area's native community type, considering past alterations that affect the classification. Classification shall be based on Florida Land Use, Cover and Form Classification System (1999) (FLUCC) codes…" and (g) "Functions performed by the assessment area's native community type." HGM does not ask for any classification of the wetland type, since it is designated for a specific wetland type and not general for a range of wetland types.

Since the scoring in WRAP is from 0 to 3 with 0.5 increments, there were not so many possible scores that the distinctions between scores were hard to make. Also, the guideline document for WRAP gives very specific benchmarks for each score in each variable. For example, when scoring Wildlife Utilization, the technical guidance document states, as shown in Table 11 below:

	Score
EXISTING WETLAND EXHIBITS NO EVIDENCE OF WILDLIFE • Existing wetland is heavily impacted. • No evidence of wildlife utilization. • Little or no habitat for native wetland wildlife species.	0
EXISTING WETLAND EXHIBITS MINIMAL EVIDENCE OF WILDLIFE UTILIZATION • Minimal evidence of wildlife utilization. • Little habitat for birds, small mammals and reptiles. • Sparse or limited adjacent upland food sources. • Site may be located in residential, industrial or commercial developments with frequent human disturbances.	1
EXISTING WETLAND EXHIBITS MODERATE EVIDENCE OF WILDLIFE UTILIZATION • Evidence of wetland utilization by small or medium-sized mammals and reptiles (observations, tracks, scat). • Evidence of aquatic macroinvertebrates, amphibians and/or forage fishes. • Adequate adjacent upland food sources. • Minimal evidence of human disturbance. • Adequate protective cover for wildlife.	2
EXISTING WETLAND EXHIBITS STRONG EVIDENCE OF WILDLIFE UTILIZATION • Strong evidence of wildlife utilization including large mammals and reptiles. • Abundant aquatic macroinvertebrates, amphibians and/or forage fishes. • Abundant upland food sources. • Negligible evidence of human disturbance. • Abundant cover and habitat for wildlife within the wetland or adjacent upland.	3

Table 11: WRAP scoring guidance for Wildlife Utilization

In scoring other variables, percentages of coverage of undesirable plants are to be used for determining scores instead of more subjective judgment words, such as “majority”, “predominantly”, “minimal”, and “sufficient”, as is found in UMAM. The WRAP rubric reduces subjectivity in scoring and would appear to improve consistency between scorers. Among the three methods utilized, WRAP was the easiest for a novice assessor.

Another feature of WRAP is that, for certain variables, the amount of area being assessed is a component of the score. That is, for WRAP, size matters! This is not the case for UMAM. HGM does take area into account, but not in as straightforward a manner as WRAP, where area is a multiplier.

The WRAP Wildlife Utilization score is based on species observed at the time of assessment. This can include evidence of wildlife such as tracks, scat, nests, remains, evidence of foraging, etc. This observation is limited to the assessment area. Thus, the score can be influenced by the time of year, or the time of day, of the assessment, as well as by a variety of other factors. UMAM assesses habitat presence and quality, and therefore the potential of the area to support wildlife. No wildlife needs to be directly observed in order to receive a high score with UMAM. HGM also scores habitat presence, not wildlife presence.

The Wetland Canopy variable "is a measure of the presence, health and appropriateness of wetland shrub and overstory canopy." This variable is straightforward in WRAP, however, canopy area or percent coverage is not addressed, only the amount (percent) of exotics. Subjective terms such as "large amounts", and "few" are used, but they are equated with percentages.

The Wetland Ground Cover variable is straightforward, similar to the Wetland Canopy variable. Area of coverage or percentage of coverage is not considered except for undesirable species.

The Habitat Support/Buffer variable consists of sub-variables that are based on buffer type and percent of area. The sub-variable "Buffer Type" is a qualitative score, which is then multiplied by the percent of total buffer area. In the technical document, there are two considerations of buffer type: width and land cover/land use. The problem with determining scores for this variable stem from the technical document description of scoring not jibing with the method for calculation laid out on the form. The technical document provides guidance, shown below in Table 12, in a format similar to the Wildlife Utilization, Wetland Canopy and Wetland Ground Cover variables, as above:

	Score
NO ADJACENT UPLAND/WETLAND BUFFER • Buffer non-existent.	0
ADJACENT UPLAND/WETLAND BUFFER AVERAGES 30 FEET OR LESS, CONTAINING DESIRABLE PLANT SPECIES • Less than 30 feet average width. • Mostly desirable plant species which provide cover, food source, and roosting areas for wildlife. • Not connected to wildlife corridors. • Greater than 300 feet but dominated (greater than 75%) by invasive exotic or nuisance plant species.	1
ADJACENT UPLAND/WETLAND BUFFER AVERAGES GREATER THAN 30 FEET BUT LESS THAN 300 FEET, CONTAINING PREDOMINANTLY DESIRABLE PLANT SPECIES • Greater than 30 feet but less than 300 feet average width. • Contains desirable plant species which provide cover, food, and roosting areas for wildlife. • Portions connected with contiguous offsite wetland systems, wildlife corridors. • Greater than 300 feet but dominated (greater than 75%) by undesirable noninvasive plant species (e.g., pasture grasses).	2
ADJACENT UPLAND/WETLAND BUFFER AVERAGES GREATER THAN 300 FEET CONTAINING PREDOMINANTLY DESIRABLE PLANT SPECIES • Greater than 300 feet wide average width. • Contains predominantly desirable plant species (less than 10% nuisance, and no exotic species) for cover, food, and roosting areas for wildlife. • Connected to wildlife corridor or contiguous with offsite wetland system or areas that are large enough to support habitat for large mammals or reptiles.	3

Table 12: WRAP scoring guidance for Habitat Support/Buffer

However, the document also states that "The criteria for determining adequate buffer sizes should be partly based on the quality of the wetland and the intensity of the adjacent land use (Castelle, et al, 1992)." Scores for various land uses are included in the sub-variables used for Water Quality Input and Treatment and are as follows:

LAND USE CATEGORY*	SCORE
natural undeveloped areas	3
unimproved pasture / rangeland	2.5
citrus grove	2
sugarcane	2
low density residential	2
low intensity commercial	2
low volume highway	2
institutional	2
single-family residential	1.5
recreational	1.5
golf course	1.5
moderately intensive commercial	1.5
high volume highway	1
industrial	1
mining	1
multi-family residential	1
improved pasture	1
row crop	1
high intensity commercial	0.5
dairy and feedlot	0

Table 13: WRAP land use categories

Since the field evaluation form specifically requests "Buffer Type", in this study, the Land Use Categories above were used in that field.

Habitat Support / Buffer

Buffer type	(Score)	X (% of area)	=Sub Totals	
				TOTAL

Table 14: WRAP table for calculating Habitat Support/Buffer

For the Field Hydrology variable, the scoring is straightforward and the technical document gives good guidance as shown in Table 15.

	Score
HYDROLOGIC REGIME HAS BECOME SEVERELY ALTERED WITH STRONG EVIDENCE OF SUCCESSION TO TRANSITIONAL/UPLAND OR OPEN WATER PLANT COMMUNITY • Wetland hydrology severely altered. • Hydroperiod inadequate to support wetland plant species for the particular community type. • Strong evidence that upland plants are encroaching into the historical wetland area as a result of a decreased hydroperiod. • Die-off of wetland plant species as a result of an increased hydroperiod. • In sites with an organic soil substrate, there is substantial soil subsidence.	0
HYDROLOGIC REGIME INADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM • Site hydroperiod inadequate to maintain the system that is being created, enhanced or preserved. • Succession of wetland plant species into transitional/upland plant species. Appropriate vegetation stressed or dying from too much or too little water. • In sites with an organic soil substrate, there is evidence of soil subsidence.	1
HYDROLOGIC REGIME ADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM. EXTERNAL FEATURES MAY AFFECT WETLAND HYDROLOGY • Wetland hydroperiod adequate, although conditions possibly interfering with or influencing the hydroperiod of site (i.e., canals, ditches, swales, berms, reduced drainage area, culverts, pumps, control elevation and wellfields) present. • Plant community healthy, although there may be some signs of improper hydrology. • In sites with an organic soil substrate, there is little evidence of soil subsidence.	2
HYDROLOGIC REGIME ADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM • Plants healthy with no stress resulting from an improper hydroperiod. • Wetland exhibits a natural hydroperiod. • Wetland not adjacent to canals, ditches, swales, berms, wellfields or other negative impacts to the wetland within the landscape setting. • In sites with an organic soil substrate, there is no sign of soil subsidence.	3

Table 15: WRAP scoring guidance for Field Hydrology

The Water Quality Input and Treatment variable is composed of two sub-variables which are in turn calculated in a manner similar to the Habitat Support/Buffer score.

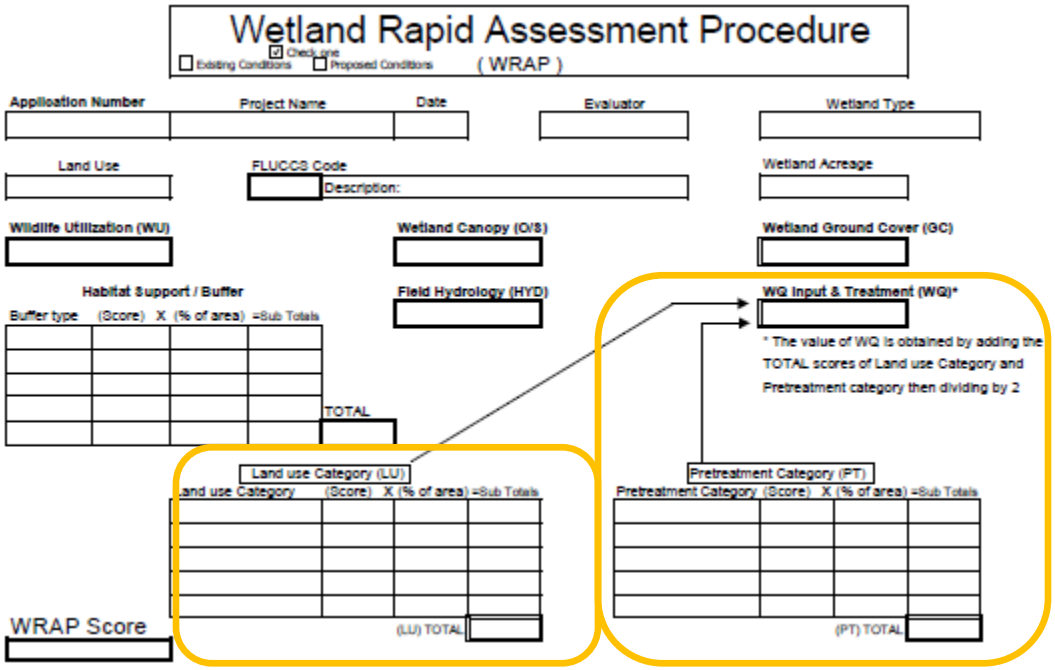


Table 16: WRAP scoring sheet upper section with Water Quality Input & Treatment sub-variables highlighted

The first sub-variable, Land Use Category, is calculated in much the same way as the Habitat Support/Buffer variable and thus, in the course of the study, often led to identical results. Another difficulty with this variable is in determining the Pretreatment Category for the site. Incomplete or unavailable site plans were one obstacle. Another resulted when a project, such as a dock or seawall, did not contain or did not require any description of water quality treatment in the permit application. In the assessments, the assignment of a Pretreatment Category was most often based on field observation of the surrounding conditions. For example, in some cases, a site was located in a typical suburban neighborhood which had varying amounts of detention/retention, swales, vegetation, etc. The Pretreatment Categories are as follows:

PRE-TREATMENT CATEGORY	SCORE
natural undeveloped area	3
wet detention with swales	2.5
wet detention with dry detention	2.5
combination grass swales with dry detention	2
grass swales only/ vegetated buffer strip	1
dry detention only	1
no treatment	0

Table 17: WRAP pre-treatment categories for Water Quality & Treatment score

As a beginning user wanting to do the most accurate assessments possible, I devised a one-page reference to take into the field with me so that I was sure to take all the prescribed factors into account on each assessment. Several aspects of this method increased the time necessary to complete the assessments. Checking carefully through the qualities associated with each variable, the determination of percents of "undesirable" species, the estimation of percent coverage involved with the calculations of Habitat Support/Buffer and Water Quality Input and Treatment, as well as the calculations themselves, all contributed to the length of time needed to complete the WRAP method.

Another issue of potential conflict among evaluators is in how to score a variable that is not present in a community type in which it would not be expected. For example, if the wetland type is a submerged bottom, wetland canopy would not be expected. The method only scores for presence or absence, not appropriateness. Thus the submerged bottom would receive a zero for wetland canopy. An argument could be made that a score of three would better reflect the appropriateness of the state of the canopy in that community type. If not, then any herbaceous wetland is penalized.

To characterize this method, both the time necessary to complete and the balance between subjective and objective input are moderate. It generally took ten to 15 minutes to complete a WRAP assessment depending on the size of the site. This time does not include the time needed to traverse the site and make general observations.

UMAM in Practice

The use of UMAM in the field proved, by the end of the study, to be the most time consuming and subjective of the methods, but that may have been due to my strict application of the rule, 62-345 F.S., which is not commonly advocated or practiced.

In 62-345.100(1) F.S., Florida law states that "The intent of this rule is to fulfill the mandate of subsection 373.414(18) F.S., which requires the establishment of a uniform mitigation assessment method to determine the amount of mitigation needed to offset adverse impacts to wetlands and other surface waters and to award and deduct mitigation bank credits." Paragraph (2) goes on to state that "the methodology in this Chapter provides a standardized procedure for assessing the functions provided by wetlands and other surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss." From these two paragraphs, it is clear that the primary intent of the Chapter is to determine mitigation requirements and that assessing wetland function is secondary to that goal. Further, the paragraph specifies that the rule should result in standardization of functional assessment; however, the subjective nature of the common practice of UMAM would seem to make standardization elusive.

UMAM consists of Part 1, the Qualitative Description of the assessment area and the surroundings. This part of the assessment is to be completed as much as possible prior to the field assessment. As in WRAP, a FLUCCS code is used to describe the wetland being assessed, but other methods of classification may also be noted. The choice of FLUCCS code, however, sets the tone for the entire assessment. As mentioned above in the discussion of WRAP, 62-

345.400 F.S. Qualitative Characterization – Part 1 (1) (e) states "Classification of the assessment area's native community type, considering past alterations that affect the classification. Classification shall be based on Florida Land Use, Cover and Form Classification System (1999) (FLUCC) codes…" and (g) "Functions performed by the assessment area's native community type."

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)

Table 18: UMAM upper portion of data sheet Part 1

In UMAM trainings offered by FDEP and SFWMD, the issue of how to properly classify the assessment area was addressed in detail. Trainers taught that, when UMAM was being used to assess a wetland being impacted, the classification should reflect the wetland type that the area most closely resembles observed at the time of assessment. However, when the assessment area was to be the site of a mitigation action, the classification should reflect the native community type, or what the goal community of the mitigation was. A commonly used example was a wet pasture. If the pasture was to be the subject of a mitigation project, then the classification should reflect what community type was present before the land was cleared for pasture. Thus, the evaluator should look to communities immediately surrounding the pasture for clues to what that may have been. But, if the pasture was to be the site of impacts, it should be classified as a wet pasture.

Part 2 is the Quantification of Assessment Area, and may be used for either an impact or a mitigation area. To a novice assessor, this appears to be the simplest of the functional assessment methods, with only three variables to determine: Location and Landscape Support, Water Environment, and Community Structure. Each of these sections is to be scored a whole number between zero and ten. 62-345.500 Assessment and Scoring – Part 2 (5) states "For the purpose of providing guidance, descriptions are given for four general categories of scores: optimal (10), moderate (7), minimal (4), and not present (0)." As with WRAP, however, there are several criteria, or attributes, that determine each of the three variables. The Location and Landscape Support section has eight such attributes, Water Environment has 12, and Community Structure has seven for either vegetation or benthos. The rule goes into considerable detail when outlining the conditions that certain scores should represent.

Again as with WRAP, as a novice practitioner, I used a UMAM reference, available through SFWMD, to use in the field to ensure that I took all relevant factors into account in scoring.

UMAM Scoring Worksheet ~ Location and Landscape Support

Guidance: *This worksheet is only a summary and is not intended to replace the rule. The rule should be used to resolve any question or dispute.*

	Optimal (10)	Moderate (7)	Minimal (4)	Not Present (0)
Location and Landscape Support	full opportunity to perform beneficial functions at optimal level	opportunity to perform beneficial functions is limited to 70% of optimal ecological value	opportunity to perform beneficial functions is limited to 40% of optimal ecological value	provides no habitat support or opportunity to provide benefits to fish and wildlife
a. Support to wildlife by outside habitats	full range of habitats needed to support all wildlife species	optimal support for most, but not all wildlife species	fail to provide support for some, or minimal support for many wildlife species	no habitat support for wildlife
b. Invasive exotics or other invasive plant species in proximity of the assessment area	not present	present but cover is minimal and has minimal adverse effects	majority of plant cover consists of invasive exotics that adversely affect functions	predominance of plant cover consists of invasive exotics so that little or no function is provided
c. Wildlife access to and from outside – distance and barriers	not limited by distance or barriers	partially limited by distance or barriers	substantially limited by distance or barriers	precluded by distance or barriers

Table 19: Selection from UMAM scoring "reference sheet" provided on SFWMD website

During the first few months of the study, I followed the training I had been given and scored each section holistically, taking the attributes into account mentally. Using this method, I found it difficult to distinguish small, subjective differences between scores. I began to write down a score for each of the attributes, and then give a section score based on the most common attribute score. This appeared to be relatively arbitrary, so I began mathematically averaging the attribute scores to arrive at the section score. When I posed this solution to an instructor at a training workshop, I was told that averaging attribute scores was not the correct way to arrive at the section score. It was specifically noted not to average the scores of the attributes to arrive at the score for the section. It was pointed out that the attributes are not evenly weighted for every site, and that flexibility, subjectivity, and professional judgment were called for site by site. Two points raised in the discussion were:

1. SFWMD provided a scoring guide indicating how to numerically score each attribute. Why provide this if averaging is not intended?

2. Averaging is more objective and consistent, a stated goal.

Responses from past and present district staff included:

1. Some local governments have, in the past, required averaging and “everybody hated it”.

2. The scoring guide is useful in that the attributes can be scored that apply to the individual assessment site, and then scientific judgment is applied to give more weight to the attributes that seem more important or applicable to the site.

In further discussion, staff went on to state that not all attributes are applicable to all sites. As with the issue of appropriateness in the discussion of WRAP above, we contended that, if a site is scored considering the appropriateness of the attribute for that wetland type, then that is accounted for. The primary example batted about was the canopy score for an herbaceous wetland. Their argument against averaging was that, in an herbaceous condition with no canopy, the wetland would get a zero and the score would be unfairly reduced. My counter argument was that, if a condition of no canopy is appropriate for the community type, then the absence of trees would give the site a high score, not a low score (again, as in the WRAP discussion above). Staff asserted that with averaging, three different scorers could come up with three very different scores. Without averaging the three may not come up with just the same scores for the site, but they are closer. And it must be right, a staff member said, "Because it's working."

At the beginning of the study, I used the method advocated in training: best professional judgment, taking the attributes into consideration. However, I found that, as I gained more experience, I began to second-guess, or reconsider, scores from earlier assessments. The project promised to become a never-ending cycle of learning new things, then going back to re-assess old projects with the new knowledge. Our team felt that more objectivity would reduce this. As we looked more carefully at the reference provided by SFWMD, it became obvious that the attributes could be scored individually, so in January to February of 2010, I began a new practice of examining each attribute during an assessment, assigning it a score based on appropriateness for the wetland type, and averaging the attribute scores to arrive at the section score.

There were other confusing aspects of the application of UMAM. Presence and/or coverage by exotic species are accounted for in more than one section variable, which results in (possibly intentional) overweighting of that attribute. In the Location and Landscape Support section, two attributes seem very similar. 62-345.500 (6) (a) (1) (d) states "Functions of the assessment area that benefit downstream fish and wildlife are not limited by distance or barriers that reduce the opportunity for the assessment area to provide these benefits." (f) of the same subsection states, "The opportunity for the assessment area to provide benefits to downstream or other hydrologically connected areas is not limited by hydrologic impediments or flow restrictions." The difference between the two provisions seems to be a distinction between hydrological and non-hydrological barriers, but this is difficult to interpret and may lead to inaccurate scores.
In practice, in the course of this study, the scoring of each attribute for each section was easier but more time consuming than judging the site holistically, as suggested by training staff. As facility with each functional assessment method was improved over the course of the study, UMAM became the most time consuming of the three functional assessment methods used. At the beginning of the study, a UMAM assessment took five to ten minutes. At the end of the study, it took 15 to 20 minutes depending on the size of the site. This time does not include the time needed to traverse the site and make general observations or to complete Part 1.

HGM in Practice

The Hydrogeomorphic Method (HGM) has a reputation for being unwieldy and extremely time consuming in the field. Other wetland assessment practitioners (both public agents and private consultants) often stated to me that they had no knowledge of HGM, or if they did have knowledge of, did not utilize HGM for that and other reasons, including the State of Florida's requirement to submit UMAM results with permit applications. Although HGM was time consuming for me at the beginning of the study, by the end, it had become much less so and WE preferred it over WRAP and UMAM because of the objectivity reflected by the field measurements, as opposed to the subjective judgments embedded in the other two methods. However, there were negatives with HGM as well.

HGM methodologies have been established by the EPA for at least 25 distinct geomorphic wetland types across North America. The one deemed similar enough to the study area was for Northwest Gulf of Mexico Tidal Fringe Marshes, which includes salt marsh and mangroves, with certain specifications tied to locations in northwest Florida and Texas. Some adaptations associated with the taller mangrove forests of southwest Florida had to be made in order to apply this method to our region of the southeastern Gulf of Mexico. These are detailed below.

The first of 14 variables was "Degree of marsh dissection/edge: area ratio. A table was given to determine the score:

Table B1
Relationship Between Edge:Area and Functional Capacity

Site Description	Edge:Area		Subindex
	Qualitative	Quantitative m/ha	
1) Marsh shows signs of deterioration due to subsidence (i.e., highly fragmented with large amounts of open water. Vegetation occurs mainly in isolated hummocks or on natural levees along tidal creeks). Although edge:area is very high, this condition is not considered sustainable in the long term (Figure D2).	Very High	>800	0.8
1) Well-developed tidal drainage network present (Figure D3), OR **2)** Simple tidal drainage network (may consist of only a single channel) present with isolated ponds and depressions present in the marsh interior (Figures D4 and D5). **3)** Atypical geomorphic configuration with a large amount of shoreline relative to total area (i.e. small island or narrow peninsula) (Figure D7).	High	350-800	1.0
1) Simple tidal drainage network (may consist of only a single channel). Isolated ponds and depressions are few or lacking, OR **2)** Narrow fringe marsh that lacks tidal creeks. One lengthwise shoreline is exposed to tidal waters. Area of marsh is small relative to shoreline length (Figures D6 and D8).	Moderate	200-350	0.7
Marsh lacks both tidal creeks and isolated ponds and depressions. Shoreline is generally linear or smooth curvilinear without embayments or convolutions. Area of marsh is large relative to shoreline length (Figure D9).	Low	<200	0.4

Table 20: HGM Table B1 scoring guidance for $V_{(EDGE)}$

Scoring could be based on qualitative or quantitative measures, according to the guidance. This was easy to observe either in the field or from aerial photos.

The second variable was $V_{(OMA)}$, the proportion of tidally connected edge to total edge. Again, this was easy to determine from field observation.

Table B2
Relationship Between Opportunity for Marsh Access and Functional Capacity

Tidally Connected Edge: Total Edge	Subindex
❑ 50-100%	1.0
❑ 35-50%	0.7
❑ 25-35%	0.5
❑ 1-25%	0.2
❑ No tidally connected edge present	0.0

Table 21: HGM Table B2 scoring guidance for $V_{(OMA)}$

The third variable, $V_{(SIZE)}$, or total effective patch size, was one of several variables that were more easily and accurately assessed from the desk, using aerial photos. The score takes into account not only the size of the wetland being assessed, but the size of nearby wetlands and their connectedness to the subject wetland as well. Taking these measurements in the field would not be as efficient or effective as using any of the very accurate digital tools easily available to analyze aerial photos, especially after making general field observations. We did this portion of the assessment from the desktop.

The fourth variable, $V_{(HYDRO)}$, indicated the hydrologic regime of the site. This was easily observed in the field.

Table B5
Relationship Between Hydrologic Regime and Functional Capacity

Site Condition	Subindex
Site is open to free exchange of tidal waters. No obvious hydrologic alteration or restrictions present.	1.0
Moderate hydrologic restriction present (i.e., presence of low-elevation berm, which is frequently overtopped by high tide events or has multiple breaches or large culverts).	0.6
Severe hydrologic restriction present (i.e., presence of high-elevation berm, which is infrequently overtopped by high tide events or has a single opening, breach or small culvert).	0.3
Site receives tidal floodwaters only during extreme storm tide events.	0.1
Site is isolated from tidal exchange. The principal source of flooding is water sources other than tidal action (i.e., precipitation or groundwater). *Note: If this condition exists, another wetland assessment model should be strongly considered unless the site was formerly a tidal wetland prior to hydrologic modification.*	0.0

Table 22: HGM Table B5 scoring guidance for $V_{(HYDRO)}$

The fifth variable, $V_{(TYPICAL)}$, measured the percent coverage of the site by "typical plant species". In order to determine the score, the practitioner is asked first to "Visually estimate the percentage of the site that is covered by non-typical, nonnative, or otherwise undesirable plant species…Subtract this number from 100 to estimate the percentage of the site that is occupied by plant species typical of the regional subclass." Resources are given with examples of invasive or undesirable plant species. I found that a conflict arises when a site lacks vegetation or is sparsely vegetated. For example, on an unvegetated site, there is 0% coverage by "non-typical, nonnative, or otherwise undesirable plant species." This results in a calculation of 100% coverage by typical plant species, even though the site may be barren. Similarly, on a site where total plant cover is sparse, say 15%, but dominated by exotics, the percent of the site covered by nonnative species may be 10%, which leads to the calculation that 90% of the site is covered by native species. Presumably, this is not the intention of the method, but there is no guidance to indicate otherwise. The calculation seems to assume that the site is 100% covered with vegetation. Total coverage is measured in a separate variable. In most cases, however, this is an easy variable to observe and determine.

The sixth variable, $V_{(NHC)}$, measures nekton habitat complexity. As with UMAM, HGM does not measure observation of wildlife, only the availability of habitat that would support wildlife. This is easily observable in the field.

6. V_{NHC} Nekton Habitat Complexity (# different habitat types)

(1) Check the habitats observed on or within a 30-m (100-ft) radius of project area perimeter.

Coarse woody debris	_____	Unvegetated flats	_____	Algal mats	_____
Subtidal creeks/channels	_____	Oyster reef	_____	Mangroves	_____
Intertidal creeks/channels	_____	Low marsh	_____	High marsh	_____
Ponds or depressions	_____	Submerged aquatic vegetation	_____		

(2) Assign variable subindex based on the chart in Figure B2. *Subindex* _____

Table 23: HGM guidance on $V_{(NHC)}$

The score is then based on how many of those different habitat types are found. Interestingly, algae are paired in UMAM with siltation as an indicator of poor vegetation/structural habitat, but in HGM, algal matting counts as a positive in habitat complexity.

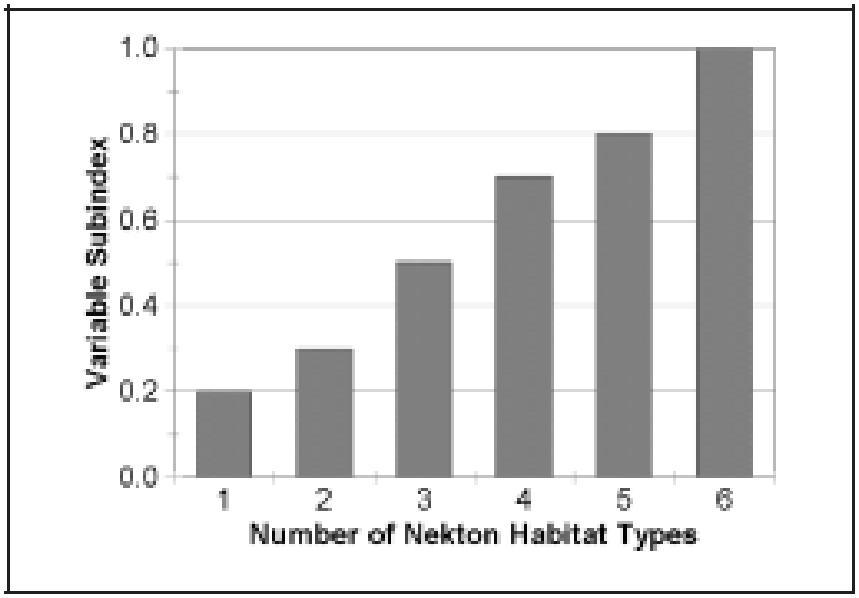


Figure B2. Relationship between nekton habitat complexity and functional capacity

Figure 31: HGM Figure B2 scoring for $V_{(NHC)}$

Neither the quality nor the extents of those habitat types found are accounted for in this variable, but may be expressed in some of the other variables that measure area and exotic vegetation.

The seventh variable, $V_{(WHC)}$ or wildlife habitat complexity, is similar to $V_{(NHC)}$, but takes into account a wider radius from the assessment site. This can be determined from observation, local knowledge and/or aerial photos.

7. V_{WHC} Wildlife Habitat Complexity (total # different habitat types)

(1) Check those habitat types **IN ADDITION TO THOSE LISTED ABOVE** that are present on or within a 2-km radius of the project area perimeter.

Supratidal habitats (hummocks, logs)	_____	Scrub-Shrub	_____	Forested uplands	_____
Unvegetated beach	_____	Grasslands	_____		

Table 24: HGM guidance for $V_{(WHC)}$

The score is then determined by combining the number of habitats checked for $V_{(NHC)}$ plus $V_{(WHC)}$.

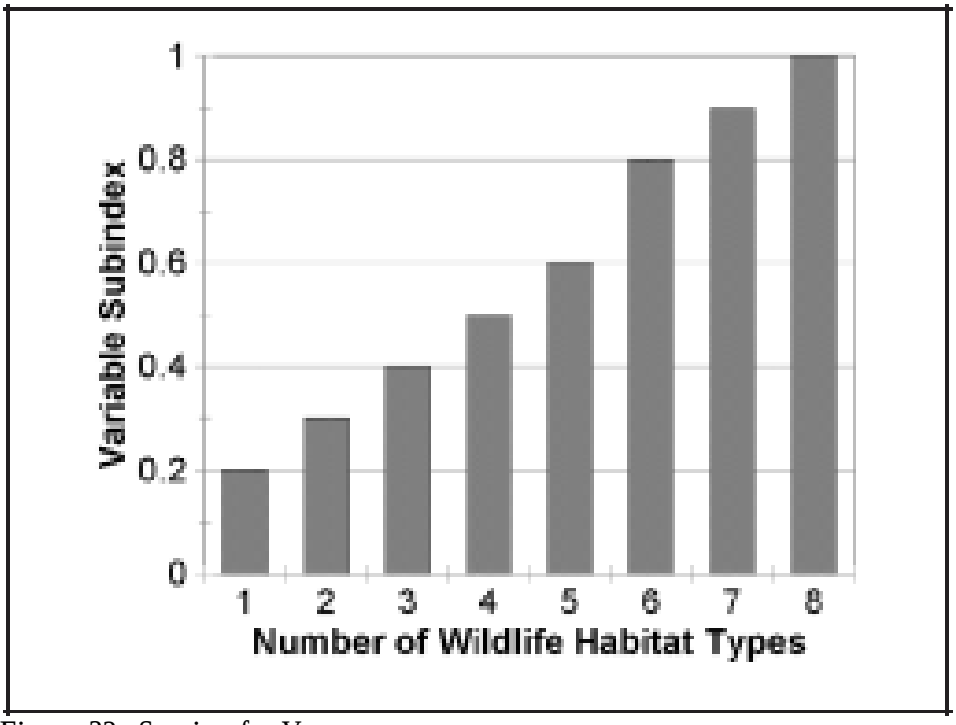


Figure 32: Scoring for $V_{(WHC)}$

The eighth variable is composed of three components and reflects surface roughness (Manning's), $V_{(ROUGH)}$. Roughness components for sediment surface, topographic relief, and vegetation are given in a table and combined. All three components are easily observable in the field. The scores for this variable tended to reach the maximum quite easily, as the vegetation score is easily influenced by small amounts of relatively tall vegetation, and the vegetation score is a much higher percentage of the overall score. This scoring appears to favor forested wetlands over herbaceous wetlands.

Table B7
Relationship Between Roughness and Functional Capacity

Roughness Component	Adjustment to *n* Value			Description of Terms
Sediment surface (n_{BASE})	0.025			Base value for bare marsh soil.
	0.03			More than 25% of sediment surface covered with gravel or broken shell.
Topographic relief (n_{TOPO})	0.001			Representative area is flat with essentially no microtopographic (i.e., hummocks) or macrotopographic relief (i.e., berms, tidal channels, ridges and swales, ponds).
	0.005			Microtopographic (i.e., hummocks) or macrotopographic relief (i.e., berms, tidal channels, ridges and swales, ponds) cover 5-25% of a representative area.
	0.010			Microtopographic (i.e., hummocks) or macrotopographic relief (i.e., berms, tidal channels, ridges and swales, ponds) cover 26-50% of a representative area.
	0.020			Microtopographic (i.e., hummocks) or macrotopographic relief (i.e., berms, tidal channels, ridges and swales, ponds) cover >50% of a representative area.
Roughness Component	**Percent Cover**			**Description of Conditions**
	<50	**50-75**	**76-100**	
Vegetation (n_{VEG})	0.025	0.030	0.035	Representative area predominantly short, flexible-stemmed grasses (i.e., short *Spartina alterniflora, S. patens, Distichlis spicata*).
	0.035	0.040	0.050	Vegetation in representative area predominantly short, with stiff, trailing stems (i.e., *Batis maritima, Salicornia virginica*).
	0.050	0.060	0.070	Representative area predominantly tall, flexible-stemmed grasses (i.e., tall *Spartina alterniflora, S. cynosuroides, Scirpus sp.*).
	0.070	0.100	0.160	Vegetation in representative area predominantly tall, with stiff leaves (i.e., *Juncus roemerianus*) or mixed woody shrubs (i.e., mangroves).

Note: Adapted from Arcement and Schneider (1989) and Gardiner and Dakombe (1983).

Table 25: HGM Table B7 scoring guidance for $V_{(ROUGH)}$

The ninth variable, $V_{(COVER)}$, measures the mean total percent vegetative cover of the site, and is based on "a representative number of locations in the WAA [wetland assessment area] using a series of 1-m^2 plots arranged along one or more 30 m (98 ft.) transects oriented perpendicular to the wetland shoreline or the hydrologic gradient." A minimum of ten plots is recommended. This was one aspect of this method that sounded daunting at the beginning of the study, but became easier as time went on.

Many of the sites assessed in this study were less than one acre, and many sites were assessed by making observations from a boat off shore from the site, when permission to access the site was not available. Making 30-m (98 ft.) transects was not practicable in these cases. Instead, total percent vegetative cover was estimated visually and confirmed from aerial photos. The score was then derived from this estimation.

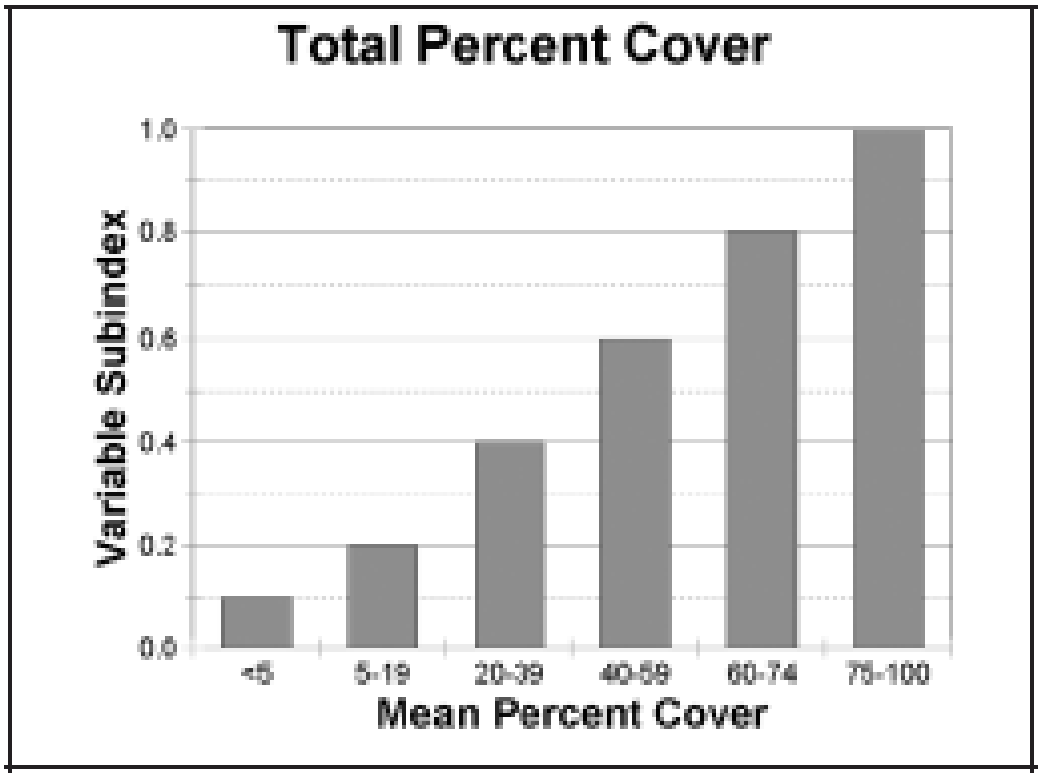


Figure 33: Scoring for $V_{(COVER)}$

The tenth variable, $V_{(VEGSTR)}$, measures the mean vegetative structure index, which indicates the height of the vegetation on the site. This measure is based on the total percent coverage, $V_{(COVER)}$, but easily reaches its maximum. This may indicate a preference for forested wetlands over herbaceous wetlands, as with $V_{(ROUGH)}$.

For this variable, the same transects and plots are to be used as in $V_{(COVER)}$. For the same reasons as above, the same modifications to the method were made.

V_{VEGSTR} = ((Hgt$_1$ × Proportion$_1$) + (Hgt$_2$ × Proportion$_2$) + ... (Hgt$_x$ × Proportion$_x$))

where: x = # plant species per plot.

[(_____ × _____) + (_____ × _____) + (_____ × _____)] = _____

(7) Compute the sum of all the vegetative structure indices generated above. _____

(8) Divide by the total number of plots to determine the mean. _____

(9) Assign a subindex value based on the chart in Figure B6. *Subindex* _____

Figure B6. Relationship between vegetation structure index and functional capacity

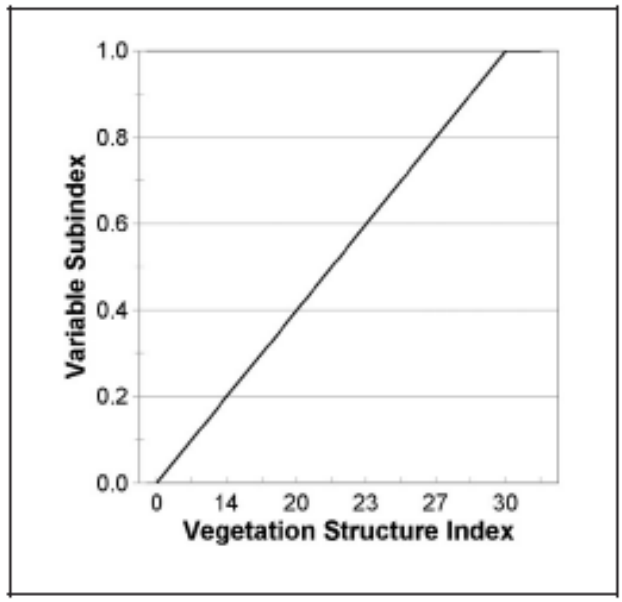


Figure 34: Guidance for scoring $V_{(VEGSTR)}$

Variables 11 through 14 are to be assessed only if it has been determined from field observations that there has been shoreline erosion at the site. Due to the extent of human presence and use of most of the sites assessed for this study, combined with the effects of sea level rise, we decided to treat every site as though it had been subject to shoreline erosion. Indeed, the vast majority of sites exhibited some evidence of erosion. HGM is the only one of the three assessment methods to take erosion and sea level rise into account.

Variable 11, $V_{(WIDTH)}$, measures the mean width of the marsh from transects running perpendicular to the shoreline or topographic gradient. After making field observations, it was most accurate to measure this from aerial photos. Several measurements were made according to the length of the shoreline, and the measurements were averaged to arrive at the score for the variable. The scoring seems to favor wider wetland systems.

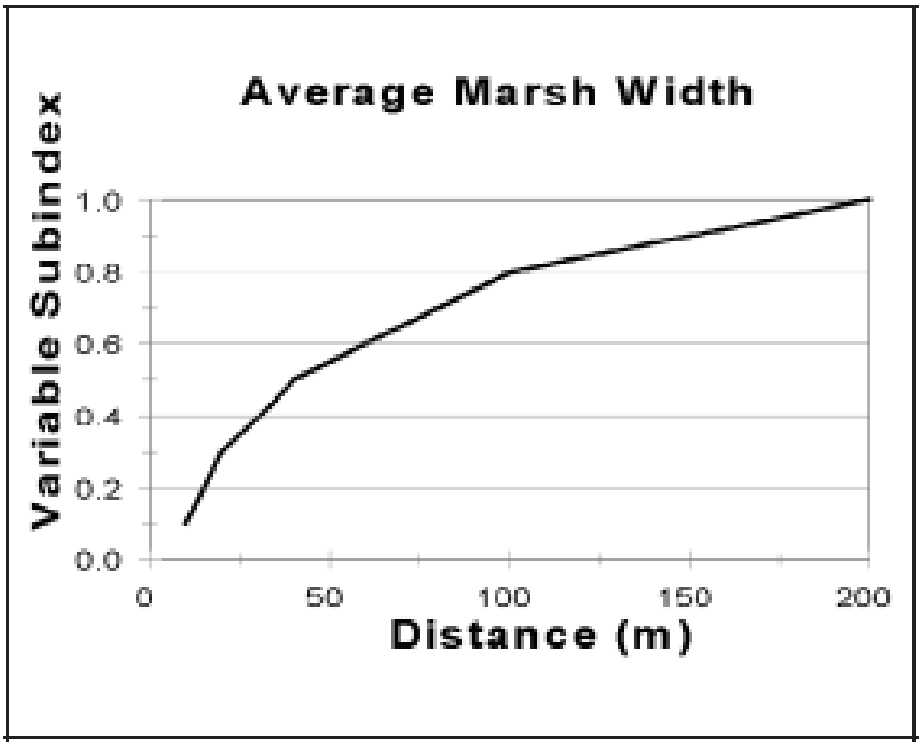


Figure 35: Scoring for $V_{(WIDTH)}$

The twelfth variable, $V_{(EXPOSE)}$, measures relative exposure, or fetch, distance across open water. This variable required modification for use in the study area, and the score was determined entirely from the desktop using the program Google Earth.

As written, fetch is to be measured for each of the 16 compass bearings, and then multiplied by factors based on nearby wind data stations. The wind data stations referenced in the guidance document were in the northwestern Gulf of Mexico on the Texas coast. In order to derive scores accurate for the study area, data from the wind data station in Ft. Myers were substituted. The study site was then located using Google Earth, and a graphic overlay of a compass rose with all 16 compass bearings was positioned with its center directly over the site. Using the distance measuring tool in Google Earth, the fetch was measured in kilometers. This measurement was combined with the information from the local wind data station, and a score was calculated according to the HGM guidance. Many of the assessment sites for the study were along narrow canals or creeks, or were at shorelines protected by basin mangrove forests. These sites had no fetch, and this could be easily observed, so there was no need to go through these calculations, saving measurable time.

$$\text{Relative Exposure Index} = \sum_{i=1}^{16} V_i \times F_i \times P_i$$

where:

V_i = mean annual wind speed (km/hr)
F_i = fetch distance (km)
P_i = proportion of time wind blew from each of 16 cardinal and subcardinal compass directions

(4) Assign variable subindex based on Figure B8. *Subindex* _____

Figure B8. Relationship between relative exposure index and functional capacity

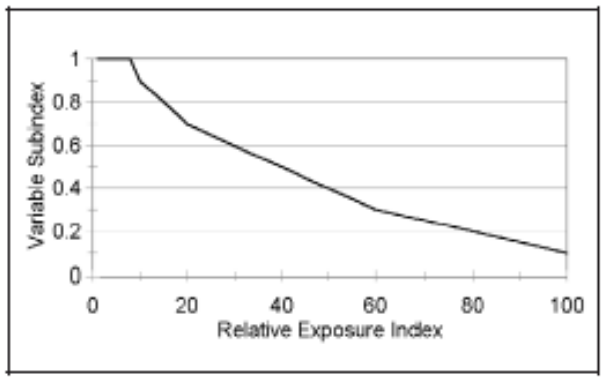


Figure 36: Scoring for $V_{(EXPOSE)}$

The thirteenth variable, $V_{(SLOPE)}$, measures distance from the site to the navigation channel or to water depths greater than or equal to two meters. This was easily observable in the field.

13. . V_{SLOPE} Distance to navigation channel OR water depths ≥2 m *Subindex* _____

Table B9
Relationship Between Shoreline Slope and Functional Capacity

Distance	Subindex
<50 m	0.1
50-150 m	0.5
>150 m	1.0

Table 26: HGM scoring for $V_{(SLOPE)}$

The fourteenth and final variable, $V_{(SOIL)}$, indicated soil texture.

14. V_{SOIL} Soil texture *Subindex* _____

Table B10
Relationship Between Soil Type and Functional Capacity

Predominant Soil Type	Subindex
Clay	1.0
Clay loam	0.8
Loam	0.6
Sandy loam	0.4
Sandy	0.2

Table 27: HGM scoring for $V_{(SOIL)}$

This was easily observable in the field. When assessing from a boat, the bottom material that came up with the anchor was observed. It was unclear how to categorize materials such as mud and muck, which were common in the study area. Most often these were described as sandy loam, loam, or clay loam, depending on the presence of sand or clay in the muck.
HGM does not have any measurement or observation of water quality, except perhaps what could be implied from the quality of vegetative cover.

One of the advantages of HGM is that no additional reference is necessary. All the guidance is included in the field data form. In the field, this reduced the amount of “paper juggling”.

At the beginning of the study, HGM was the most time consuming, requiring 15 to 20 minutes in the field to complete. By the end of the study, HGM took ten to 15 minutes in the field, depending on the size of the site. This time does not include the time needed to traverse the site and make general observations or to complete the desktop portions.

Overall, by the end of the study, we preferred the HGM method of functional assessment. As we gained experience and learned more, we found ourselves second-guessing the subjective judgments we had made at the beginning of the study using WRAP and UMAM. The measurements taken for HGM removed some of that subjectivity so that across the study period, HGM assessments were more consistent. Since consistency among users is one of the intents of Florida law, use of a less subjective assessment method should be considered.

Evaluated wetland projects

Of 118 functional assessments performed in the field, 95, or 80.51%, were in Lee County; 19, or 16.10%, were in Charlotte County; and 4, or 3.39%, were in Sarasota County.

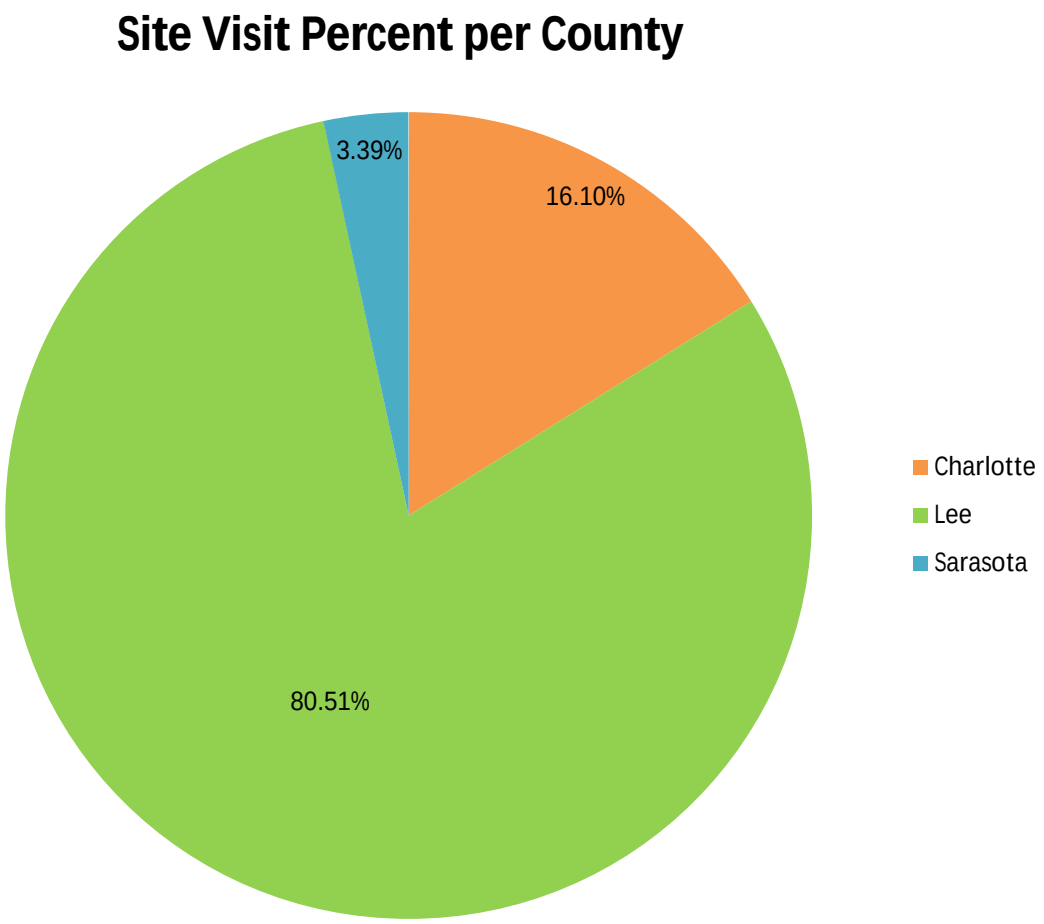


Figure 37: Percentage of projects by county

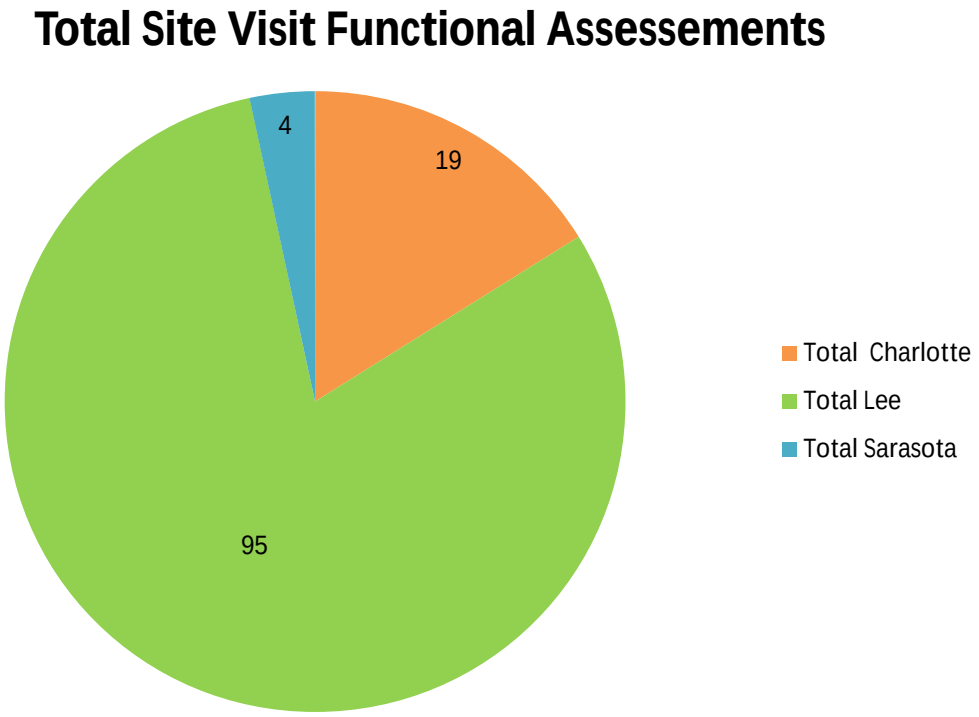


Figure 38: Number of projects by county

It is important to note that some permitted projects contained more than one assessment location. If a project site contained two or more distinct wetland types, each wetland type was assessed separately. Also, some projects contained on-site mitigation. In these cases, the on-site mitigation area was assessed separately.

Lee County projects were chosen for assessment from South Florida Water Management District (SFWMD) Environmental Resource Permits (ERPs). Charlotte County projects were chosen for assessment from SFWMD and Florida Department of Environmental Protection (FDEP) permits. Sarasota County projects were to be chosen from Southwest Florida Water Management District (SWFWMD) ERPs, but the cost to search in person through permits and permit applications on-site at the SWFWMD offices in Sarasota made this impractical. Instead projects were chosen from the PI's personal history as a regulator, where the nature and extent of the project was personally known.

Project Status

The site conditions at the time of evaluation were either in the pre-project condition prior to implementation of the wetland impact (70%) or in a post project essentially post construction condition (30%).

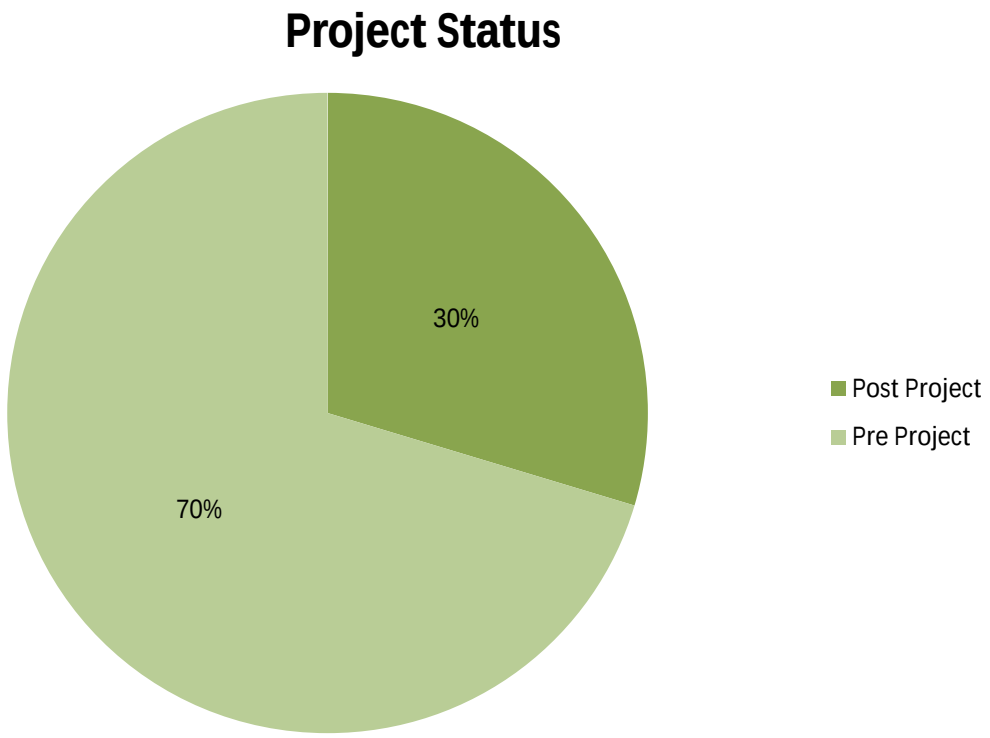


Figure 39: Percentage of projects by project status

Project Types

The project type associated with each assessment location is broken down in the following graphs. Project types were assigned according to the type given on the permit document, or, if "other" was entered as the type, a more specific category was chosen based on the proposed result of the project. "Commercial" projects include construction of primarily commercial properties, such as grocery stores. "Residential" projects include construction of single- or multi-family residences. Both commercial and residential project types may have included filling of wetlands as an impact. The single project categorized as "fill" took dredged material from elsewhere in the project bounds and deposited it in a nearby stormwater treatment pond. "Navigation" projects were primarily dredging for vessel access.

The largest category of projects across the study is the residential category, comprising almost 17% of all assessment locations. However, when all dock, dock-related and marina projects are combined, they represent 25% of all projects.

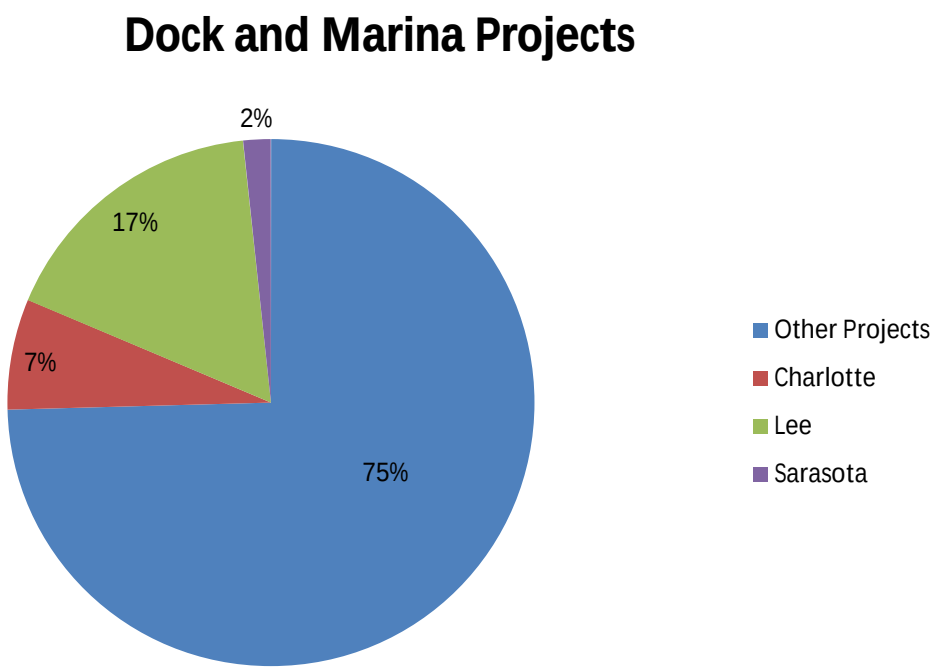


Figure 40: Percentage of dock and marina projects

Roadway projects make up almost 16% of the total. All shoreline hardening projects combine to 8%, about the same percentage as recreation projects. Preservation projects comprise the same proportion of projects as riprap additions.

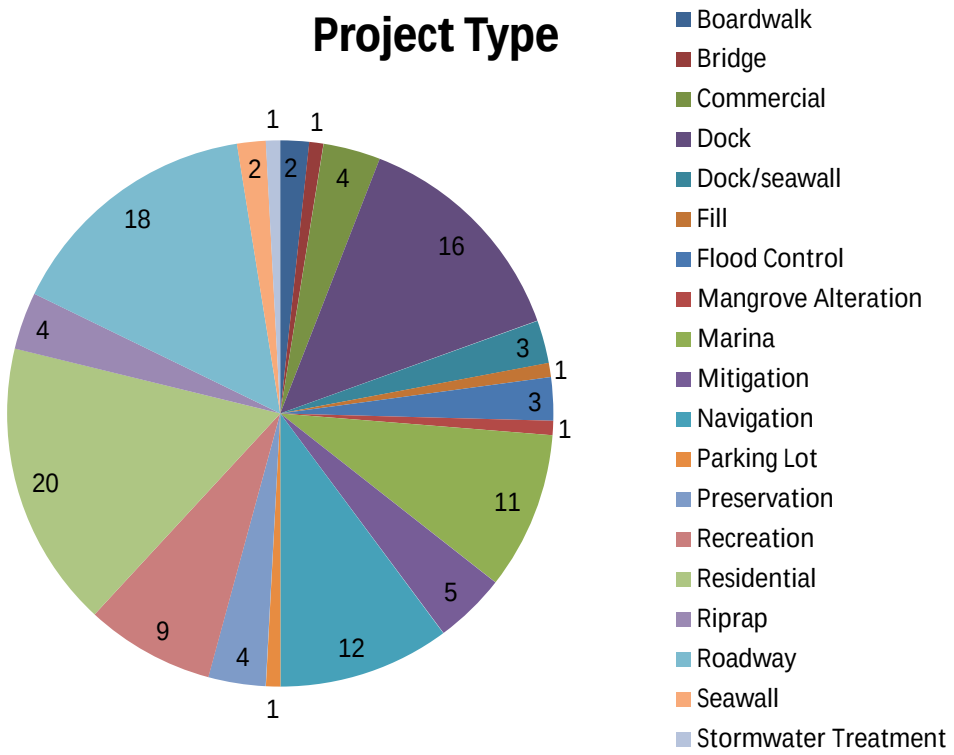


Figure 41: Number of projects by project type

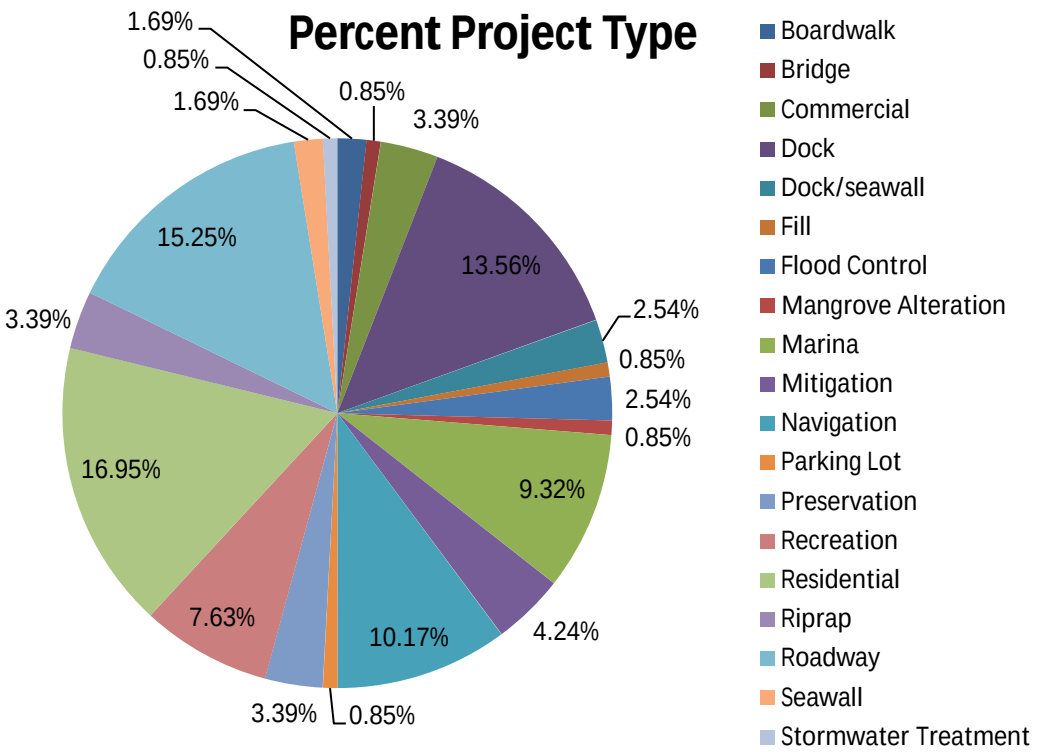


Figure 42: Percentage of projects by project type

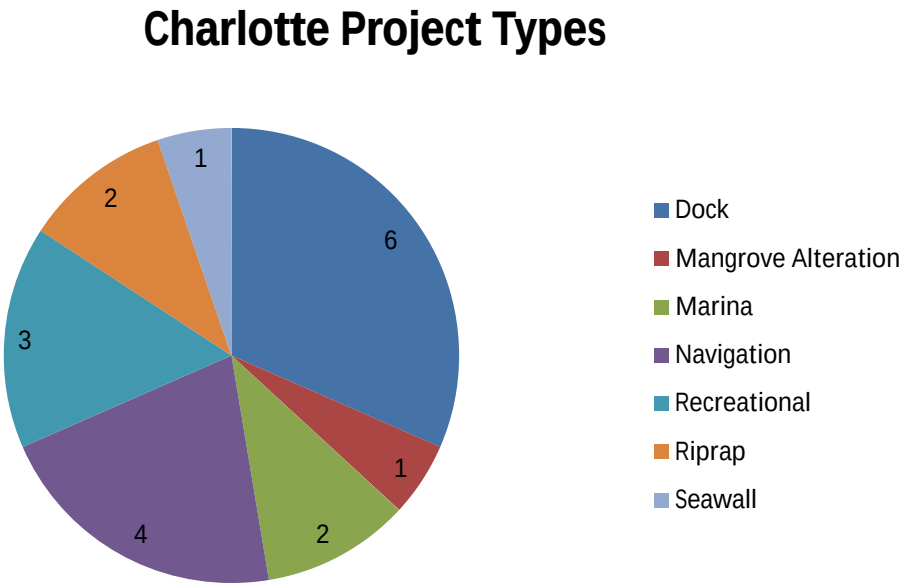


Figure 43: Number of projects by project type in Charlotte County

Nineteen assessments were performed in Charlotte County. The majority of these functional assessments were docks (31.58%), and when marina projects are added to that, the proportion grows to about 42%. Navigation projects make up the second largest sector, 21%.

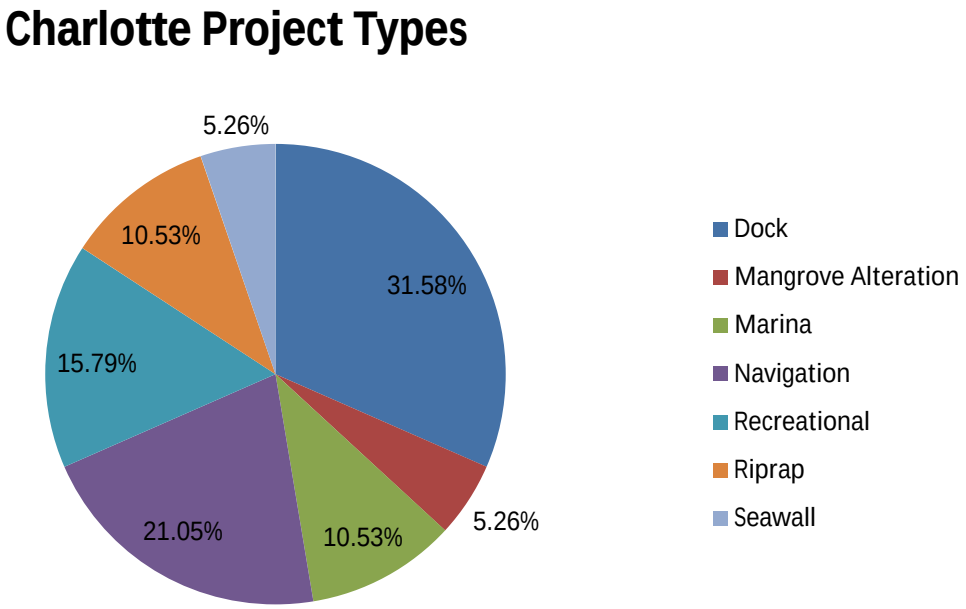


Figure 44: Percentage of projects by project type in Charlotte County

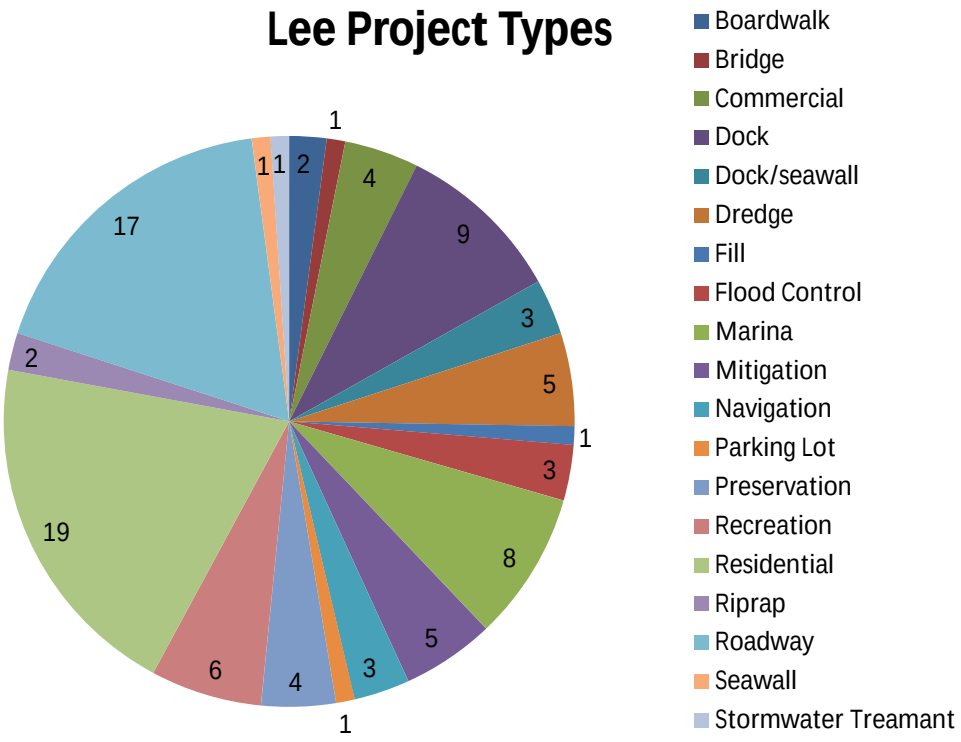


Figure 45: Number of projects by project type in Lee County

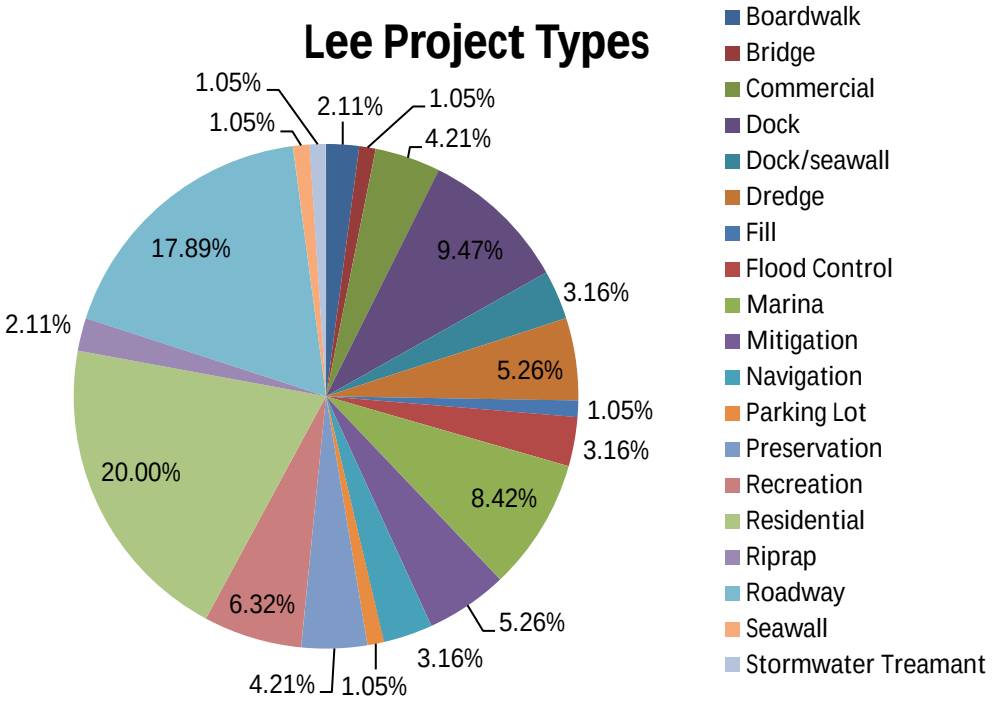


Figure 46: Percentage of projects by project type in Lee County

In Lee County a total of 95 functional assessments are represented. As in Charlotte, residential projects make up the majority of the functional assessments done – 20%. Again, as in Charlotte, when all dock, dock-related and marina projects are combined, they comprise 21%. Roadway projects are the second largest category with almost 18% of all assessments.

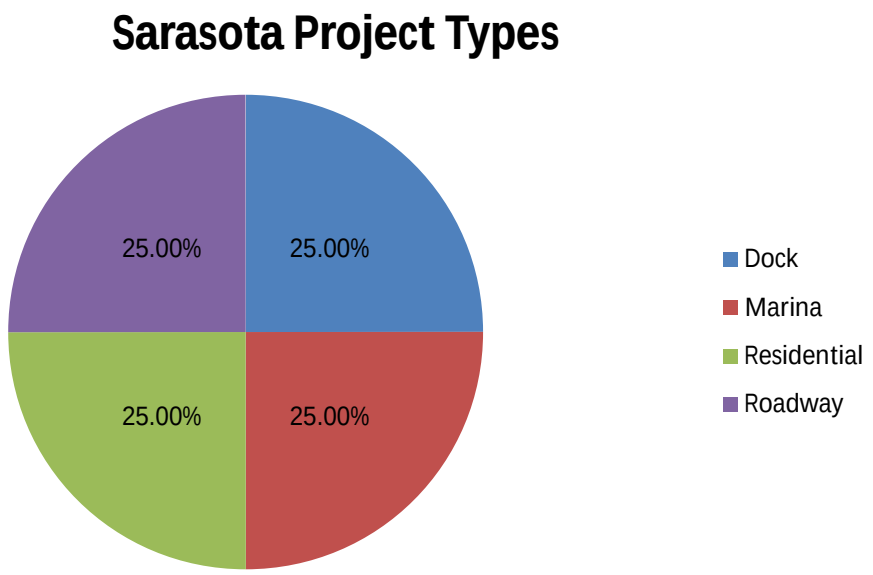


Figure 47: Percentage of projects by project type in Sarasota County

In Sarasota County, 4 functional assessments were performed, each representing a different category. Again, however, when dock and marina projects are combined, that becomes the largest category at 50% of all assessments.

Habitat Types: Federal Classification

Florida wetlands are defined by plants, soils, and hydrology, but systems for classifying wetlands vary. Often, wetlands are classified by community type. This classification can include references to dominant plant types, placement in the landscape, or frequency of flooding. Terms such as “swamp”, “marsh”, “saltern”, and “flat” all convey particular characteristics of vegetative cover or position relative to tides, for example.

One of the most commonly used classification schemes in Florida is the Florida Land Use, Cover and Forms Classification System (FLUCCS), originally published by the Florida Department of Transportation in 1985 (Florida Department of Transportation 1999). FLUCCS is a hierarchical system that reflects land uses and land cover in greater detail with each hierarchical level. The most general level reflects features that can be obtained from remote sensing satellite imagery. Classifications range from “Urban and Built-Up” (100), to “Transportation, Communication and Utilities” (800), and include classifications for agriculture (200), rangeland (300), upland forests (400), water (500), wetlands (600), and barren land (700). This classification scheme was used during the study to characterize coastal wetlands.

Another important classification system is found in “Classification of Wetlands and Deepwater Habitats of the United States” from the US Fish and Wildlife Service (USFWS) (Cowardin, et al. 1979). This system is exclusively for wetlands, whereas FLUCCS addresses most, if not all, land covers and uses. The Cowardin scheme was developed by wetland ecologists to meet four long-term goals, as stated by USFWS: “(1) to describe ecological units that have certain homogeneous natural attributes; (2) to arrange these units in a system that will aid decisions about resource management; (3) to furnish units for inventory and mapping; and (4) to provide uniformity in concepts and terminology throughout the United States.” (Cowardin, et al. 1979) Since this study is funded by USEPA, analysis has been done to “translate” the FLUCCS habitat classifications into the USFWS classifications.

In the USFWS system, “systems” form the highest level of the classification hierarchy and there are five types used: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. This study focuses on habitats found in the Estuarine System, so this discussion will be limited to the characteristics of Estuarine Systems.

The Estuarine System has two Subsystems – Subtidal and Intertidal. Within the Subsystems, Classes are based on substrate material and flooding regime, or on vegetative life form, whichever best describes the general appearance of the habitat and can be recognized without the aid of detailed environmental measurements. If vegetation (except pioneer species) covers 30% or more of the substrate, Class is based on that vegetation type which makes up 30% or more of the uppermost stratum. If vegetation covers less than 30% of the site, the Class is based on substrate. Each Class based on substrate has a definition based on particle size or material, such as Rock Bottom (bedrock, boulders, or stones), Unconsolidated Shore (cobbles, gravel, sand, mud, or organic material), and Reef (living and dead remains of invertebrates such as corals, mollusks, or worms). Classes based on vegetative form include Aquatic Bed, Moss-Lichen Wetland, Emergent Wetland, Scrub-Shrub Wetland and Forested Wetland. Classes in this study were limited to Scrub-Shrub, Forested, Emergent, Unconsolidated Shore, Rocky Shore,

Unconsolidated Bottom, Aquatic Bed, Rock Bottom, and Streambed. Modifiers can be used to specify plant or animal dominance or water regimes. A finer point is put on the type of substrate material or dominant plant or animal with the Subclass designations. In the scheme, particular Subclasses are prescribed for particular Classes, that is, not every Subclass can be applied to every Class.

Table 28 below is a "crosswalk" showing the FLUCCS-based habitat types and how they were related to the USFWS scheme for this study. Details of each individual assessment site especially contributed to the assignment of Class and Subclass.

Project Name	Project Type	Primary Habitat	System	Subsystem	Class	Subclass
Tranquility Bay	Residential	Basin Mangrove Forest/High Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Orchid Cove Publix (exotic wetland hardwoods)	Commercial	Exotic Wetland Hardwoods	Estuarine	Intertidal	Forested	Broad-Leaved Deciduous
Community Palm Cove	Residential	High Marsh	Estuarine	Intertidal	Emergent	Persistent
Stringfellow Multifamily	Residential	High Marsh	Estuarine	Intertidal	Emergent	Persistent
Dean Park Emergency Pumping	Flood Control	High Marsh	Estuarine	Intertidal	Emergent	Persistent
Winkler 10 acre RPD	Residential	High Marsh	Estuarine	Intertidal	Forested	Broad-Leaved Deciduous
Old Bridge Dredge-Pond	Filling	Littoral Shelf	Estuarine	Intertidal	Emergent	Persistent
Orchid Cove	Residential	Low Marsh	Estuarine	Intertidal	Emergent	Persistent
Eagle Lake Observation Deck	Boardwalk	Mangrove Forest	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Demere Preserve North	Mitigation	Mangrove Forest	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Ceitus Boat Lift Removal	Navigation	Mangrove Forest	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Laishley Park Boat Ramp	Recreational	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Harborview Mangrove Fringe	Navigation	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Burnt Store Lakes Boat Ramp	Recreational	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
19003 Midway	riprap	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
24096 Jean LaFitte	riprap	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
13180 Joseffa Ct.	Dock	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
3250 Waterside	Dock	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved

						Evergreen
13010 Garfield Ct.	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
10460 Sunny Dreams	Dock	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
3270 Waterside Dr.	Seawall	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
4025 Bay Oaks Cir.	Dock	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
4111 N. Beach Rd.	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
900 McCall Rd	Mangrove Alteration	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Harbor Point Villas #8 Updated Permit	Residential	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Centennial Park Uplift Area	Mitigation	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Waterside at Bay Beach Phase VI	Residential	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Harbour Pointe Entrance Road	Roadway	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Cherry Estates Island 9	Residential	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Cherry Estates RV Park	Residential	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Palm Island Single Family Dock	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Richview Court Drainage Improvements	Roadway	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Hanna Wood Dock	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen

Sirenia Vista Park	Recreational	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Calusa Cove	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Bokeelia Boat Ramp	Marina Impact	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Porpoise Point	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Lover's Key Boat Ramp Dredging	Dock	Mangrove Fringe	Estuarine	Intertidal	Unconsolidated Shore	Sand
G-5 Properties/Palms of McGregor	Residential	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Shell Cut Marina	Marina Impact	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Hidden Harbor	Residential	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Hancock Harbor Yacht Club	Residential	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Tarpon Point Docks	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Matanzas Pass Dredging	Navigation	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Mangrove Waterways	Commercial	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Dean Park Emergency Pumping	Flood Control	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Dean Park Emergency Pumping/Caloosahatchee	Flood Control	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Tsuda Dock	Dock	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Caloosahatchee Creeks Hydrologic	Preservation	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved

Restoration						Evergreen
US 41 Widening	Roadway	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Old Bridge Dredge-N. Channel	Navigation	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Arroyal Place	Marina Impact	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Boca Bay Retaining Wall	Seawall	Mangrove Fringe	Estuarine	Intertidal	Unconsolidated Shore	Sand
Sanibel Causeway Bridge NW Site	Roadway	Mangrove Fringe	Estuarine	Intertidal	Unconsolidated Shore	Sand
Sanibel Causeway Bridge SW Site	Roadway	Mangrove Fringe	Estuarine	Intertidal	Unconsolidated Shore	Sand
Bokeelia Harbor Resort Open	Commercial	Mangrove Fringe	Estuarine	Intertidal	Rocky Shore	Rubble
Pondella 460	Residential	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Leeward Marina	Marina Impact	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Owl Creek Marina I (North River Village)	Marina Impact	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Owl Creek Marina II (North River Village)	Marina Impact	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Williams Island Marina (North River Village)	Marina Impact	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Cayo Costa ADA Shelter	Recreational	Mangrove Fringe	Estuarine	Intertidal	Unconsolidated Shore	Sand
US 41 Bridge Expansion	Roadway	Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Eagle Point Community Dock	Dock	Mangrove Fringe	Estuarine	Intertidal	Unconsolidated Shore	Sand
Venetian Waterway Park	Residential	Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved

						Evergreen
Harborview Mangrove Overwash Island	Navigation	Mangrove Overwash Island	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Ponce de Leon Park boardwalk	Recreational	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
River Watch Lot 7	Boardwalk	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Caribbean Cove Estates	Residential	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Cayo Costa Dock Expansion	Dock	Mangrove Swamp	Estuarine	Intertidal	Unconsolidated Shore	Sand
Harbour Pointe @ South Seas Resort	Residential	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
San Carlos Drive Paving	Roadway	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Bunche Beach Park Improvements	Recreational	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Orchid Cove Publix ("high quality wetlands")	Commercial	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Tarpon Point Bridge	Roadway	Mangrove Swamp	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Gladiolus Widening	Roadway	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Manatee Park Shoreline Stabilization	Recreational	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Deep Lagoon Preserve Parcel 78	Preservation	Mangrove Swamp	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Blind Pass Dredging	Navigation	Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Harbor Point Villas #8 Original Permit	Residential	Mangroves	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen

Orange River Landing	Residential	Mangroves	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen
Preliminary Geotechnical Investigation/Popash Creek	Roadway	Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Preliminary Geotechnical Investigation/Tidal Marsh	Roadway	Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Deciduous
Preliminary Geotechnical Investigation/Tidal Creek	Roadway	Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Deciduous
Harbor Club	Marina Impact	Salt Marsh	Estuarine	Intertidal	Emergent	Persistent
Stringfellow Lakes Estates (wetlands)	Mitigation	Salt Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen
Caloosahatchee Creeks Hydrologic Restoration	Preservation	Salt Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Deciduous
Lakes Park Water Quality Improvements	Recreational	Salt Marsh	Estuarine	Intertidal	Emergent	Persistent
Burnt Store Road Widening - Hermosa Canal	Roadway	Salt Marsh	Estuarine	Intertidal	Rocky Shore	Rubble
Burnt Store Road Widening - Horseshoe Canal	Roadway	Salt Marsh	Estuarine	Intertidal	Emergent	Persistent
Burnt Store Road Widening - Arroz Canal	Roadway	Salt Marsh	Estuarine	Intertidal	Emergent	Persistent
Burnt Store Rd Widening-Gator Slough	Roadway	Salt Marsh	Estuarine	Intertidal	Emergent	Persistent
Stringfellow Lakes Estates (saltern)	Residential	Saltern	Estuarine	Intertidal	Emergent	Persistent
Harborview Juncus Marsh	Navigation	Saltwater Marsh	Estuarine	Intertidal	Emergent	Persistent
Demere Preserve Pond	Mitigation	Saltwater Marsh	Estuarine	Intertidal	Emergent	Persistent
Sanibel Causeway Bridge SE Site	Roadway	Saltwater Marsh	Estuarine	Intertidal	Emergent	Persistent
M&J Wick Shoreline Stabilization	riprap	Shoreline	Estuarine	Intertidal	Unconsolidated Shore	Sand
Black Island Parcel D	dock/seawall	Shoreline	Estuarine	Intertidal	Unconsolidated Shore	Sand

Windward Point	riprap	Submerged	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Alligator Creek Realignment	Navigation	Submerged Bottom	Estuarine	Subtidal	Aquatic Bed	Rooted Vascular
Parkhill	Marina Impact	Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Quail Creek	Navigation	Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Old Bridge Dredge-W. Channel	Navigation	Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Old Bridge Dredge-E. Channel	Navigation	Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Old Bridge Dredge-Bridge	Navigation	Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Sanibel Causeway Recreation Pier	Recreational	Submerged Bottom	Estuarine	Subtidal	Rock Bottom	Rubble
Bokeelia Harbor Resort Basin	Residential	Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Fisherman's Wharf	Marina Impact	Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Riviera Marina	Marina Impact	Subtidal	Estuarine	Subtidal	Unconsolidated Bottom	Mud
HLH Real Est. Prop Docking Fac.	dock/seawall	Subtidal	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Rails End Multifamily Dock	dock/seawall	Subtidal	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Coast Guard Pier Expansion	Dock	Subtidal	Estuarine	Subtidal	Unconsolidated Bottom	Sand
Matlacha Pass Bridge Replacement	Bridge	Subtidal	Estuarine	Subtidal	Unconsolidated Bottom	Mud
Burnt Store Road Widening - Shadroe Canal	Roadway	Tidal Flat	Estuarine	Intertidal	Unconsolidated Shore	Mud
Caloosahatchee Creeks Hydrologic	Preservation	Tidal Freshwater	Estuarine	Intertidal	Streambed	Mud

Restoration		Marsh				
WINK TV/Fort Myers Broadcasting Expansion	Parking Lot	Tidal Marsh	Estuarine	Intertidal	Streambed	Mud
Manuels Branch Siltation Structure	Stormwater Treatment	Tidal Marsh	Estuarine	Intertidal	Streambed	Sand
Sanibel Causeway Mitigation Modification	Mitigation	Wetland Hardwood Forest	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen

Table 28: FLUCCS/USFWS crosswalk for the field-reviewed projects

System	Number of Sites	% of Sites
Estuarine	118	100%
Subsystem		
Intertidal	103	87%
Subtidal	15	15%
Class		
Scrub-Shrub	32	27%
Forested	42	36%
Emergent	14	12%
Unconsolidated Shore	10	8%
Rocky Shore	2	2%
Unconsolidated Bottom	13	11%
Aquatic Bed	1	1%
Rock Bottom	1	1%
Streambed	3	3%
Subclass		
Broad-Leaved Evergreen	69	58%
Broad-Leaved Deciduous	5	4%
Persistent	14	12%
Sand	11	9%
Rubble	3	3%
Mud	15	13%
Rooted Vascular	1	1%

Table 29: Federal wetland classification

The following are the definitions from USFWS for the Classes and Subclasses used in this study.

1) Subsystems

   i) Intertidal - Substrate is exposed and flooded by tides; includes the associated splash zone.

   ii) Subtidal - Substrate is continuously submerged.

2) Classes

   i) Scrub-Shrub - Areas dominated by woody vegetation less than six meters (20 feet) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions.

   ii) Forested - Areas dominated by woody vegetation that is six meters (20 feet) tall or taller.

iii) Emergent - Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, present for most of the growing season in most years (marsh, slough, etc.)

iv) Unconsolidated Shore - Characterized by less than 75% coverage of stones, boulders or bedrock, less than 305 coverage of vegetation other than pioneer plants and a water regime that is no more than irregularly exposed (dry).

v) Rocky Shore - Areas characterized by bedrock, stones, or boulders which singly or in combination have an aerial cover of at least 75% and vegetative cover of less than 30% and a water regime that is no more than irregularly exposed.

vi) Unconsolidated Bottom - Includes all wetland habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%. Water regimes in these areas are wet more often than dry, which distinguishes this type from Unconsolidated Shore.

vii) Aquatic Bed - Includes wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.

viii) Rock Bottom - Includes all wetlands with substrates having an aerial cover of stones, boulders, or bedrock 75% or greater and a vegetative cover of less than 30%. This is distinguished from Rocky Shore by having a wetter water regime or no less than semipermanently flooded.

ix) Streambed - Includes all channels of the Estuarine System.

3) Subclasses

i) Broad-Leaved Evergreen - Dominated by red mangroves (*Rhizophora mangle*), black mangroves (*Avicennia germinans*), white mangroves (*Laguncularia racemosa*), or buttonwood (*Conocarpus erectus*) that are less than six meters tall.

ii) Broad-Leaved Deciduous - Characterized by red maple (*Acer rubrum*), American elm (*Ulmus americana*), ashes (*Fraxinus pennsylvanicus* and *F. nigra*), black gum (*Nyssa sylvatica*), tupelo gum (*N. aquatica*), swamp white oak (*Quercus bicolor*), overcup oak (*Q. lyrata*), and basket oak (*Q. michauxii*).

iii) Persistent - Dominated by species that normally remain standing at least until the beginning of the next growing season, such as salt marsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*), and needlerush (*Juncus roemerianus*), among others.

iv) Sand - Dominated by unconsolidated particles smaller than stones.

v) Rubble - Less than 75% areal cover of bedrock, but stones and boulders alone or in combination with bedrock cover 75% or more of the area.

vi) Mud - Dominated by unconsolidated particles smaller than stones which are predominantly silt and clay, although coarser sediments or organic material may be intermixed.

vii) Rooted Vascular - Also known as seagrass beds, turtle grass beds, and others, these areas are dominated by vascular aquatic plants.

Because of the study area chosen, all of the assessment sites were in the Estuarine System. 87% of the sites were found to be Intertidal. This is consistent with the predominance of mangrove habitats involved with the permitted projects.

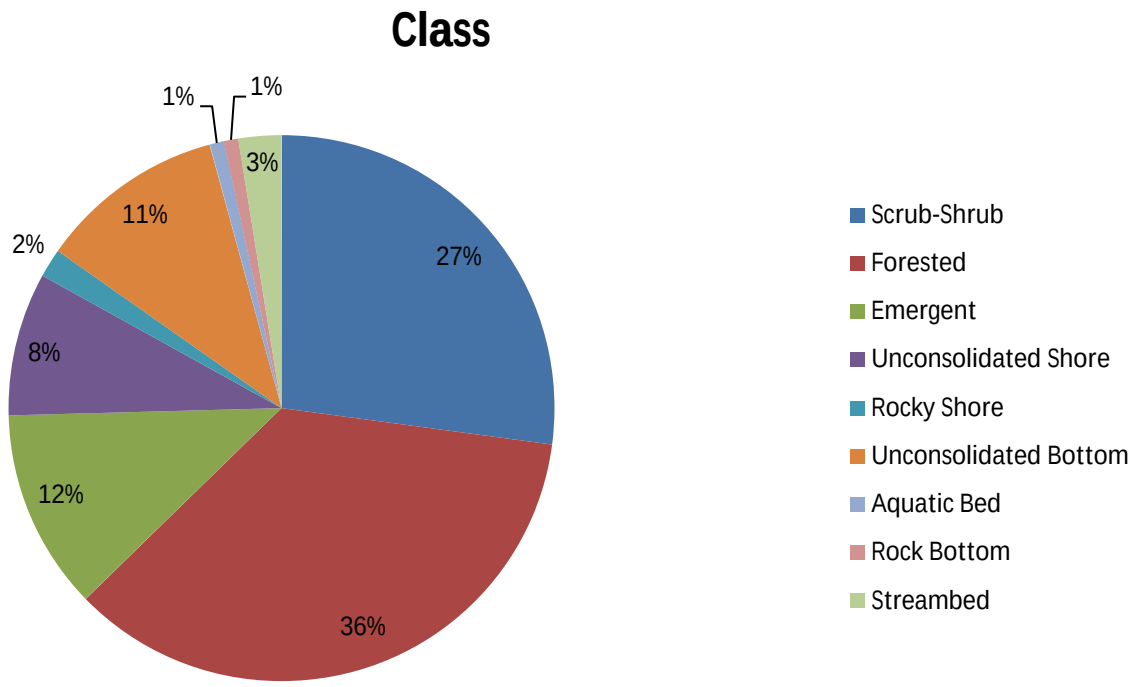


Figure 48: Percentage of projects by Federal wetland class

The Class "Forested" comprised 36% assessed sites. This is also indicative of the predominance of mangrove habitats and testifies to the density of mangrove coverage and size of the individual mangrove trees at the locations of potential and permitted projects. The majority stake of the Subclass designation went to "Broad-Leaved Evergreen", the major component of this Subclass being mangrove species.

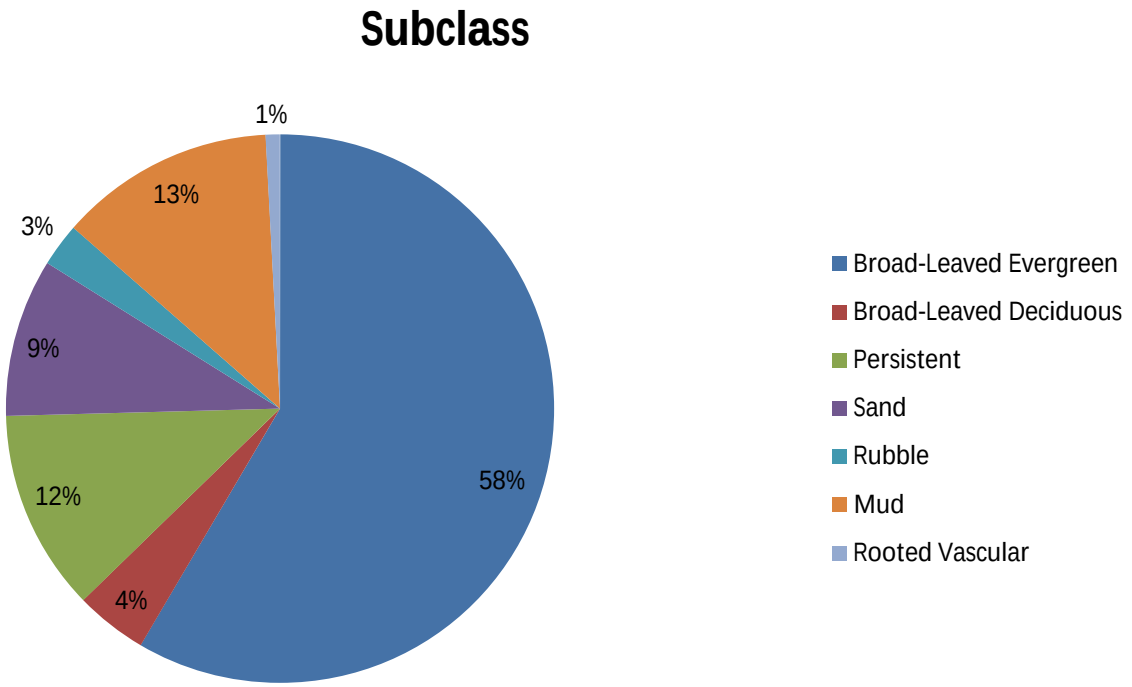


Figure 49: Percentage of projects by Federal wetland subclass

Each System, Subsystem, Class, and Subclass has an abbreviation associated with it. The organization chart below shows how the hierarchical layers are arranged and the abbreviations that go with each classification. The chart shows the entire classification scheme. The Estuarine System chart is the only part that is applicable to the sites in this study.

WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

System	M - Marine							
Subsystem	1 - Subtidal				2 - Intertidal			
Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	RF – Reef	AB – Aquatic Bed	RF – Reef	RS – Rocky Shore	US – Unconsolidated Shore
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 5 Unknown Submergent	1 Coral 3 Worm	1 Algal 3 Rooted Vascular 5 Unknown Submergent	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

System	E - Estuarine											
Subsystem	1 - Subtidal				2 - Intertidal							
Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	RF – Reef	AB – Aquatic Bed	RF – Reef	SB – Streambed	RS – Rocky Shore	US – Unconsolidated Shore	EM – Emergent	SS – Scrub-Shrub	FO – Forested
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	1 Mollusk 2 Worm	1 Algal 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	1 Mollusk 2 Worm	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Non persistent 5 *Phragmites australis*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen

System	R - Riverine						
Subsystem	1 - Tidal	2 – Lower Perennial	3 – Upper Perennial	4* - Intermittent	5 – Unknown Perennial		
Class	RB – Rock Bottom	UB – Unconsolidated Bottom	SB** – Streambed	AB – Aquatic Bed	RS – Rocky Shore	US – Unconsolidated Shore	EM – Emergent
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble-Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Non Persistent

* **Intermittent** is limited to the **Streambed** Class
** **Streambed** is limited to **Tidal** and **Intermittent** Subsystems

Classification of Wetlands and Deepwater Habitats of the United States
Cowardin *et al.* 1979 as modified by USFWS for wetlands mapping. March, 2008

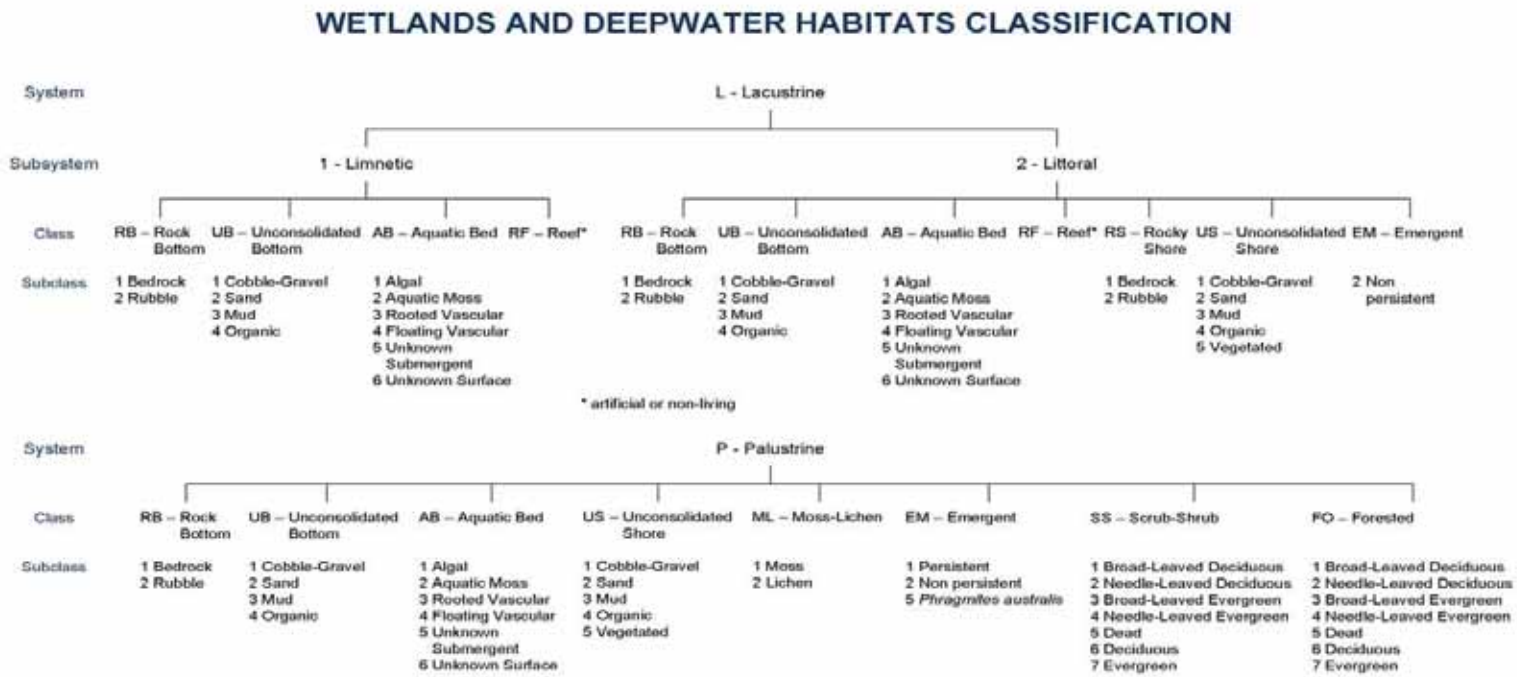


Figure 50: Hierarchy of the Federal Wetland Classification System
Source: Heber 2008

Using the abbreviations as above, the sites assessed for this study can be given federal wetland classifications. The "translation" from the habitat designations assigned in the field to the designations in the USFWS scheme is shown below. The table represents all the different habitats encountered in the study, but does not show multiples of the same type.

Primary Habitat	System	Subsystem	Class	Subclass	System	Subsystem	Class	Subclass
Basin Mangrove Forest/High Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen	E	2	SS	3
Exotic Wetland Hardwoods	Estuarine	Intertidal	Forested	Broad-Leaved Deciduous	E	2	FO	1
High Marsh	Estuarine	Intertidal	Emergent	Persistent	E	2	EM	1
High Marsh	Estuarine	Intertidal	Forested	Broad-Leaved Deciduous	E	2	FO	1
Littoral Shelf	Estuarine	Intertidal	Emergent	Persistent	E	2	EM	1
Low Marsh	Estuarine	Intertidal	Emergent	Persistent	E	2	EM	1
Mangrove Forest	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen	E	2	SS	3
Mangrove Fringe	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen	E	2	FO	3
Mangrove Fringe	Estuarine	Intertidal	Rocky Shore	Rubble	E	2	RS	2
Mangrove Fringe	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen	E	2	SS	3
Mangrove Fringe	Estuarine	Intertidal	Unconsolidated Shore	Sand	E	2	US	2
Mangrove Overwash Island	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen	E	2	FO	3
Mangrove Swamp	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen	E	2	FO	3
Mangrove Swamp	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen	E	2	SS	3
Mangrove Swamp	Estuarine	Intertidal	Unconsolidated Shore	Sand	E	2	US	2
Mangroves	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen	E	2	FO	3
Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved	E	2	SS	1

				Deciduous				
Marsh	Estuarine	Intertidal	Scrub-Shrub	Broad-Leaved Evergreen	E	2	SS	3
Salt Marsh	Estuarine	Intertidal	Emergent	Persistent	E	2	EM	1
Salt Marsh	Estuarine	Intertidal	Rocky Shore	Rubble	E	2	RS	2
Saltern	Estuarine	Intertidal	Emergent	Persistent	E	2	EM	1
Saltwater Marsh	Estuarine	Intertidal	Emergent	Persistent	E	2	EM	1
Shoreline	Estuarine	Intertidal	Unconsolidated Shore	Sand	E	2	US	2
Submerged Bottom	Estuarine	Subtidal	Aquatic Bed	Rooted Vascular	E	1	AB	3
Submerged Bottom	Estuarine	Subtidal	Rock Bottom	Rubble	E	1	RB	2
Submerged Bottom	Estuarine	Subtidal	Unconsolidated Bottom	Mud	E	1	UB	3
Subtidal	Estuarine	Subtidal	Unconsolidated Bottom	Mud	E	1	UB	3
Subtidal	Estuarine	Subtidal	Unconsolidated Bottom	Sand	E	1	UB	2
Tidal Flat	Estuarine	Intertidal	Unconsolidated Shore	Mud	E	2	US	3
Tidal Marsh	Estuarine	Intertidal	Streambed	Mud	E	2	SB	3
Tidal Marsh	Estuarine	Intertidal	Streambed	Sand	E	2	SB	2
Wetland Hardwood Forest	Estuarine	Intertidal	Forested	Broad-Leaved Evergreen	E	2	FO	3

Table 30: FLUCCS/USFWS crosswalk abbreviations

When this reclassification was complete, it was found that 34% of assessment locations were considered E2FO3, or Estuarine Intertidal Forested Broad-Leaved Evergreen, which coincided with the FLUCCS-based category 612, indicating a mangrove-dominated fringe, forest, swamp, or overwash forest with mangrove trees at least six meters (20 feet) tall.

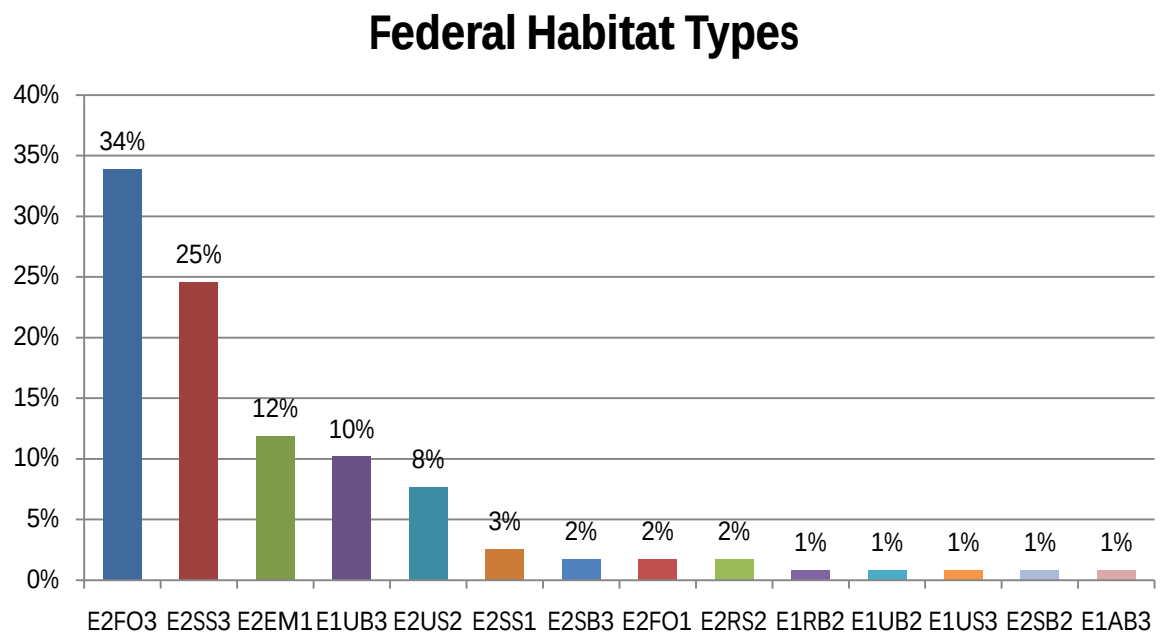


Figure 51: Percentage of projects by Federal wetland habitat designation

Habitat Types: State Classification

Habitat types at each location of a functional assessment were assigned according to FLUCCS number. Mangroves (612) made up the largest category of habitat assessed at 63%. Within that category, mangrove fringe included 54 of the total 118 assessment locations, or 46%. Other types of mangrove habitat encountered included basin mangrove forest, mangrove overwash island, mangrove swamp and mangrove forest. The salt marsh category includes saltern, high marsh, low marsh and tidal flats and comprised 20% of all habitats assessed.

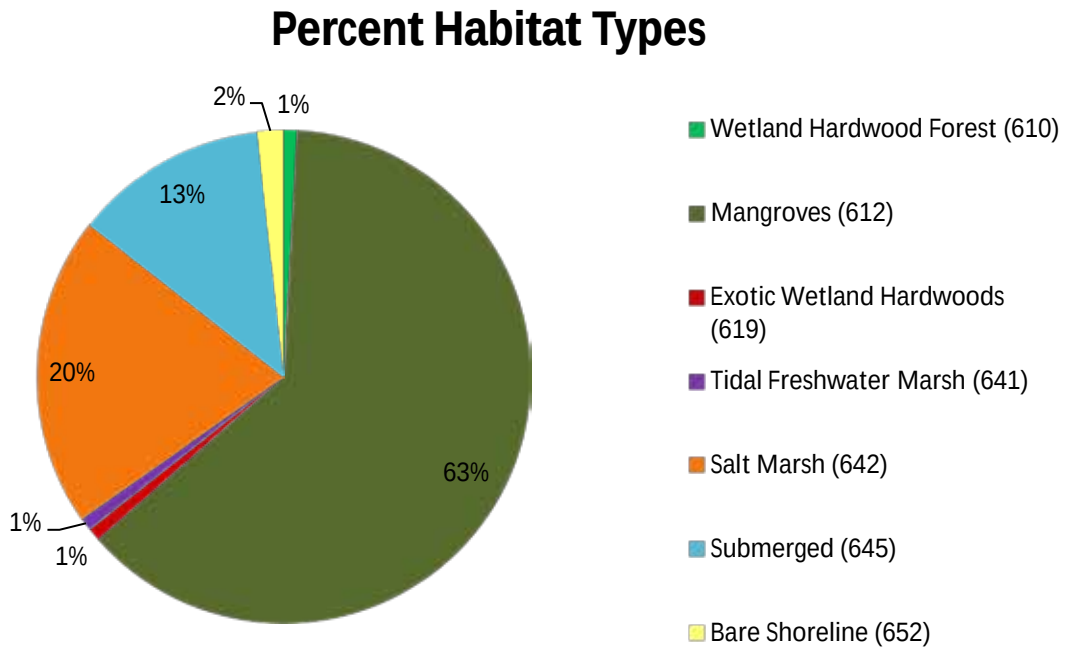


Figure 52: Percentage of projects by state wetlands habitat type

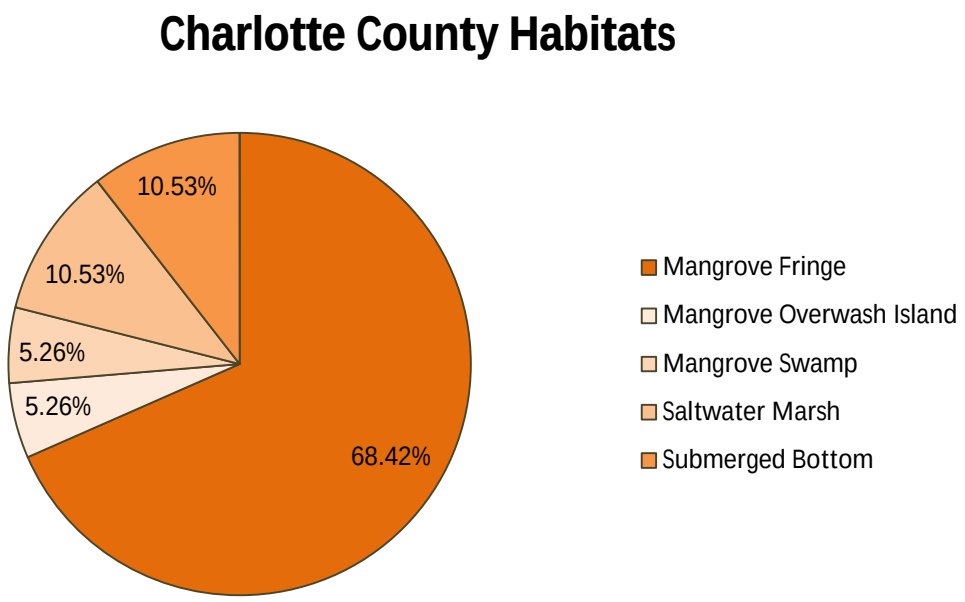


Figure 53: Percentage of projects by habitat in Charlotte County

Projects by Watershed

Functional assessments were performed on projects in nine different watersheds within the CHNEP study area: Dona Bay, Roberts Bay, Lemon Bay, Charlotte Harbor, the Peace River, Gasparilla Sound, Matlacha Pass, Pine Island Sound, the Caloosahatchee River, San Carlos Bay, and Estero Bay. 32%, or 38 of 118 assessments were located in the Caloosahatchee River basin, while 15%, or 18 of 118, were located in Estero Bay.

The distribution of projects assessed was determined to some degree by the facility of finding pertinent permit information. The majority of projects in Lee County (Gasparilla Sound, Matlacha Pass, Pine Island Sound, the Caloosahatchee River, San Carlos Bay, and Estero Bay) were under the jurisdiction of the South Florida Water Management District (SFWMD). SFWMD maintains a website (http://my.sfwmd.gov/ePermitting/PopulateLOVs.do?flag=1) where permit and background documents are stored and kept accessible to the public. Records that are part of the permitting process are scanned and maintained in their entirety and the database is searchable by permit number, application number, applicant name, company name, project name, township, range or date. This method of maintaining records made it very easy to narrow the search for permits that fit the parameters of this study from the convenience of the researcher's desk and at no charge to the user.

Other projects, especially in Charlotte County, were under the jurisdiction of the Florida Department of Environmental Protection (FDEP). Finding applicable permits was more difficult with this agency. At this writing, FDEP does not maintain a searchable electronic database for ERP permits. Requests for information had to go to the local office staff. An appointment was then made for the researcher to go into the office and peruse the files that had been pulled according to some general parameters that had been set in the request. Each paper file had to be examined in person to determine which pages were necessary. Those pages were marked, the files were returned to FDEP staff, and copies were made, sometimes by a third party service. Per page and hourly charges were paid. Copies were delivered several days following the search appointment.

The dearth of Sarasota County projects assessed for this study is owed to the difficulty in getting permit information from the Southwest Florida Water Management District (SWFWMD), which has jurisdiction over a large part of Charlotte County and all of Sarasota County. Although SWFWMD maintains a searchable database of permit information, it does not keep scanned documents in this database. So, while it was possible to find permit numbers for projects that had occurred in potentially appropriate locations in Sarasota County, details were not visible electronically. In order to get more detailed information required for the study, it would have been necessary to travel to the Sarasota office of SWFWMD 161 kilometers (one hundred miles) away, pull copies of the permits found on the website, determine their appropriateness to the study, and pay per page copy charges for whatever documents were kept. This level of effort was deemed by the researchers not to be an efficient use of study resources. The four projects in Sarasota County were found in the process of looking at FDEP-permitted projects outlined above.

A breakdown of project types according to basin is located below. It shows that the largest overall number of project type in any basin was residential projects in the Caloosahatchee River basin. Second highest was dock projects in the Lemon Bay basin. Marina projects in the Caloosahatchee River and roadway projects affecting Matlacha Pass were the next most common.

The study area included tidally influenced areas of Lee, Charlotte and Sarasota Counties. The focus of the study on tidally influenced coastal wetlands kept the eastern extent of the study area well west of the county boundaries. Additionally, in Sarasota County, the Upper Myakka River basin was not included.

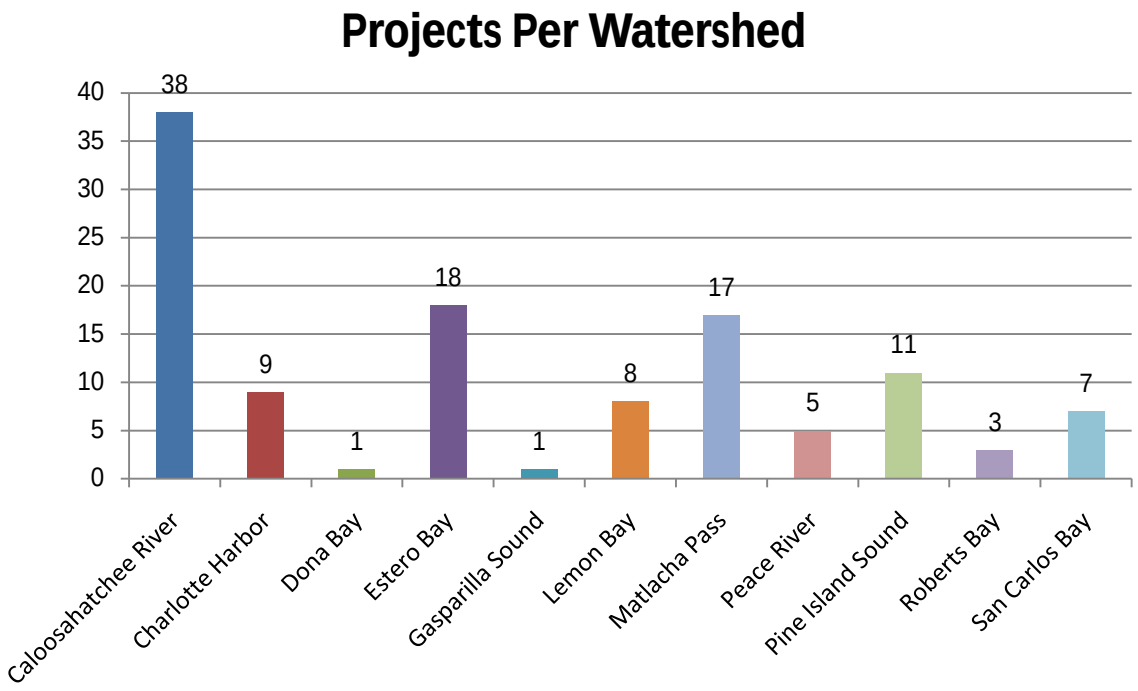


Figure 54: Number of projects by watershed

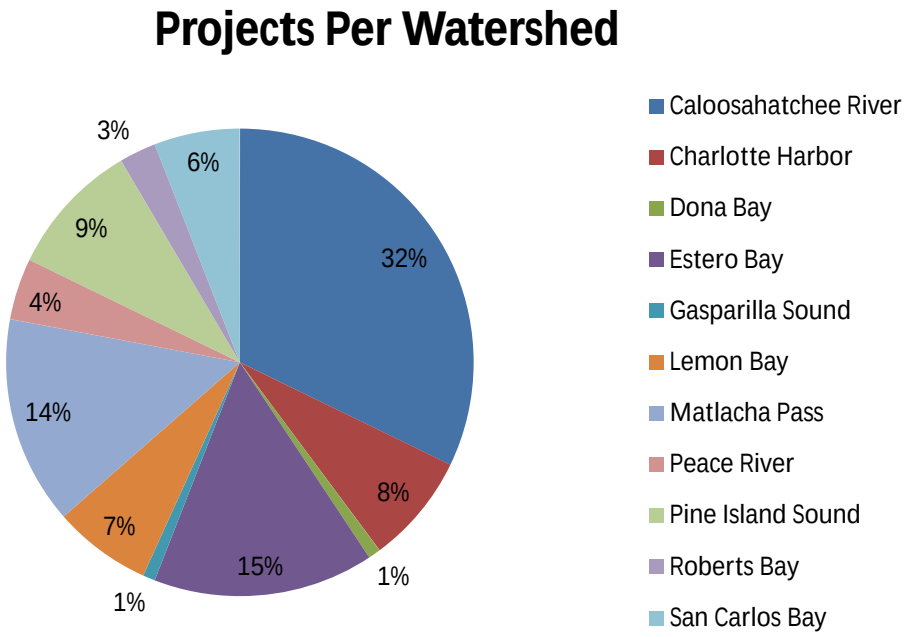


Figure 55: Percentage of projects by watershed

Wildlife

Mangrove ecosystems are important habitat for at least 1,300 species of animals including 628 species of mammals, birds, reptiles, fish, and amphibians, providing areas for breeding, nesting, foraging, and shelter (Odum *et al.* 1982, Day *et al.* 1989, Odum and McIvor 1990, Gilmore and Snedaker 1993, Beever 1989). The mangrove forest provides a multitude of habitats for resident, seasonal, and transient organisms from adjacent terrestrial and marine habitats. Many of the larger, motile species are not restricted to mangroves, but are seasonal or opportunistic visitors. However most invertebrate and some resident vertebrate species are totally dependent upon mangroves to survive and complete important life-cycle functions (Tomlinson 1986). Fish and invertebrates from open water marine habitats are frequent visitors to mangrove communities, as are birds and other organisms from nearby terrestrial systems.

Vertebrate species that utilize mangroves throughout the year are capable of tracking the changes in food availability as mangroves bloom, germinate, and fruit, and the subsequent changes in invertebrate and small vertebrate populations in response to these food resource changes. Other vertebrate species visit the mangrove habitat during the period that best suits their life cycle. The most seaward habitat is the mangrove fringe area containing red or black mangroves. The littoral and benthic components of this microhabitat contribute to the structure and resources available to organisms. As previously discussed, prop roots of red mangroves provide a specific microhabitat for resident species (e.g., tunicates, crustaceans, mollusks, and fish) that spend their entire life cycle either on or among the roots systems. Transient species are not dependent upon the prop root system, but use them intermittently for shelter, feeding, and/or breeding. The prop

root system also provides an important nursery for organisms (e.g., crustaceans, mollusks, and fishes) that develop here and spend their adult lives elsewhere (Gilmore and Snedaker 1993).

At least seven endangered species, five endangered subspecies and three threatened species utilize natural mangrove habitats. At least five of these are mangrove dependent in south Florida.

The value of the red mangrove as the basis of the detrital food chain of estuarine waters is well documented (Odum *et al.* 1982, Seaman 1985, Hutchings and Saenger 1987). It is recognized that over 90% of commercial fishery species and at least 70% of sports fishery species depend on the natural mangrove forest for a critical part or for their entire life cycle, for food and habitat (Lewis *et al.* 1985). In concert with sea grass beds, macrophytic algae, phytoplankton, benthic micro-algae and emergent marshes, the mangroves provide the primary productive food base of the estuarine system. The detritus provided by decomposition of seasonally shed mangrove leaves, and other aquatic vascular and non-vascular plants, is the food base for micro-crustaceans and other detrital processors that are consumed by larger crustaceans, small fishes and other first order predators. The animals in turn are the prey of larger fish species such as snook, snapper, tarpon, jack, sheepshead, spotted sea trout, and redfish. This diverse fish community also includes drums, porgys, grunts, mojarras, mullet, pipefish, flounder, sole, sea robins, toadfish, anchovies, herrings, needlefish, pinfish, silver perch, pigfish, scaled sardines, live bearers, silversides, sea cats, gobies, sharks, and rays. Based on surveys performed during the preparation of the Charlotte Harbor Aquatic Preserve Management Plan, at least 230 species of fish depend directly upon the mangrove ecosystem of Charlotte Harbor for food, shelter, breeding and/or nursery grounds (Beever 1989). System-wide, from Lemon Bay in Sarasota County to the Ten Thousand Islands area of Collier County, the estuaries of southwest Florida support at least 384 species of bony and cartilaginous fish (Beever 1989). Most of the 350+ species of marine invertebrates of Charlotte Harbor are found in or depend in some part upon the mangrove forests for habitat or food.

The life cycle of the snook (*Centropomus undecimalis*), a state species of special concern, is intimately linked to healthy mangrove systems and adjacent estuarine habitats. Early life stages enter estuarine tributaries and high marsh habitats for protection, feeding and osmoregulation. Young fish find nursery habitat among red mangrove prop roots. Adults forage in vegetated and unvegetated estuarine habitats, sheltering in mangrove prop root habitat during the day.

The Atlantic sturgeon (*Acipenser oxyrhynchus*) has two subspecies in Florida. The threatened Gulf subspecies, *desotoi*, is found in most major rivers and estuaries from the panhandle south to southwest Florida (Gilbert 1992). It is anadromous, carrying out different parts of its life cycle in fresh and in salt water. Adults enter fresh water in mid-February and spawn from March through May. The population then migrates downstream from October through December. Preferred habitats lack submerged aquatic vegetation, but it feeds on the food webs based on detrital productivity.

The dominant fish species of the basin mangrove forests are poeciliids, the mosquitofish, the least killifish, and the sailfin molly. These cyprinodont fish are a fundamental link between primary producers and higher trophic level fish and wildlife species. The typical cyprinodont

diet consists of plant and animal tissue, including periphyton, insect larvae, and vascular plant detritus. They subsequently are food for sport fish and wading bird species. Fourteen (26%) of the 54 freshwater fish species found in south Florida (Kushlan and Lodge 1974) utilize the mangrove wetlands during wet season, high runoff events (Odum *et al.* 1992).

Some species that depend primarily on the mangrove habitat are now imperiled because of loss and degradation of their habitat. The mangrove rivulus (*Rivulus marmoratus*) is a small fish living only in and around mangrove areas from Indian River County on the east coast and Tampa Bay on the west coast south through the Keys. It is the only species of rivulus in North America and has adapted to conditions of varying water levels and low oxygen levels characteristic of the mangrove community. It is an important link in the food chain, as it has been found to constitute part of the diet of many organisms including the endangered wood stork (*Mycteria americana*) (Ogden *et al.* 1976). It is listed as a species of special concern by FWC and the Florida Committee on Rare and Endangered Plants and Animals (FCREPA) because of its limited distribution and vulnerability to loss of its habitat. The mangrove gambusia (*Gambusia rhizophorae*) is another small fish species associated with red mangrove roots in southeastern Florida, mainly in Miami and the Keys. It was listed as a species of special concern because of its dependence on a vulnerable habitat. The mangrove crab, *Goniopsis cruentata*, is restricted to mangrove forests in central and southern Florida mangrove areas and is listed as a species of special concern because of its susceptibility to local extirpations and declining habitat.

The arboreal canopy provides habitat to both aquatic and amphibious resident and transient species (Simberloff 1973, Beever *et al.* 1979, Gilmore and Snedaker 1993). Aquatic organisms such as crabs and snails spend part of their time in the water, but can also migrate up into the canopy of mangroves. Many resident species of insects and birds take advantage of the arboreal canopy for breeding, feeding, molting, and shelter. Several migratory birds, like diving and wading birds, use the arboreal canopy to roost and nest. Long distance migrating birds are dependent on the mangrove community as a stopover habitat during seasonal migrations. The high productivity of mangrove ecosystems provides an energy source important for migrating bird species traveling on long distance migrations (Day *et al.* 1989). Approximately 264 species of arboreal arthropods inhabit the mangrove canopy, branches and wood (Beever *et al.* 1979).

The mangrove tree crab, *Aratus pisonii*, is found only in estuarine areas south of the Indian River Lagoon area on the east coast, and the Tampa Bay area on the west coast, south to the Florida Keys. This species is restricted to mangrove areas for its adult life cycle, especially red mangroves. It is listed as threatened by FCREPA because of its restricted distribution and dependence on vulnerable habitat. It is one of the few crabs that also uses the arboreal canopy and can climb to the uppermost branches which it forages upon.

The mangrove buckeye butterfly (*Junonia evarete*) is found in coastal areas of peninsular Florida and the Florida Keys. This butterfly is listed as a species of special concern by FCREPA because of its restricted distribution in Florida and its close association with its host plant, the black mangrove, in which it lays its eggs and feed upon and. The mangrove skipper butterfly (*Phocides pigmalion okeechobee*) is endemic to coastal areas in south Florida and the Keys. FCREPA listed it as a species of special concern because of its close association with its host plant, the red mangrove, upon which it lays its eggs and feeds.

One hundred and ninety one or 70% of the bird species known from south Florida are found in the mangroves. A neotropical migratory bird is a bird species that nests in the Nearctic region of North America, north of the Tropic of Cancer, and over-winters in the Neotropical region including the Mexican rainforest and South America. Many of the birds of the mangroves are neotropical migratory birds that utilize the habitats in their migration from northern breeding grounds to southern wintering grounds in autumn and the subsequent return in spring. These neotropical migratory birds are a focus of considerable concern since many species are apparently in decline due to habitat loss in northern breeding grounds, southern wintering grounds, and the stopovers in the migratory corridor in coastal Florida. Other birds, including shorebirds, ducks, and perching birds, migrate to south Florida for wintering and are found only in late autumn, winter and early spring . A few bird species visit the mangroves in the summer and then return south to the tropics for the winter.

Mangrove canopies provide habitat for several species and subspecies of songbirds that occur only in this habitat and only in Florida in the United States. These include the black-whiskered vireo, mangrove cuckoo, and the Florida prairie warbler. The black-whiskered vireo nests primarily in red mangroves up to 4.5 meters (15 feet) above the ground. The mangrove cuckoo (*Coccoyzus minor*) is considered a rare bird species by FCREPA because it requires large expanses of undisturbed forested mangrove and hardwood hammock habitat (Smith 1996). It is found primarily in the southernmost parts of Florida from Charlotte Harbor to the Florida Keys. The mangrove cuckoo nests on horizontal branches of mature mangrove trees. The Florida prairie warbler nests 3 to 6 meters (10 to 20 feet) high in mangroves.

In addition to these mangrove endemic species, many estuarine birds utilize fringing mangrove forest as loafing areas and foraging perches. Included in this group are osprey, kingfisher, bald eagle, peregrine falcon, merlin, brown pelican, double-crested cormorant, anhinga, and a variety of wading birds. As loafing areas this habitat provides resting areas near their food supplies until the proper conditions exist to efficiently catch prey. This allows the use of foraging habitat distant from night time roosts or nesting areas without the added energy cost of flight. For other species in this group the height of the mangroves offers a better view of prey. In developed areas where mangrove has been cleared, prey resources may be underutilized by predator populations simply because of the lack of roost sites.

The endangered wood stork (*Mycteria americana*) is found throughout Florida and has established several rookeries on mangrove overwash islands in south Florida. Mangrove rookeries include islands in the Myakka River and Peace River. Wood storks are sensitive to the quality and quantity of mangrove habitats, and alterations of this habitat make this species vulnerable to population declines. Wood storks utilize the mangroves for foraging, nesting, and roosting. Wood stork activity often concentrates in shallow bay and creek waters during winter low tides. During winter and early spring months, foraging occurs in the depressional pools of the high marsh and hydric pine flatwoods, when the dry-down hydrology concentrates fish and other aquatic life. The hydrology of the unaltered mangrove swamps can dependably provide the critical foraging habitat of 15 – 50 centimeters (6-10 inches) of water, during the critical February to April breeding season (Ogden 1978d). Recently, mangrove rookeries for wood storks have been more dependable than freshwater interior rookeries that have suffered due to bad water management practices, drought, and flood.

The brown pelican (*Pelecanus occidentalis*) is a state species of special concern and nests in south Florida dominantly in mangrove communities, using other species only outside of the range of the mangrove. Brown pelicans nest on overwash mangrove islands and forage over open waters, mudflats, and seagrass beds in the shallow waters of estuaries, creeks, and nearshore areas. In south Florida, brown pelican rookeries are located on isolated red mangrove islands with a substantial water depth barrier that protects the nests from mainland predators. Brown pelicans utilize a variety of saltwater habitats in south Florida. Their diet consists of fish of all sizes. Foraging can consist of plummeting dives, short plunges, and swimming scoops of fish. As opposed to wading birds, pelicans were more frequently observed foraging in mangrove estuaries during higher tides throughout the year. Historically, pelican populations were reduced as a result of pesticides. Today, the greatest threats pelicans face are still human caused. Pelicans are vulnerable to destruction of their mangrove nesting and loafing sites by construction, dredge and fill activities, nest site disturbance, and monofilament line entanglement. Pelicans are especially susceptible to death and injury caused by sport fishing equipment and it has been estimate that over 500 individuals die each year as a result of contact with fishing tackle (Schreiber 1978).

The majority of south Florida wading bird species utilize mangrove habitats, and are state species of special concern: little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*) , reddish egret *(Egretta rufescens*), roseate spoonbills (*Ajaja ajaja*), and white ibis (*Eudocimus albus*) (GFC 1996). Tricolored heron, little blue heron, snowy egret, and white ibis forage and nest in mangroves. These species can also breed in freshwater rookeries and forage in adjacent mangroves if water levels are naturally timed. Tricolored herons utilize a wide variety of freshwater and saltwater habitats in south Florida. Their diet consists of small fish, crustaceans, and insects. Ogden (1978a). Little blue herons and white ibis are the most common of the listed wading bird species observed in mangroves in southwest Florida (Beever 1992). Little blue herons, white ibis, and snowy egrets utilize a wide variety of freshwater and saltwater habitats in south Florida. Their diet consists of small fish, crustaceans, insects, frogs, and lizards. Nesting can occur in a variety of wetland trees including mangroves typically on overwash islands. They appear to prefer to forage in freshwater habitats even when nesting in saltwater wetlands. The little blue heron forages throughout the wet and dry season in mangroves. Adjacent tidal wetlands are used throughout the year with greater emphasis during low tides on sea grass beds. The snowy egret forages throughout the wet and dry season in mangrove wetlands of the proper depth to allow for their foraging methods. Snowy egrets are the third most abundant listed wading bird observed. Their preferred foraging areas are the seagrass beds and mudflats adjacent to the mangroves, and their diet consists of crustaceans, insects, and small fish Ogden (1978c).
In south Florida, reddish egrets and roseate spoonbills are obligate mangrove breeders. Reddish egrets forage on the sandbars and mudflats adjacent to mangroves, in an active fashion with spread wings and rapid steps over unvegetated and seagrass bottoms in marine and estuarine waters. The reddish egret is the least abundant of the listed wading birds of mangroves. Reddish egrets utilize a limited set of saltwater habitats that allow for use of their unique foraging method. Their diet consists of crustaceans and small fish. Kale and Maehr (1991) indicate that red mangrove rookeries are used during the December through June breeding period.
Roseate spoonbills use dry-down pools in the high marsh and mangroves during low tides. Preferred foraging areas included sheltered coves, and they often forage in groups and with other

wading birds including wood storks, common egret, white ibis, and snowy egret. Roseate spoonbills nest exclusively in mangrove forests in south Florida, typically on overwash islands, and forage wherever concentrations of small fish and crustaceans allow the birds to utilize their unique bills for feeding (Ogden 1978b).

A wide variety of shorebird species forage on the mudflats of mangrove estuaries. Among the listed species are the least tern (*Sterna antillarum*), listed as threatened by the state; the threatened roseate tern (*Sterna dougalli*); the black skimmer (*Rynchops niger*), a state species of special concern; and the American oystercatcher (*Haematopus palliatus*) a state species of special concern. Least terns forage in south Florida mangrove waters during spring and summer. Least terns and roseate terns require open beach or bare substrates for nesting areas near areas where schools of forage fish concentrate. American oystercatchers utilize oyster bars and mudflat areas in mangroves and nest on bare unvegetated shores associated with mangrove swamps. Foraging occurs throughout the year with seasonal movements tracking warmer conditions. South Florida is a popular foraging area principally during the winter.

Mangrove clapper rails (*Rallus longirostris insularum*) use high marsh and basin black mangrove forest areas, foraging on fiddler crabs and other small crustaceans. Little is known of their life history due to their crepuscular to nocturnal activity period, the heavy cover of their preferred habitat and the excellent camouflage of their plumage.

Mangroves also provide foraging habitat for a variety of raptors including northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), and Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk (*Buteo lineatus*), broad-winged hawk (*Buteo platypterus*), short-tailed hawk (*Buteo brachyurus*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius sparverius*), and peregrine falcon (*Falco peregrinus tundrius).*

The peregrine falcon is associated with groups of migratory and resident shorebirds gathered on the exposed mudflat and sandbars on the shoreline edge associated with mangrove forests. They utilize wintering areas in south Florida that provide them bird prey for food (Snyder 1978) and perches on which to roost, sun, and feed. Mangroves provide these prerequisites in combination with open foraging grounds. Other peregrine falcons migrate through south Florida, along the coast, to the neotropics.

Southern bald eagles (*Haliaeetus leucocephalus*), utilize mangroves and pine trees of coastal south Florida as nest trees, particularly where this community is located adjacent to an estuarine, riverine, or lacustrine foraging area. Both breeding and non-breeding eagles forage in mangrove waters. Eagle use of mangroves of south Florida is concentrated during the breeding season from October to May. Mangrove foraging areas are critical to the south Florida breeding population of eagles. In extreme south Florida, mangrove trees serve as nest trees for the eagle populations of the Ten Thousand Islands, Florida Bay and the Florida Keys. On occasion, immature and apparently adult eagles utilize mangrove forests through the summer.

The osprey (*Pandion haliaetus*) is a state listed species of special concern only in the lower Florida Keys. It nests in a variety of trees, principally tall mangroves and artificial structures, and forages for fish prey in a variety of marine and estuarine habitats.

The endangered manatee (*Trichechus manatus latirostris*) uses mangrove and salt marsh estuaries, including river systems, of south Florida throughout the year. Primary habitat requirements include proximity to waters 1 to 2 m (3 to 6.5 ft.) deep; and access to vascular plants (seagrasses, mangroves, etc.), freshwater sources, warm water refugia during winter (Hartman 1978). Sheltered bays, coves, and mangrove-lined canals are important for resting, feeding, and reproductive activity (Bengtson 1981, Powell and Rathbun 1984). Florida manatees will eat overhanging mangrove vegetation and show a preference for white mangroves (Hartman 1978). Manatees can migrate a significant distance during summer, but the North American breeding population is restricted to regions of warm waters.

Mangroves, in combination with pine flatwoods, other forested and shrubby uplands and seasonal wetland habitats, provide critical foraging, breeding, and wildlife corridor habitat for the endangered Florida panther (*Felis concolor coryi*). The documented foraging and breeding territories of radio-collared Florida panthers, and documented sightings of Florida panther include large expanses of undisturbed forests (Maehr 1992), and range into the mangrove forests of south Florida. Ecotones are particularly important to the panther because they support an increased variety and density of species. Prey animals, including white-tailed deer and wild hog, utilize the plant diversity of edge communities such as mangrove ecotones (Layne and McCauley 1976). Panthers require large territories and abundant prey (Maehr 1992). Additionally, forests associated with natural drainage patterns provide the travel corridors essential to the panther for moving between the fragmented foraging areas remaining in Florida.

The Florida black bear (*Ursus americanus floridanus*), listed as threatened by the state, is a forest habitat generalist with seasonal preference for wherever food is most available. Black bear utilize all the natural forested systems of south Florida, with a decided preference for upland/wetland ecotones, including the boundaries between mangroves and other plant communities. The documented movements of radio-collared Florida black bears in Lee and Collier counties and documented sign and sightings of Florida black bears in Charlotte, Collier and Lee counties indicate that the large areas of relatively undisturbed mangrove forest, in combination with hydric and mesic forests and the major wetland basins, provide the principal habitat of the black bear in southwest Florida (Brady and Maehr 1985, Maehr 1984, Maehr *et al.* 1988, Land 1994). Bears are omnivores that feed on readily available food resources. Preferences for berries, insect larvae, the occasional small animal (frogs, mice, etc.), eggs, and wild honey can be satisfied in the mangrove environment. Seasonal abundances of propagules and insects are consumed when available. Occasionally fish and carrion are also eaten. Movement by individuals can be extensive and may be related to both mating and food availability. Black bears will swim between mangrove islands in Collier County. The large mangrove forests and pine flatwoods provide the forested habitat corridors essential to the black bears for forage and movement between the fragmented foraging areas remaining in southwest Florida.

The Big Cypress (mangrove) fox squirrel (*Sciurus niger avicennia*), listed as threatened by the state, is found in mangroves south of the Caloosahatchee River along the estuarine coast south to the western edge of the Everglades sawgrass marshes. Currently there is greater abundance of this fox squirrel outside of the Big Cypress Swamp National Preserve proper. The Big Cypress

fox squirrel utilizes a wide variety of forested and non-forested upland and wetland systems including mangroves. The Big Cypress fox squirrel possesses a large territory from which it harvests seasonally available bounties of cones, nuts, and seeds. The fox squirrel forages on mangrove propagules, particularly those of the black mangrove. Nesting occurs in pines; hardwoods, including oak and black mangrove; cypress; cabbage palms; and bromeliad clumps. The wide variety of habitats is used in a seasonal rotating basis depending on food availability, hydrology and the reproductive cycle. Optimal natural habitat consists of a reticulate matrix of upland and wetland habitats including hydric, mesic and xeric pine flatwoods, mature mangrove forest, open cypress and wet prairies, oak and hardwood hammocks, and riverine hardwoods.

The Everglades mink (*Mustela vison evergladensis*) is found in the Big Cypress Swamp, the wetlands of western Collier County, and the western edge of the Everglades (Allen and Neill 1952). Brown (1978b) indicates a distribution in southeastern Lee County and all of Collier County. Humphrey and Setzer (1989) define a range more limited to Dade, mainland Monroe, Collier, and southern Lee counties. Humphrey (1992) further restricts the range to southern Collier, mainland Monroe and Dade Counties. Mink are nocturnal and crepuscular predators of mammals, reptiles, birds, amphibians, fishes, and eggs. The species does not appear to be numerous and, given its period of activity, the literature on distribution is based primarily on road kills. The everglades mink is found in a wide variety of shallow wetland systems including mangrove swamps.

Bobcat (*Lynx rufus floridanus*) is a common predator of mangrove forests throughout the mangrove range. Bobcats move easily between habitat types and a single cat's territory can include xeric scrub, all three types of pine flatwoods, high marsh and the basin black mangrove forest (Beever 1992). Bobcat droppings indicate a varied diet of small rodents, birds, fish, and reptiles from mangroves.

River otter (*Lutra canadensis lataxina*) use a variety of saltwater wetlands in south Florida including high marsh, salt marsh, and all types of mangrove swamp. River otter scats indicate a diet of fish and crustaceans that is often dominated by crustaceans. River otters use mangroves throughout the year.

Twenty-four or 50% of the species of reptiles in south Florida utilize the mangroves as habitat. This includes 25 snakes, 4 sea turtles, 1 terrapin, 7 lizards, the American alligator and the American crocodile. Reptiles utilize both aquatic and arboreal habitats of the mangroves, although different species may be present during different hydrologic conditions. Resident species include the Florida water snake, Atlantic salt marsh snake, rough green snake, eastern indigo snake, the orange morph of the yellow rat snake, green anole, and mangrove terrapin. Seasonal or low tide visitors include box turtles, the cottonmouth, and the American alligator.

The endangered American crocodile is found in marine and estuarine habitats from Charlotte Harbor to southern Palm Beach County in mangroves, high marsh, and saline lakes. Courtship and mating occur in late winter through early spring. Nesting begins in late April to early May on beaches, stream banks, and levees. Hatching is in late July and early August. Current documented breeding occurs from Cape Sable to Turkey Point on the mainland, on North Key Largo, and on some islands in Florida Bay (Moler 1992). American crocodiles require lower

salinities in their estuarine nursery habitats during juvenile stages, but can tolerate higher salinities as adults. The population has fluctuated as salinity has affected their nursery and nesting mangrove habitats.

American alligators (*Alligator mississippiensis*) use mangroves throughout south Florida in estuarine areas, particularly in the summer. The riverine and fringing mangroves are preferred alligator use areas. Adults and subadults tend to be observed alone. Track evidence indicates nocturnal use of the high marsh during summer and autumn

All five of the marine turtles found in Florida, the endangered Atlantic green sea turtle (*Chelonia mydas mydas*), the endangered Atlantic hawksbill turtle (*Eretmochelys imbricata imbricata*), the threatened Atlantic loggerhead turtle (*Caretta caretta caretta*), the endangered Atlantic Kemp's Ridley sea turtle (*Lepidochelys kempi*), and the endangered leatherback turtle (*Dermochelys coriacea*), are found in association with mangroves at tidal passes, estuarine waters, seagrass beds and some nesting beaches in South Florida. The green turtle nests on the east coast from Volusia to Dade Counties. Population concentrations of green sea turtle adults occur in seagrass systems of the Gulf of Mexico, Florida Bay and the Indian River Lagoon (Ehrhart and Witherington 1992). The hawksbill turtle is associated with hard bottom communities north to Duval County on the east coast and north to Levy County on the west coast. Diffuse nesting can occur from Cape Canaveral to the Dry Tortugas (Meylan 1992). Ridley turtles occur south to Cape Canaveral on the east coast and along the entire Gulf of Mexico coast (Ogren 1992). Successful nesting is known from Pinellas County. Young forage over sand and mud bottoms of less than 2-m (6.6-feet) depth. Loggerhead turtles nest on beaches west of the Apalachicola River, south of Pasco County and north of Dade County. They utilize a wide range of marine habitats (Dodd 1992) and are by far the most abundant sea turtles in mangrove estuaries and in Florida.

The eastern indigo snake (*Drymarchon corais couperi*) utilizes a wide variety of habitats throughout Florida, in habitats ranging from mangroves to xeric scrub. Where available, gopher tortoise burrows are utilized as shelter. In mangroves, tree cavities in mature trees are used. Kochman (1978) states that eastern indigo snakes are susceptible to desiccation and are more characteristic of mesic than xeric habitats in south Florida. These snakes are diurnal and actively search for prey, particularly at upland/wetland ecotones. Their summer ranges extend 51 to 101 hectares (125 to 250 acres) or more. Winter range tends to be smaller as the snakes stay close to shelter. Shedding occurs frequently. Breeding occurs from November through April. Eggs are laid from May through June. Diet includes small mammals, birds, frogs, lizards, and other snakes (Moler 1992). In the dry season, indigo snakes are found in the moister, but not submerged, areas of mangroves, marshes, hydric pine flatwood and other seasonal wetlands.

Five (25%) of the 20 amphibian species found in south Florida utilize the mangroves for feeding and/or breeding. The most frequently encountered and abundant amphibians are tree frogs and, unfortunately, the exotic marine toad (*Bufo marinus*). The amphibian life-cycle is poorly adapted to the saline mangroves. No listed amphibians are found in mangrove habitats.

A wide variety of wildlife (184 species) was observed, directly or by sign, during project site visits including 10 mammal species, 55 bird species, 8 reptile species, 3 amphibian species, 36

fish species, 44 terrestrial invertebrate species, 28 marine/aquatic invertebrate species. The invertebrates include 15 butterfly, 2 moth, 7 dragonfly, 4 damselfly,7 other insect, 9 crab, 13 crustacean species, 17 mollusks species.

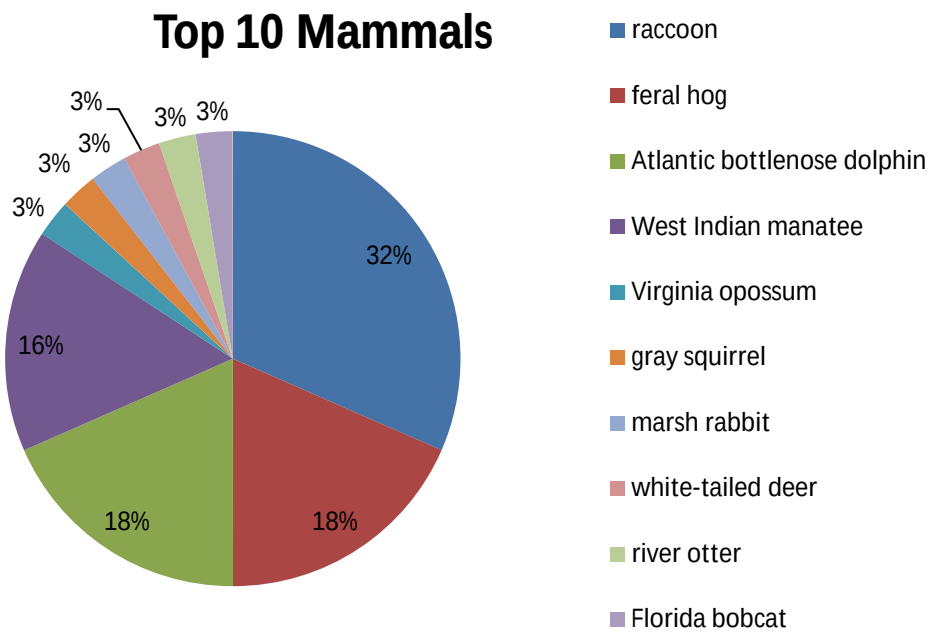


Figure 56: Top ten mammal species observed

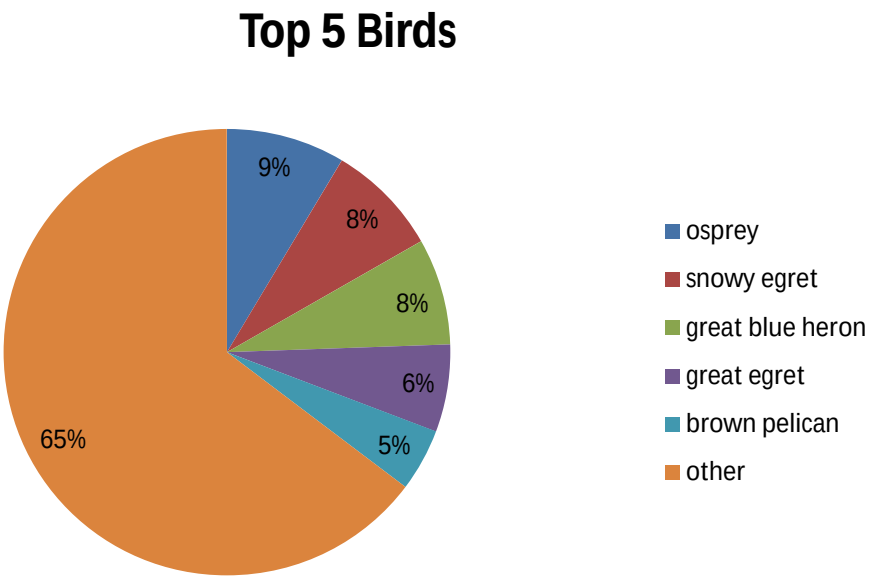


Figure 57: Top five bird species observed

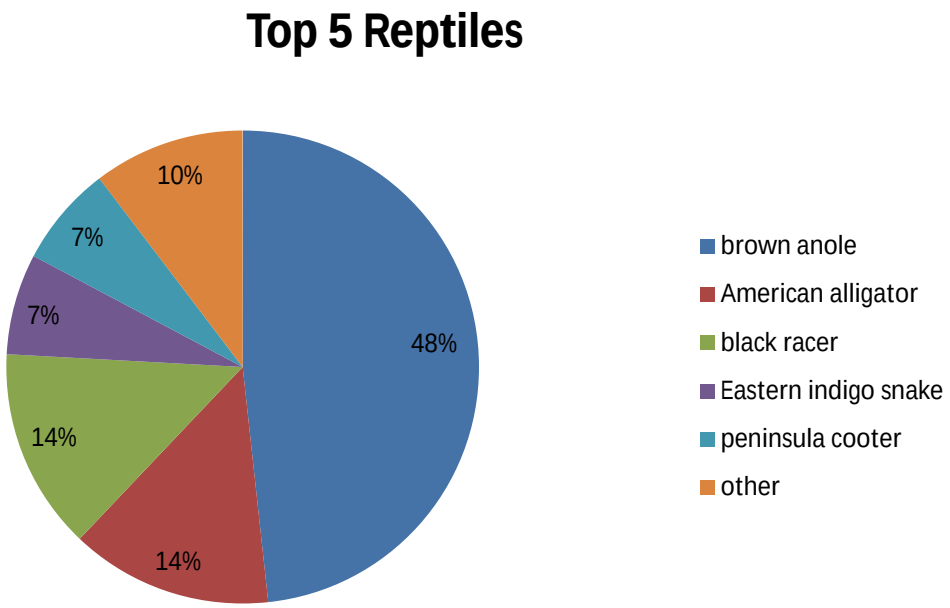


Figure 58: Top five reptile species observed

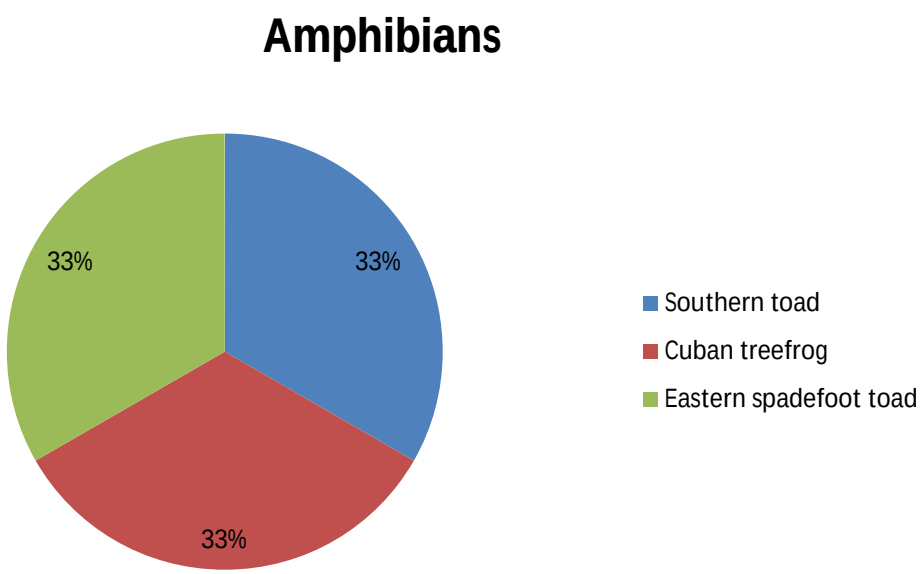


Figure 59: Relative occurrence of the three amphibian species observed

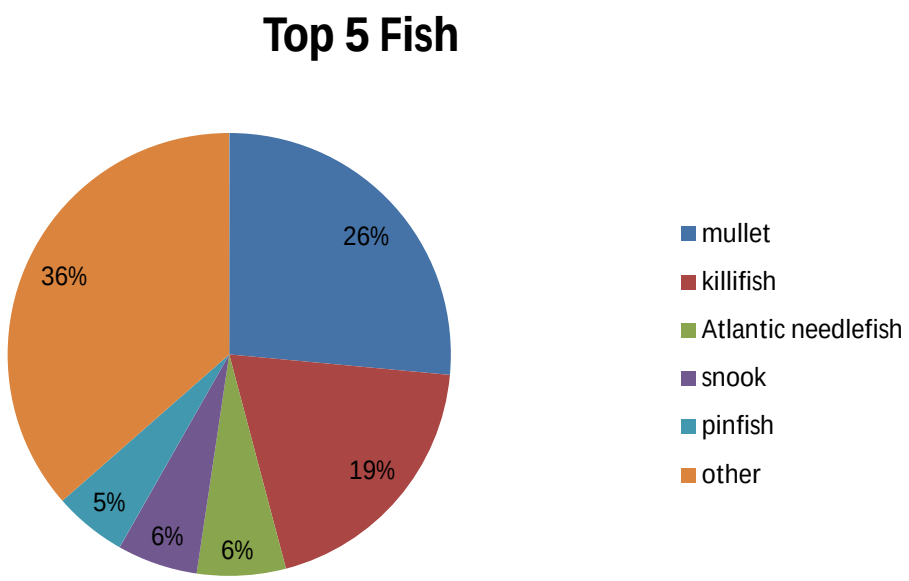


Figure 60: Top five fish species observed

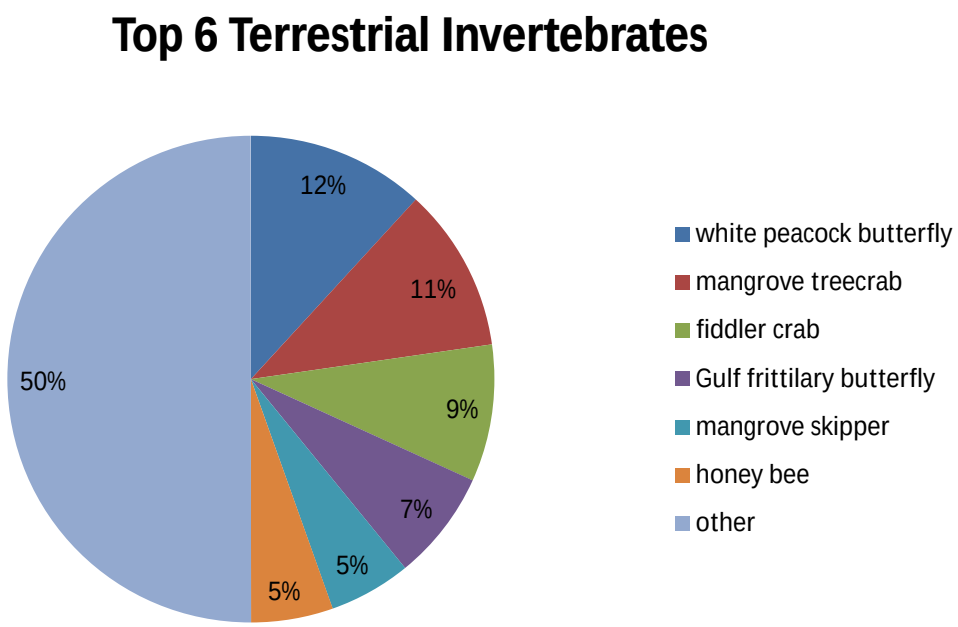


Figure 61: Top six terrestrial invertebrates observed

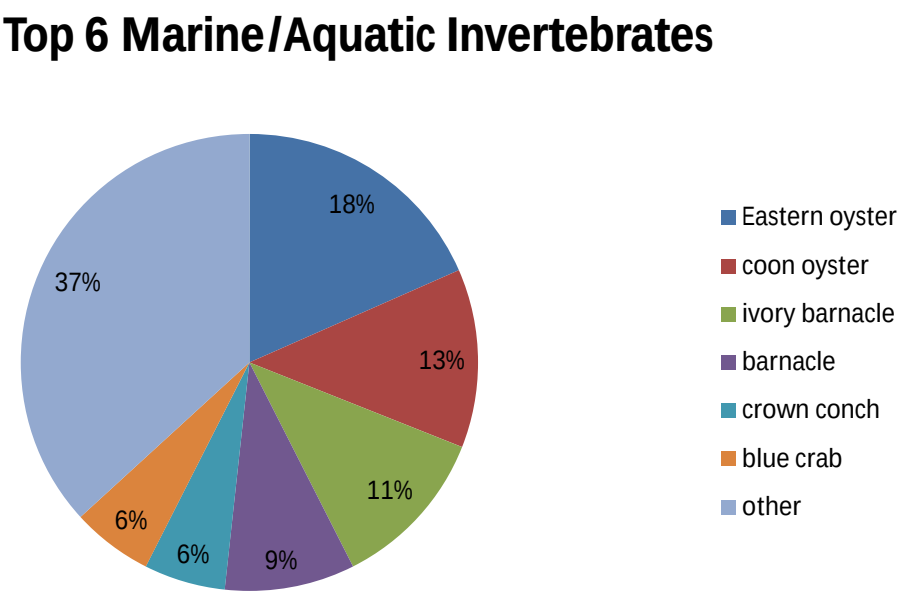


Figure 62: Top six marine/aquatic invertebrates observed

Species Group	Species	Occurrences
Total Terrestrial Invertebrates	44	110
Total Marine/Aquatic Invertebrates	28	87
Total Fish	36	170
Total Amphibians	3	3
Total Reptiles	8	29
Total Birds	55	221
Total Mammals	10	38
Total All	**184**	**658**

Table 31: Animal species totals observed

Projects by Township

The majority of the projects where functional assessments were performed were in Lee County. Within Lee County, most projects were located in Township 44 South. This Township runs through Lee County just north of center and includes downtown Fort Myers and the surrounding portion of the Caloosahatchee River. The Caloosahatchee River as a basin contained the largest

proportion of assessment sites in the study. This Township also contains the northern half of Pine Island where a large number of assessed projects were located, within the Matlacha Pass basin. In all, Township 44 South contained 27% of all assessment sites.

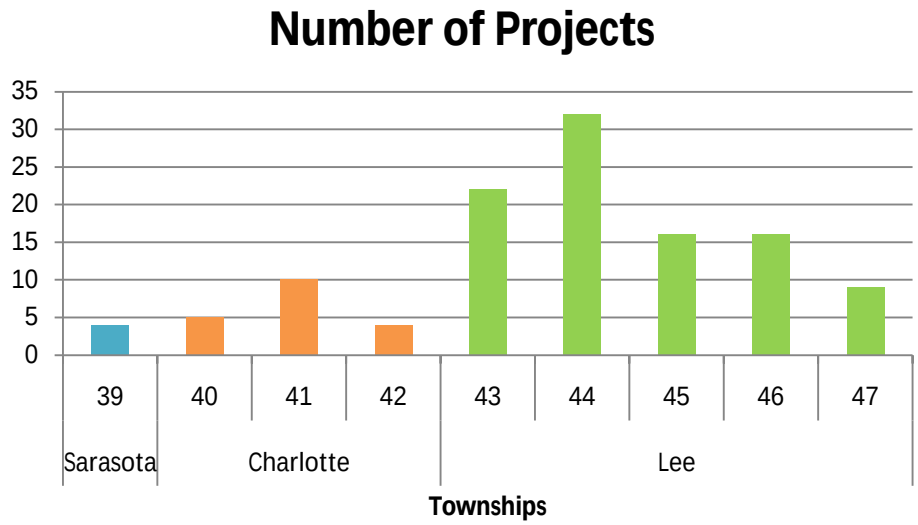


Figure 63: Number of projects by township

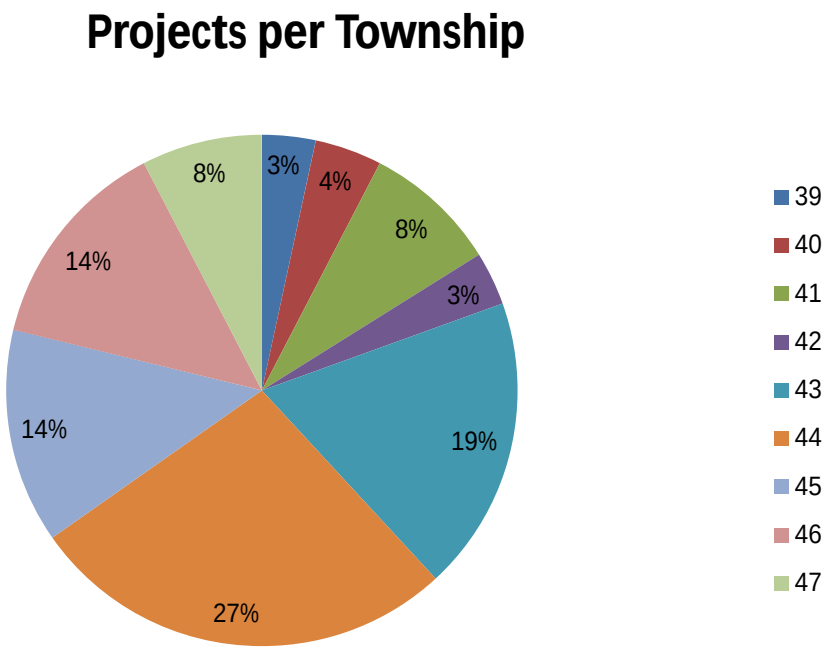


Figure 64: Percentage of projects by township

Summary Statistics of Projects

For the 118 evaluated projects a total of 199 hectares (491.9 acres) of coastal wetlands were subject to review for potential impacts. The largest area of coastal wetlands on a project site was 30 hectares (74.08 acres). Some submerged bottom sites had no emergent wetlands. A total of 21.5 hectares (53.08 acres) of on-site coastal wetland loss was permitted. This is a 10.79% of on-site loss of wetlands between the pre-project condition and post project condition.

The largest on-site wetland loss for a single project site was 4.5 hectares (11.12 acres). On average a permit included 0.19 hectares (0.46 acres) of coastal wetland loss. This fits with a general pattern of many projects with a perceptually small wetland impact of less than ½ acre with a cumulative effect that can sum to more substantial acreage.

Pre-project functional assessment scores

The mean pre-project wetland functional assessment score for all projects was 0.66 with a standard deviation of 0.18 using UMAM functional wetland analysis. UMAM scores ranged from 0.97 to 0.15. Generally, UMAM scored the pre-project wetlands as having a lower functional score than the other two methods.

The mean pre-project wetland functional assessment score for all projects was 0.69 with a standard deviation of 0.18 using WRAP functional wetland analysis. WRAP scores ranged from 1.0 to 0.09.

The mean pre-project wetland functional assessment score for all projects was 0.72 with a standard deviation of 0.19 using HGM functional wetland analysis. HGM scores ranged from 0.98 to 0.15. Generally HGM scored the pre-project wetlands as having a higher functional score than the other two methods.

The pre-project scores from all three methods were significantly correlated with each other using 0.01 level two-tailed tests for Pearson's Correlation Coefficient, Kendall' s tau-b, and Spearman's rho.

The UMAM and WRAP methods are not statistically significantly different in their pre-project scores (Sig. 0.018) for all projects. In contrast HGM is significantly different than WRAP (sig. 0.003) and UMAM (sig, 0.0000067).

Post project functional assessment scores

The mean post-project wetland functional assessment score for all projects was 0.55 with a standard deviation of 0.21 using UMAM functional wetland analysis. UMAM scores ranged from 0.92 to 0.

The mean post-project wetland functional assessment score for all projects was 0.60 with a standard deviation of 0.19 using the WRAP functional wetland analysis. WRAP scores ranged from 1.0 to 0.

The mean pre-project wetland functional assessment score for all projects was 0.65 with a standard deviation of 0.23 using the HGM functional wetland analysis. HGM scores ranged from 0.96 to 0. Generally, HGM gave the post-project wetlands a higher functional score than the other two methods.

All three methods were significantly correlated with each other using 0.01 level two-tailed tests for Pearson's Correlation Coefficient, Kendall' s tau-b, and Spearman's rho.

The UMAM and WRAP methods are statistically significantly different in their results (Sig. 0.000005) for all projects. HGM is significantly different than WRAP (sig. 0.0004) and UMAM (sig, 0.0000000008).

Best Professional Judgment Scores

The average Best Professional Judgment (BPJ) score, made by project investigators prior to using the functional assessment methods was 0.59, with a standard deviation of 0.26. BPJ scores ranged from 1 to 0.

Functional Difference Pre Scores to Post Scores

The mean difference between pre- and post-project UMAM functional assessment scores for all projects was 0.12 with a standard deviation of 0.18, with a range of 0.79 to -0.27.

The mean difference between pre- and post-project WRAP functional assessment scores for all projects was 0.09 with a standard deviation of 0.15, and a range of 0.76 to -0.43.

The mean difference between pre- and post-project HGM functional assessment scores for all projects was 0.07 with a standard deviation of 0.20, and a range of 0.67 to 0.

UMAM and WRAP methods were statistically significantly different in their results (Sig. 0.006) for all projects. HGM was not significantly different than WRAP (sig. 0.12) and was significantly different than UMAM (sig. 0.001). See Table 32.

Functional Assessment Method	WRAP	UMAM	HGM
Pre-construction FA Score	0.66+0.18	0.69+0.18	0.72+0.19
Post-construction FA Score	0.55+0.21	0.6+0.19	0.65+0.23
Functional Difference	0.12+0.18	0.09+0.15	0.07+0.20

Table 32: Wetland functional assessment score means

A Comparison of the Two Different Methods Utilized By Agencies and Consultants for UMAM

In the course of this study, training materials were examined, agency-conducted training sessions were experienced firsthand, presentations by agencies were reviewed, and permits were reviewed and evaluated in the field. It became apparent that the UMAM method is being performed in two distinctly different ways by practitioners in both the public and private sectors.

The method described in Chapter 62-345, Florida Statutes (F.S.), provides that the functional assessment scores for each of the three major variables are averaged for a total score.

As indicated in a previous section, an instructor at a training workshop stated that averaging the scores for the attributes that make up the major variables was not the correct way to arrive at the score for the major variable. It was specifically noted **not** to average the scores of the attributes to arrive at the score for the major variable. It was pointed out that the attributes are not evenly weighted for every site, and that flexibility, subjectivity, and professional judgment were called for site by site.

For a comparison, this study examined and analyzed UMAM scores arrived at with two methods: a holistic scoring, as advocated by agency training materials and an average scoring, as suggested in the rule. Each project in the study was scored in both ways. Those results were then compared.

The mean of un-averaged pre-project UMAM scores was 0.67 $\pm$ 0.19, and the mean of post-project scores was 0.55 $\pm$ 0.22. Using this method, pre-project UMAM scores were statistically significantly different from pre-project WRAP and pre-project HGM scores. In contrast, the mean post-project UMAM score was not statistically significantly different from post-project WRAP or post-project HGM scores.

When the attributes that were present at a site were averaged to generate the score, the mean pre-project UMAM was 0.73 $\pm$ 0.13 and the mean post-project UMAM was 0.64 $\pm$ 0.19. Using attribute averaging, pre-project UMAM was statistically significantly different from pre-project

WRAP and pre-project HGM, while post-project UMAM was not statistically significantly different from post-project WRAP or post-project HGM.

Mitigation Bank Functional Assessment Scores

The Little Pine Island Mitigation Bank is the principle available mitigation bank with a service area that includes most of the CHNEP coastal wetlands area.

The Little Pine Island Wetland Restoration & Mitigation Bank is a public-private partnership between the state of Florida and Mariner Properties Development, Inc., of Fort Myers. Situated within the Matlacha Pass Aquatic Preserve between Pine Island and Matlacha, Little Pine Island represents over 1,902 hectares (4,700 acres) of mangrove and high marsh wetland ecosystem with a hydric pine and mesic pine upland core.

Beginning in the 1960s, exotic plant species, principally melaleuca (*Melaleuca quinquenervia*), invaded the island, displacing native plant species and wildlife so aggressively that the island's wetland functions were severely reduced. Under private ownership, the island's wetlands were drained by ditches. Soon, the island became dominantly infested with exotic plant species. As the exotics proliferated, the variety of native birds and animals plummeted.

The state of Florida established wetland mitigation banks in 1990, in order to create a regional, master-planned approach to wetland restoration and management.

The Little Pine Island Restoration and Mitigation Bank was created in 1994, when Mariner Properties nominated the property to become its mitigation project. In 1996, Mariner Properties entered a public-private partnership with the state of Florida to restore 633 hectares (1,565 acres) of the island's 1900+ hectares (4,700 acres), of which about 1254 hectares (3,100 acres) are protected mangroves. The bank was formally established February 1996 by Permit Number 362434779.

Mariner Properties Development, Inc., with the guidance of scientists and the oversight of state and federal agencies, began the job of removing the exotic plants. Working with chainsaws and other hand tools, work teams began removing an average of 30 tons of exotic biomass per acre - an amount roughly equal to the full cargo capacity of a tractor-trailer. Although laborious and time-consuming, hand-removal ensures millions of exotic plant seeds are taken away, reducing their regeneration on the island.

Birds and animals began returning, and native seeds which had lain buried and dormant for 30 years began sprouting anew. Today, Little Pine Island stands as a good example of what a public-private partnership can accomplish.

In 1996, Mariner Properties was permitted under Florida law to restore Little Pine Island, and provide "mitigation credits." These credits offer developers a form of wetland replacement for permitted wetland impacts. The sale of wetland mitigation credits is used to fund the multimillion dollar cost of restoring Little Pine Island. One wetland mitigation credit is the

regulatory equivalent to the ecological value of one acre of wetland creation. Their purchase relieves public and private development interests of the cost and liability associated with on-site wetland mitigation.

Figure 65: Aerial view of Little Pine Island Mitigation Bank, Matlacha Pass, Lee County

The 633 hectares (1,565 acres) of the Little Pine Island Mitigation Bank has generated 807 potential credits.

In 1996, Little Pine Island Wetland Restoration and Mitigation Bank prices averaged $28,000 per credit. The market value had risen steadily to $53,000 by the year 2001, due to the substantial cost savings provided by mitigation credits when compared to other mitigation alternatives.

Two sites on Little Pine Island were assessed for the study. The results of those assessments are in Table 33 below.

Functional Assessment Method	WRAP	UMAM	HGM

West Side	0.97	0.87	0.85
North Side of Pine Island Road	0.89	0.9	0.94
Mean	0.93	0.89	0.90
Standard Deviation	0.04	0.02	0.04

Table 33: Wetland functional assessment scores for Little Pine Island Mitigation Bank

Internal correlations of variables measured

For UMAM, all three of the measured factors are significantly correlated with the other. To a certain extent, the final UMAM score is driven most strongly by the community variable. The landscape and water variables are both very strong determinants of the final score. See Table 34.

		1landscape	2water	3communty	UWAM
1landscape	Pearson Correlation	1	.608**	.761**	.890**
	Sig. (2-tailed)		.000	.000	.000
	N	120	120	120	120
2water	Pearson Correlation	.608**	1	.672**	.847**
	Sig. (2-tailed)	.000		.000	.000
	N	120	120	120	120
3communty	Pearson Correlation	.761**	.672**	1	.924**
	Sig. (2-tailed)	.000	.000		.000
	N	120	120	120	120
UWAM	Pearson Correlation	.890**	.847**	.924**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	120	120	120	120

**. Correlation is significant at the 0.01 level (2-tailed).

Table 34: Correlations of internal measures in the UMAM process

Mitigation

Of the 118 projects, a total of 30 proposed some form of mitigation. This includes 13 with on-site mitigation, 6 with offsite mitigation and 11 with both on-site and off-site mitigation. The total area of all on-site mitigation was 135 hectares (333.53 acres) or 14.2% of the total project sites. Five large projects make up the bulk of this on-site mitigation preserve area including Harbour Pointe at South Seas Resort, Stringfellow Lakes Estates saltern, Harborview *Juncus* Marsh, Demere Preserve Pond, and Tranquility Bay.

Off-site mitigation area totaled 12.85 hectares (31.76 acres), principally established at the Little Pine Island Mitigation Bank.

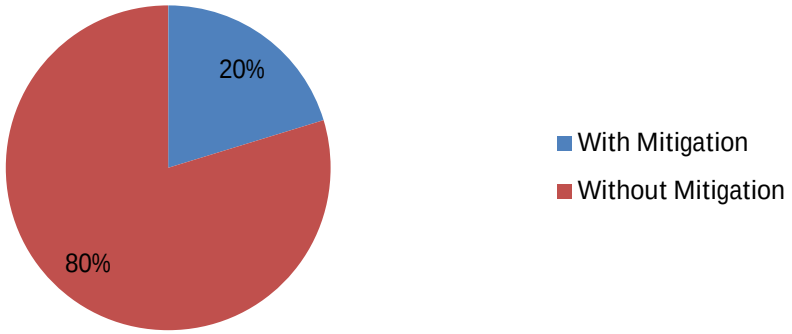


Figure 66: Number of projects with mitigation

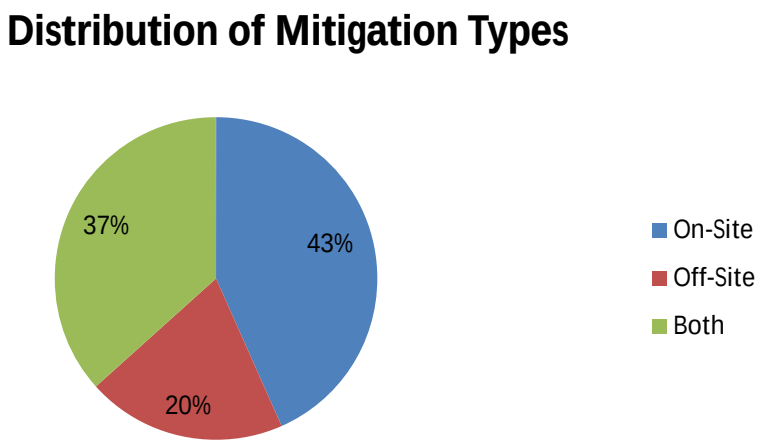


Figure 67: Percentage of projects with mitigation

The mean wetland functional assessment score for the projects with on-site mitigation was 0.75 with a standard deviation of 0.22 using UMAM. UMAM scores ranged from 1 to 0.36.

The mean wetland functional assessment score for the projects with on-site mitigation was 0.79 with a standard deviation of 0.17 using WRAP. WRAP scores ranged from 1 to 0.4.

The mean wetland functional assessment score for the projects with on-site mitigation was 0.81 with a standard deviation of 0.20 using HGM. HGM scores ranged from 1 to 0.31.

The mean wetland functional assessment score for the projects with off-site mitigation was 0.92 with a standard deviation of 0.13 using UMAM. UMAM scores ranged from 1 to 0.68.

The mean wetland functional assessment score for the projects with off-site mitigation was 0.92 with a standard deviation of 0.13 using WRAP. WRAP scores ranged from 1 to 0.66.

The mean wetland functional assessment score for the projects with off-site mitigation was 0.93 with a standard deviation of 0.11 using HGM. HGM scores ranged from 1 to 0.71.

In the process of calculating functional assessment scores, the total area of wetlands assessed was multiplied by the functional assessment value of those wetlands to generate the functional units of mitigation that need to be balanced in the mitigation permitting process. Since the functional assessment value is always less than or equal to 1, the total value of the functional assessment units will never be greater than the total acres of wetlands on the site or mitigation area. In the process of balancing the mitigation functional units relative to the number of functional units lost to the project impact, it would be expected that the post-project functional units would be equal to or greater than the number of functional units lost in the process of implementing the project. There are two ways that the post-project functional units would be less than the number of functional units lost in implementing the project: when no mitigation is implemented or required for the loss of the pre-project wetlands; or if the number of wetland functional units is less than the number of wetland functional units lost.

For the total set of evaluated projects, the UMAM assessment generated 362.27 pre-project functional assessment units (FAU), the WRAP assessment generated 390 pre-project FAU, and HGM assessment generated 383.72 FAU. For the total set of evaluated projects, the UMAM assessment generated 606.06 post-project FAU, the WRAP assessment generated 650.03 post-project FAU, and HGM assessment generated 733.4 FAU. This is a difference of 243.79 FAU for UMAM, 260.02 FAU for WRAP and 349.68 FAU for HGM.

The mitigation ratio for all UMAM scores was 1.5 with a standard deviation of 3.26. This is skewed by four projects with high or very high mitigation ratios generated by large on-site wetland preserves on Pine Island.

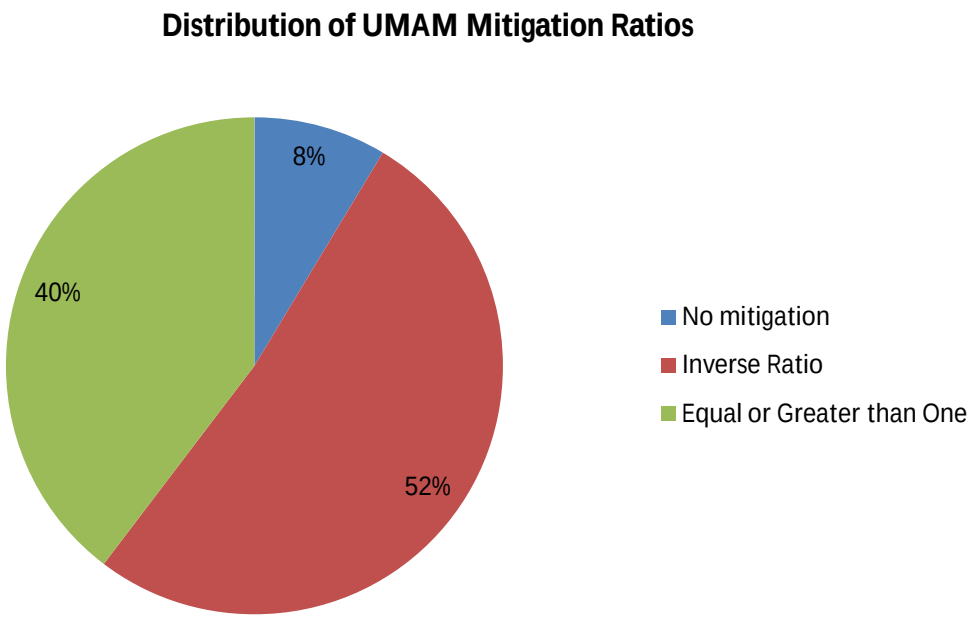


Figure 68: Distribution of UMAM mitigation ratios

The mitigation ratio for all WRAP scores is 1.61 with a standard deviation of 3.5.

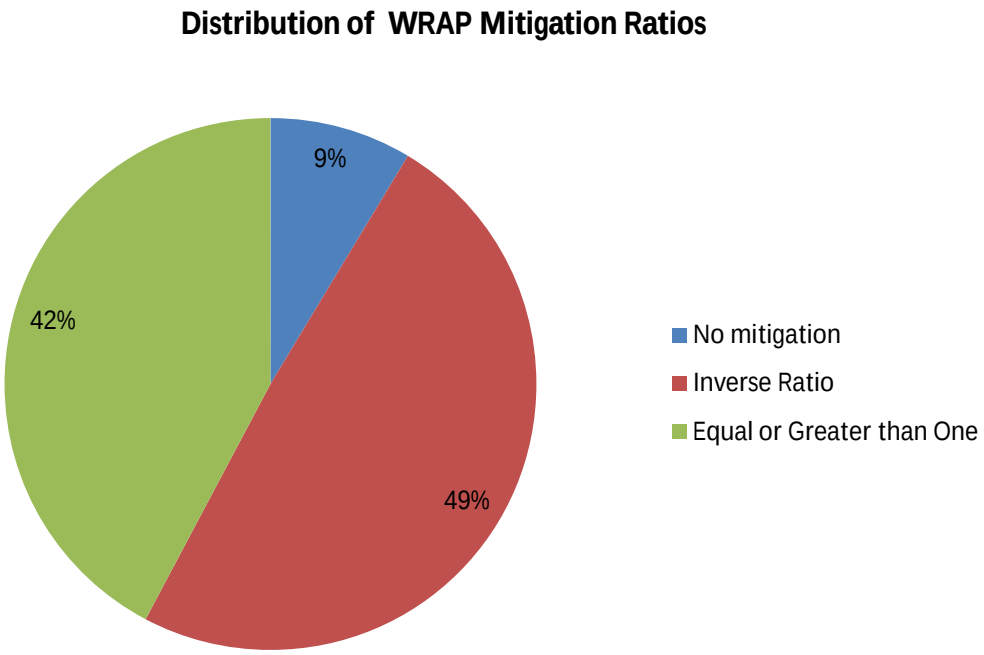


Figure 69: Distribution of WRAP mitigation ratios

The mitigation ratio for all HGM scores is 1.61 with a standard deviation of 3.45.

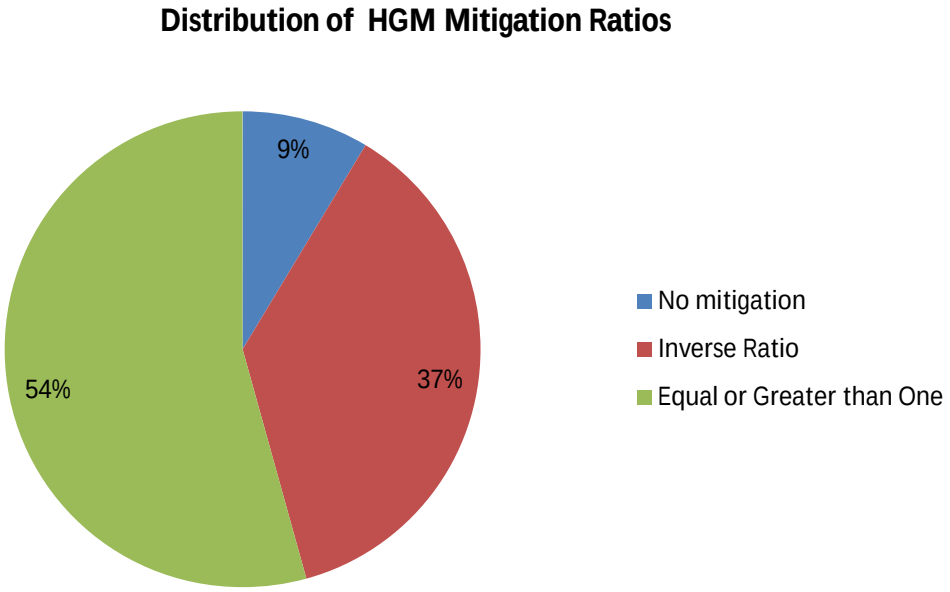


Figure 70: Distribution of HGM mitigation ratios

If the four unusual projects are removed from the analysis, then the mitigation ratios for each method would be 1.02 with a standard deviation of 0.91 for UMAM, 1.08 with a standard deviation of 0.93 for WRAP and 1.1 with a standard deviation of 0.88 for HGM.

Utilizing t-tests, the mitigation ratios generated for all projects are not statistically significantly different between UMAM, WRAP, and HGM.

Comparison of public and private projects

We assembled two sample sets of projects from the collected data: public projects for roadways, parks, boat ramps, channel dredging, and habitat restorations with public access and private sector projects located in residential and private settings. There were 41 public projects and 75 private sector projects reviewed.

The public projects had mitigation ratios of 0.98 with a standard deviation of 0.44 for UMAM, 1.11 with a standard deviation of 0.82 for WRAP and 1.06 with a standard deviation of 0.5 for HGM. A total of 0.42 acres of on-site and 11.66 acres of off-site mitigation were generated by the public sector projects. None of the public sector projects failed to identify in the permit review process that wetlands were present or that there would be wetland impacts.

The private projects had mitigation ratios of 1.78 with a standard deviation of 3.99 for UMAM, 1.87 with a standard deviation of 4.27 for WRAP and 1.9 with a standard deviation of 4.22 for

HGM. A total of 333.11 acres of on-site and 124.08 acres of off-site mitigation were generated by the 75 public sector projects. Ten of the public sector projects failed to identify in the permit review process that wetlands were present and/or that there would be wetland impacts. If the four unusual projects mentioned above are removed, then the mitigation ratios for each method would be 0.95 with a standard deviation of 0.76 for UMAM, 0.987 with a standard deviation of 0.72 for WRAP and 1.08 with a standard deviation of 0.98 for HGM.

Mitigation Ratios			
Functional Assessment Method	**WRAP**	**UMAM**	**HGM**
Public	1.11+0.82	0.98+0.44	1.06+0.5
Private with large preserve outliers	1.87+4.27	1.78+3.99	1.9+4.22
Private without outliers	0.99+0.72	0.95+0.76	1.08+0.98

Table 35: Mitigation ratios generated by WRAP, UMAM, and HGM for the study sites

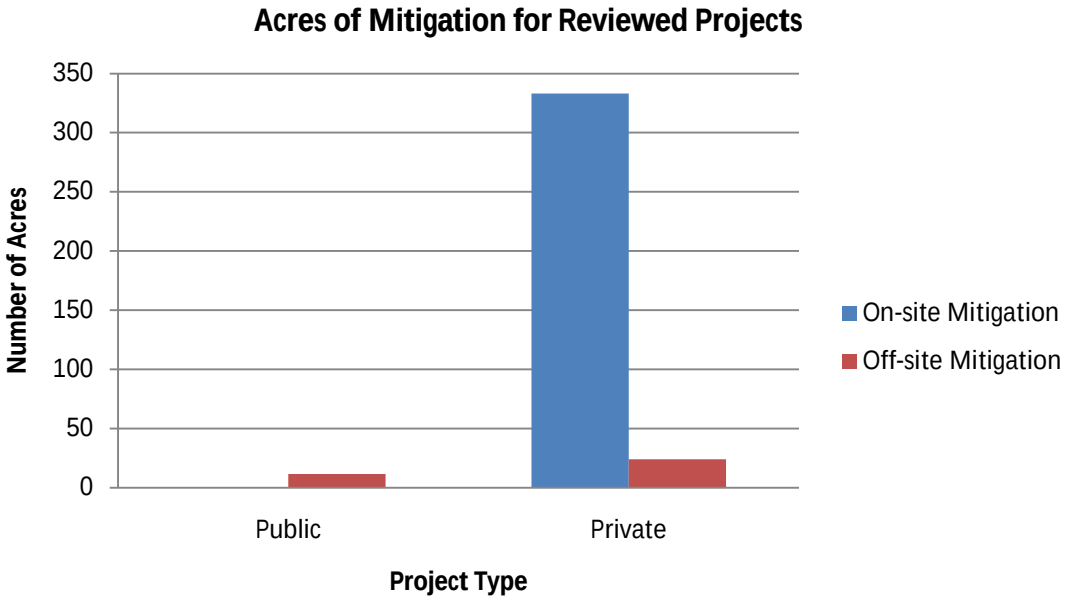


Figure 71: Number of acres of on-site and off-site mitigation in public and private projects

Features of off-site mitigation projects

Of the twelve projects that utilized off-site mitigation and that identified the location of the off-site mitigation area, 54% utilized an off-site area (bank) located in a different watershed and 46% utilized an off-site mitigation bank or area within the same watershed. The location of off-site mitigation was 83% Little Pine Island Mitigation Bank in the Matlacha Pass watershed, 8% at the Island Park Mitigation Bank in the Estero Bay watershed, and 9 % in the Dinkins Bayous area in Pine Island Sound.

Sending Watershed	Receiving Watershed	Number of Projects	Percent of Projects with Off-site Mitigation
Caloosahatchee River	Matlacha Pass	3	25.00%
Pine Island Sound	Matlacha Pass	1	8.33%
Estero	Matlacha Pass	2	16.67%
San Carlos Bay	Matlacha Pass	1	8.33%
Estero	Estero	1	8.33%
Pine Island Sound	Pine Island Sound	1	8.33%
Matlacha Pass	Matlacha Pass	3	25.00%

Table 36: Distribution of the location of sending and receiving watersheds for off-site mitigation

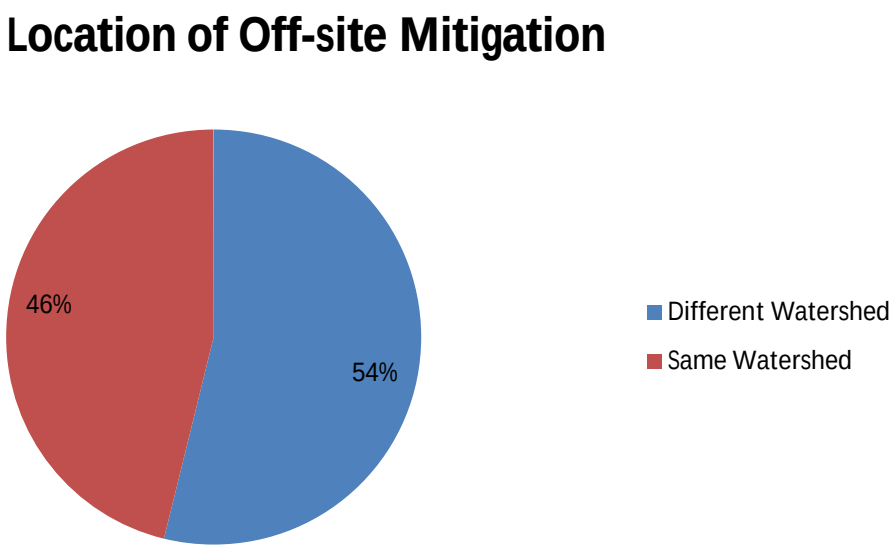


Figure 72: Relative proportion of projects that utilized off-site mitigation in the same vs. a different watershed

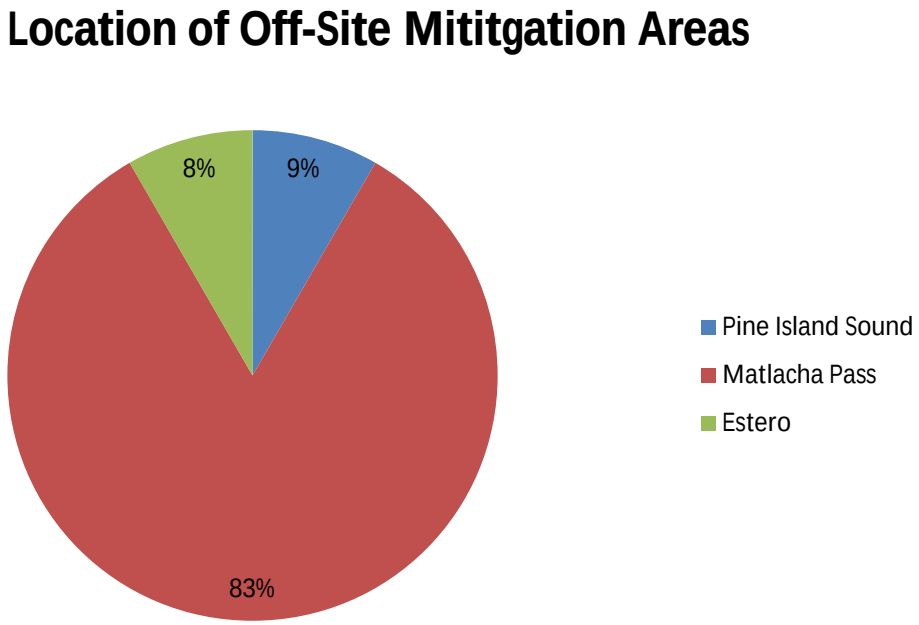


Figure 73: Location of off-site mitigation areas used by projects in the study

A Question of Balance

The use of any functional assessment method with mitigation banks can result in a balance of wetland functions being retained if the actual performance of the mitigation bank and the time lag to achieve the final mitigation state are accounted for. However, it can also result in a net loss of wetlands acres and/or a net loss of wetland function while appearing on the ledger to have been an equivalent trade of mitigation for loss of function from the permitted impacts. This can occur in six different but potentially co-occurring ways including:

1. Relocation of the wetland functions to an out-of-basin watershed.

2. The loss of acres and functions to conservation easement mitigation credits that do not increase function or acres of wetlands.

3. The presumption that the final wetland functional assessment score for the mitigation bank will be 1.0. Actual final wetland functional scores of released credit wetlands are less than 1.0, generating a 7-11% disparity between impact and mitigation functions.

4. Creation of an inverse mitigation ratio. Wetlands to be impacted are assessed as having a low functional score, while the promised mitigation wetland is granted a 1.0 perfect score (See point 3 above). As a result, for example, three acres of impacted wetland may be offset by one acre of mitigation wetland.

5. Insufficiency of mitigation credit purchase tracking. During permit review, mitigation credits are declared available from a particular mitigation bank, however there appears to be no follow-up to see if the credits are actually purchased as promised or that the mitigation activity was actually completed at the bank.

6. The existence of unidentified wetlands that sustain impacts that are never mitigated.

Relocation of the wetland functions to an out-of-basin watershed.

The service area of a wetland mitigation bank is often much larger than the watershed containing any individual project with impacts and so may be located one or two watersheds away from the impact site. This process of relocating wetland functions out of an impacted watershed and concentrating them in a singular, sometimes distant, watershed results in a net functional wetland loss to the impacted watershed. Typically, this is done to be able to provide approved off-site mitigation in the category of coastal wetland habitat that is being impacted. In southwest Florida, for example, certain types of salt water credits are only available at one mitigation bank, Little Pine Island. This results in all impacts across the very large service area being mitigated in one location – the concentration of all wetland function for that wetland type into one geographic location. While the functional assessment evaluation shows a mathematical balance for the total service area that is equal to or better than parity, with rare exception there is a real loss of wetland acres and function in the donor watershed and, potentially an increase in function, but not new acres, of wetlands created in the receiving watershed. If the mitigation credit utilized at the receiving bank area is from the establishment of a conservation easement, then there may not be any wetland functional increase.

The loss of acres and functions to bank conservation easement credits.

One complex issue associated with the use of functional assessment calculations for mitigation areas is “Does the establishment of a conservation easement to prevent future impacts to that mitigation wetland constitute a functional increase in wetland function in that wetland?” It would seem that, if a wetland is left alone (with or without legal protection from future development), and if all other aspects are equal, then the wetland functional assessment score for it should remain the same, rather than increase.

Historically, preservation of intact ecosystems through a conservation easement has been a form of mitigation that has been used to offset impacts in limited cases. Because, technically, no ecological function has been gained by the recording of a document, simple “preservation” was considered of restricted value in offsetting real wetland losses. However, because of development pressures, relatively unregulated loss of supporting uplands, and the degradation of ecosystems by exotic or nuisance species, establishing non-degrading conservation easements is considered to be protection against losing function over time, and mitigation value is assessed by comparing the anticipated condition *with preservation* to the anticipated condition *without preservation*. By rule, no mitigation credit may be released until the mitigation bank, or phase thereof, has a recorded conservation easement and financial assurance for its implementation and long-term management (Ch. 62-342.470(3), F.A.C.) over the project area, regardless of its current condition. Therefore all mitigation credits represent some degree of protection from

development and ecological degradation. However, there is wide variation among banks in the degree to which the preservation of intact ecosystems generates mitigation credit.

The mitigation bank permits reviewed by Reiss et al. (2007) did not consistently distinguish between credits awarded for preserving intact communities with a high degree of function from credits awarded for filing a conservation easement over communities in pre-restored condition. About half of the studied banks had phases or polygons containing intact wetlands or uplands where very little enhancement was required and management in perpetuity was assumed to maintain function. Even these banks did not specifically separate the potential credit attributed to this preservation. It is unclear whether credits have been allocated as credits for conservation easements or as preservation credits based on the difference between the current condition and the assumed "without mitigation" scenario.

As a result of this practice, when preservation is the source of a mitigation bank credit, the area in acres and the functional loss to a watershed that occurs in a permitted ERP project can be eliminated without any new areas of wetland being created or any lift in wetland function occurring at the mitigation offset site. In reality then, there is both a loss of total acres of wetlands and a loss of function within the impacted watershed even if it is the same watershed that the mitigation bank is in.

<u>The presumption that the final wetland functional assessment score for the mitigation bank will be 1.0. Actual final wetland functional scores of released credit wetlands are less than 1.0, generating a 7-11% disparity between impact and mitigation functions.</u>

One issue that is not clear in the use of off-site mitigation banks is whether the final restored wetland actually achieved the functional assessment value specified or envisioned in the proposed balance of functional resources lost to the impacts of the project.

The base principle of permitting wetland impacts with a functional assessment tool is that the functional attributes lost to the impacts permitted in the proposed project will be equally offset by the functions provided by the mitigation wetland site. It is important to understand that, in most documented permits, the final mitigation wetland is presumed to have a functional score at or approaching 100%. Actual scores for on-site and off-site mitigation areas are typically less than 100%.

Shafer and Roberts (2008) found that, for eighteen mitigation sites in Florida that had originally been sampled in 1988 and were re-visited in 2005, after 13–25 years, stand structure in mangrove mitigation wetlands in Florida still differed from that of natural sites. Although the number of mangrove species was similar, mitigation sites had lower basal area and height than natural sites, and were more dense and complex than natural sites.

Reiss et al (2007) found in a permit review of mitigation banks that the determination of potential credits, when based on assessment methods (commonly WRAP and UMAM), generally assumed that mitigation would result in full wetland function and assigned the highest possible scores for with-mitigation scenarios ("with bank"), anticipating full function would return to a site once mitigation activities were completed. This was true even in cases where the

surrounding landscape would have an impact on water quality or quantity, or where wildlife support or movement was significantly curtailed. In fact, it often seemed that the assessment was focused only on the anticipated capacity to support vegetation rather than the full suite of integrated wetland functions of the community. This practice could lead to an over-estimation of ecological lift and mitigation credit.

In reality, overall, wetland assessment areas in banks that had achieved final permit success criteria did not receive the highest attainable scores for the functional assessment methods employed, suggesting full wetland function had not been achieved. Reviews of the wetland functional scores of extant mitigation banks and on-site mitigation areas by this study and other studies further indicate that they do not. Reiss et al (2007) found a UMAM score of 0.93 for successfully restored Little Pine Island Mitigation Bank salt marsh. We found that the UMAM scores for completed mitigation sites in the same mitigation bank was 0.89 $\pm$ 0.2.

<u>Creation of an inverse mitigation ratio. Impacted wetlands are assessed as having a low functional score, while the promised mitigation wetland is granted a 1.0 perfect score. As a result, for example, three acres of impacted wetland may be offset by one acre of mitigation wetland.</u>

In the process of assessing a wetland impact site, the existing conditions of the potential impact area are, obviously, present, physically accessible, and empirically subject for judgment. Every potential flaw is evident and, depending upon the best professional judgment of the assessor in methods that allow weighting and personal latitude such as UMAM, it is easy to score debits against the various functions. In some field tests, participants have stated that they immediately look for the exotic vegetation as the clear measure of impairment of system function and health. The 50% melaleuca rule practiced in the SFWMD is a prime example of this type of assessment.

As indicated above, the final condition of a mitigation bank project is usually considered, albeit erroneously, to be 100%. This necessarily sets up an inverse mitigation ratio.

The mean pre-project wetland functional assessment score for the projects in this study was 0.66 with a standard deviation of 0.18 using UMAM; 0.69 with a standard deviation of 0.18 using WRAP; and 0.72 with a standard deviation of 0.19 using HGM. All of these functional assessment values are low relative to the presumed functional assessments granted to proposed future mitigations, whether they are on-site or off-site. So, with the major three wetland functional assessment methods, the physically existent pre-project wetland that will be assessed for impact is already 28% to 31% lower in function than the hypothetical mitigation wetland. As a result, a basic 1.5 to 1.4 functional units of impact-site wetlands could be impacted for each acre of mitigation wetland provided.

Insufficiency of mitigation credit purchase tracking. During permit review, mitigation credits are declared available from a particular mitigation bank, however there is no follow-up to see if the credits are actually purchased as promised or that the mitigation activity was actually completed at the bank.

In discussions with agency staffs, we found a significant discrepancy between the promise of mitigation provided during the permit process and actual documentation that the off-site mitigation was performed to achieve the level of functional replacement proposed by the application and permitted by the agency. In practice, all that is required in order to proceed with the permit process is a document from the mitigation bank indicating that a sufficient number of mitigation credits are available from the bank to meet the requirements of the proposed permit's functional assessment needs. Thereafter the permit can be issued on the basis of this promise alone, without documents confirming that the credits were actually purchased or that the mitigation was physically completed and met the 1.0 functional assessment score promised in the proposed functional assessment mitigation plan. It is only later, during compliance enforcement, that there may be a conclusion that the credits were not purchased, that mitigation was not completed, or, in the case that credits were purchased and the mitigation completed, that the mitigation site did not achieve the anticipated 1.0 functional assessment score. This problem is further complicated when the off-site mitigation bank utilized is reviewed and managed by one state agency (FDEP) while the permitting that utilizes the bank is performed by another state agency (WMD) and there does not appear to be any mechanism for the one agency to contact or inform the other of the state of the mitigation bank and the status of the actual credit purchase by the applicant.

The existence of unidentified wetlands that sustain impacts that are never mitigated.

There were seven projects that indicated in the permit submissions and the permit reviews by the WMD that no wetlands were present at the project site or would be affected by the works of the proposed project, but upon site inspections, were found to indeed have wetlands. In some cases these wetlands were even observable form aerial photography of the project site.

For example in the Arroyal Place project located in the Imperial River watershed, the WMD staff report wording states that "there are no wetlands or other surface waters located within or affected by the proposed project." At the April 13, 2010 Interagency Project review committee meeting discussion of Arroyal Place project on Imperial River, we asked why, given that mangroves were present on the site based on direct observations and photographic evidence, was it stated in the site review by WMD that there were no wetlands on the site? The answer given by SFWMD staff was that areas below and up to the mean high water line are considered "other surface waters" (OSW) and are not considered to be wetlands. Wetlands are considered to begin in the areas landward of the mean high water line. This policy indicates a conflict between the WMD interpretation and the state and/or federal wetlands jurisdiction rules which do not indicate that the tide line is a boundary for the definition of wetland existence or wetland jurisdiction.

Historical mitigation success rates for permitted coastal wetland projects

In October to December of 1989 Robert K. Loflin, Ph.D. and the principle author reviewed, via field site visits, 43 projects which had included on-site mitigation in the Florida Department of Environmental Regulation (FDER) permits located in or adjacent to wetlands of four of the southwest Florida Aquatic Preserves: Pine Island Sound, Matlacha Pass, Estero Bay, and Rookery Bay.

That study revealed the following:

Of these projects 18 (42%) had not had the mitigation done at all, although the environmental impacts had been permitted and implemented by the applicant.

Of the remaining projects all 25 (100% of residual, 58% of total) had initially been planted correctly. Of these planted projects 18 (72% of residual, 42% of total) experienced subsequent planting failure from active destruction subsequent to initial compliance inspection, loss to exotics encroachment, and/or lack of proper maintenance. Subsequent natural recruitment of failed planting areas by native vegetation restored five (28% residual, 12% of total) of the mitigation sites to some level of natural wetland function.

In result, four (9% of total) of the projects were successful mitigation projects from initiation to completed compliance inspection. An additional five (12% total) projects retained limited success due to unplanned natural recruitment, principally of mangrove species.

Of the remaining 34 projects, six (13% of total) could be brought to success by implementation of the required exotic control criteria within the permit language.

Of the 43 projects, 13 (30% of total) had specific conditions of adequate specificity and extent to allow for effective enforcement of permit conditions. Of the four successful projects, two (50% of residual) had adequate permit conditions.

Principle problems with mitigation success are shown in Table 37 below (note values exceed 100% since several projects had multiple problems).

Exotic vegetation dominating site	28	65%
Project incorrectly graded or not graded	18	42%
Plantings not performed	17	40%
Plantings not surviving due to natural causes	3	7%
Plantings not surviving due to human activities	7	16%
Insufficient hydrology for the wetland type	2	5%
Disease	1	2%
% cover not obtained after successful start	1	2%
Direct violation by the applicant following DER compliance inspection	1	2%

Table 37: Principal problems with mitigation success of coastal wetland D&F projects in 1989

Of the successful projects, all involved brackish water wetlands with mangroves. One also included smooth cordgrass. Two of these projects have the continued potential for failure unless exotic removal is maintained.

Four other interior wetland sites located within Aquatic Preserve drainage basins, but not closely adjacent, were inspected with FDER staff. Of these projects, two (50%) had been planted properly, and these projects had experienced planting survival but did not constitute mitigation success due to exotic plant invasion.

In a total of 47 projects investigated, four (8.5%) successfully met mitigation success criteria. Five other projects (10.6%) attained a wetland cover due to natural recruits that would provide some level of habitat value. Total cumulative success rate would therefore by 19.1%. Successful projects were in mangrove estuarine wetlands with excellent to good water quality and adjacent natural mangrove wetlands which acted as propagule donor sources.

Permit Type	Total	Successful	Successful	% normal	% recruit	% all success

				success	success	
Standard Form	17	2	0	11.76%	0.00%	11.76%
Short Form	27	2	4	7.41%	14.81%	22.22%
Enforcement Action	3	0	1	0.00%	33.33%	33.33%

Table 38: Permit mitigation success rates in 1989

In 2010-2011, the current investigators revisited the available project sites 22 years later to perform functional assessments on the mitigation areas that had been successful, and some that were not successful at the time of the 1989 study in order to ascertain their current condition.

Of fourteen coastal wetland mitigation sites in the CHNEP boundary examined in 1989 and again in 2011, eight (57%) remain and continue to be successful in 2011, twenty two years later. The failed sites are in residential, marina, and a bridge setting. The principle reasons for mitigation failure of these coastal wetlands projects have changed from the time of the original study. Instead of exotic plant species occurrence exceeding the mitigation criteria the sites had been significantly altered by human activity in trimming the mangrove areas, placing fill into the mitigation area, and planting upland and non-native species in the areas of mitigation. While some of this mangrove-killing hedging may have occurred during the one year hiatus in mangrove protection on the Aquatic Preserve shoreline, the level of mangrove trimming clearly continues into the present.

Plantings not surviving due to human activities	6	35%
% cover not obtained after successful start	5	29%
Insufficient hydrology for the wetland type	4	24%
Project incorrectly graded or not graded	3	18%
Plantings not surviving due to natural causes	2	12%
Erosion	2	12%
Freeze	1	6%
Exotic vegetation	1	6%
Direct violation by the applicant following DER compliance inspection	1	6%

Table 39: Principal problems with mitigation success of coastal wetland projects in 2010-2011

Projects that had utilized mangrove plantings in areas of rip-rap or had utilized plastic tube forms for mangrove planting lost their plantings or suffered mangrove cover loss from lack of

mangrove expansion within the hard substrate, heavy hedge trimming pressure, and erosion of high energy shorelines. Successful projects tended to occur in areas that had large wetlands that could provide natural recruitment from a standing source of propagules, seeds, and vector fauna.

Watershed Scale Functional Analysis of Wetland Habitats

As part of a watershed study, Collier County employed PBS&J and the DHI to analyze the condition of the watersheds of Collier County (Cabezas et la. 2010). Two of the tools utilized were a watershed scale analysis of the Vegetation and the Hydrologic Change Functional Assessment Scores in the UMAM for the entire Big Cypress Basin watershed.

We decided to attempt to utilize this method in the Estero Bay Watershed of the CHNEP to see what results we would be able to obtain for the CHNEP watershed in direct proximity and contact with the Big Cypress Watershed study.

The protocol designed by Cabezas et la. (2010) for the watershed scale UMAM vegetation change intensity scoring is as follows:

Vegetation scoring generally represents the functional value of a parcel of land based on the degree to which the parcel retains natural vegetation. A cell that has experienced large change from pre-development vegetation (i.e., to a developed land use) would receive low scores, while little or no change in vegetation cover (i.e., same as pre-development, or shift to another natural vegetation classification) would result in a high score. The vegetation scoring method also reflects the value of certain developed land uses for local sensitive wildlife species (e.g., relatively high score for pasture due to utilization by Florida panther, burrowing owl, gopher tortoise, and Audubon's crested caracara).

The vegetation scoring method is summarized in the following bullets:

- Polygons whose existing FLUCCS designation indicates the same dominant vegetation or natural water body as in the Pre-Development Vegetation Map (PDVM) (e.g., hydric flatwoods predevelopment and existing) received a score of 10;

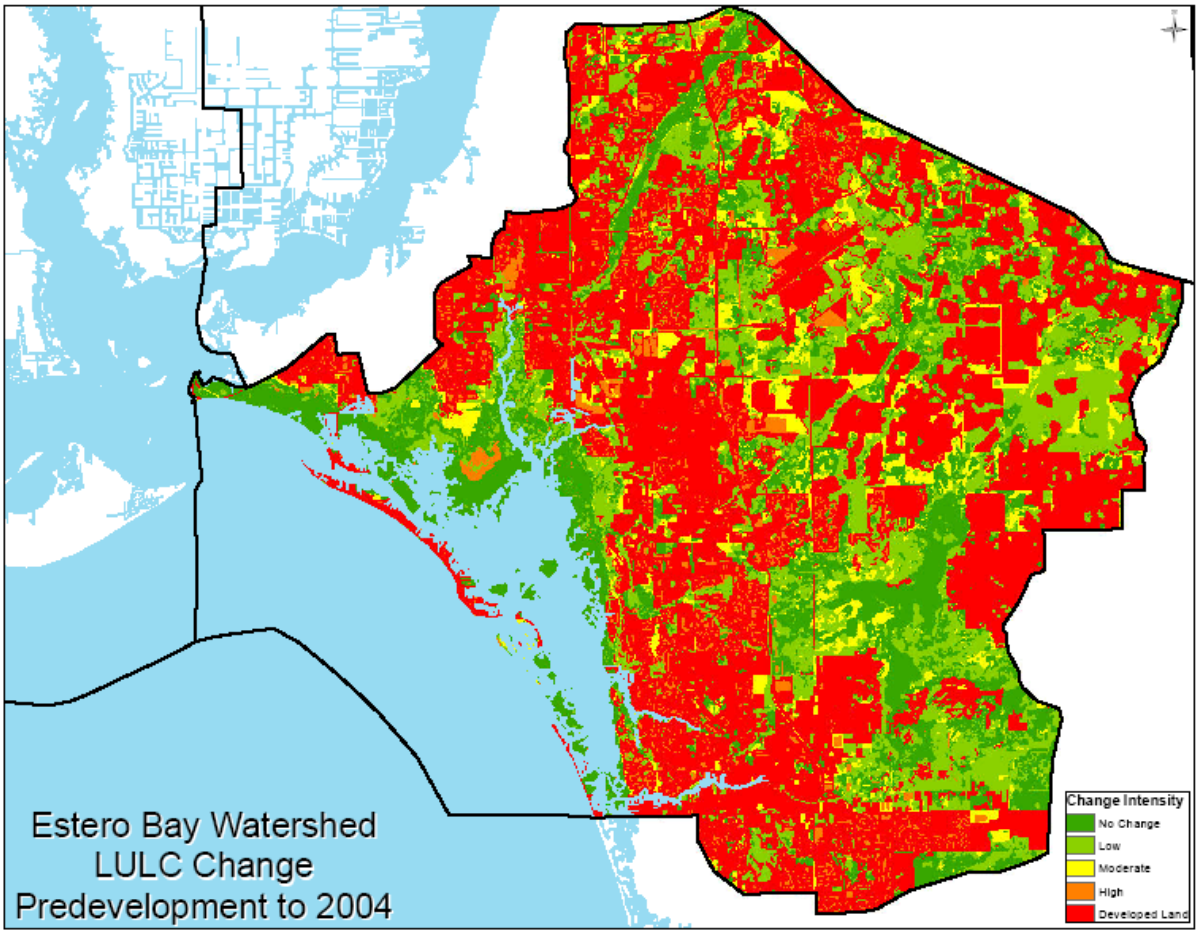
- Polygons that retained the same dominant stratum and ecosystem type (e.g., freshwater forested wetland to freshwater forested wetland) also received a score of10;

- Polygons that shifted from one dominant stratum to another but retained the same ecosystem type (e.g., freshwater forested wetland to herbaceous freshwater wetland) received a score of 8;

- A shift between mesic to hydric flatwoods or vice-versa received a score of 8;

- Vegetation that shifted between natural ecosystem types and stratum (e.g., herbaceous freshwater wetland to forested native upland or natural water body)received a score of 8;

- Polygons that have been converted to an artificial water body received a score of 6.



Map 96: Vegetation Change Intensity in the Estero Bay Watershed

In the Estero Bay Watershed comparison between the predevelopment landscape land cover and the 2004 landscape land cover, 25,657.95 hectares (63,402.07 acres) of habitats (29%) remained in the original habitat type; 37,945.76 hectares (93,765.86 acres) of habitats (43%) have been eliminated by human activities; and 24,097.68 hectares (59,546.58 acres) (27%) of predevelopment habitat changed to another habitat type.

Similar to the approach used for assessing the vegetation functional value, hydrology scoring represents the functional value of a parcel of land based on the degree to which the parcel retains the same hydrological characteristics as its pre-development reference condition (Cabezas et la. 2010). Pre-development hydrological conditions are estimated based on the typical range of depth and duration (hydroperiod) of inundation of the vegetation community present on the PDVM per Table 40. No change from pre-development would result in a score of 10, while total

loss of hydrology (e.g., a cell dominated by a pre-development wetland or open water body but which now experiences no inundation) would result in a score of 0. Current average depth and hydroperiod were determined from the MIKE SHE/MIKE 11 model developed for this project. As with the vegetation scoring method, the hydrology score was applied to the 457 m x 457 m (1500 x 1500 ft) model cells.

The hydrology score for a parcel is based on the ratio of the existing depth and duration in comparison to the reference condition, adjusted to a scale of 0 to 10. For instance, a site whose reference hydrological condition is an average hydroperiod of 6 months and an average inundation of 30.48 cm (12 inches), but which currently is inundated for only 2 months at an average depth of 10.16 cm (4 inches) (i.e., the site currently experiences one-third of the depth and duration of the reference condition for that site), would receive a hydrology score of 3.3.The reference condition for hydrological scoring is dependent on whether the existing plant community remains in the same plant/hydrological class as in the PDVM, per Table 40.

Where the plant community currently dominating a cell is different than it was in the PDVM, the hydrological reference condition is the minimum depth and hydroperiod typical of the PDVM plant community. In cells with the same existing vegetation class as PDVM, the hydrological reference condition is the maximum depth and hydroperiod typical of the plant community. The hydrology score is the average of the depth and hydroperiod scores. Due to a wide range of hydroperiod and depth of inundation for mangroves and salt marshes, no specific standards were established for these systems in Table 40, but a hydrology score of 8 was globally assigned. The overall hydrology scoring approach allows for a single score to be developed for each cell. Also for its use as a performance measure for proposed project evaluations, it differentiates between the hydrologic “lift” associated with projects that could enhance a particular wetland type without altering it (e.g., hydric flatwoods that will become wetter through project implementation) versus projects that would likely convert the site’s vegetation to achieve the PDVM vegetation community (e.g. wet prairie that would be rehydrated to achieve pre-development freshwater marsh hydrology).

The basic formulae used in calculating the hydrology scores are:

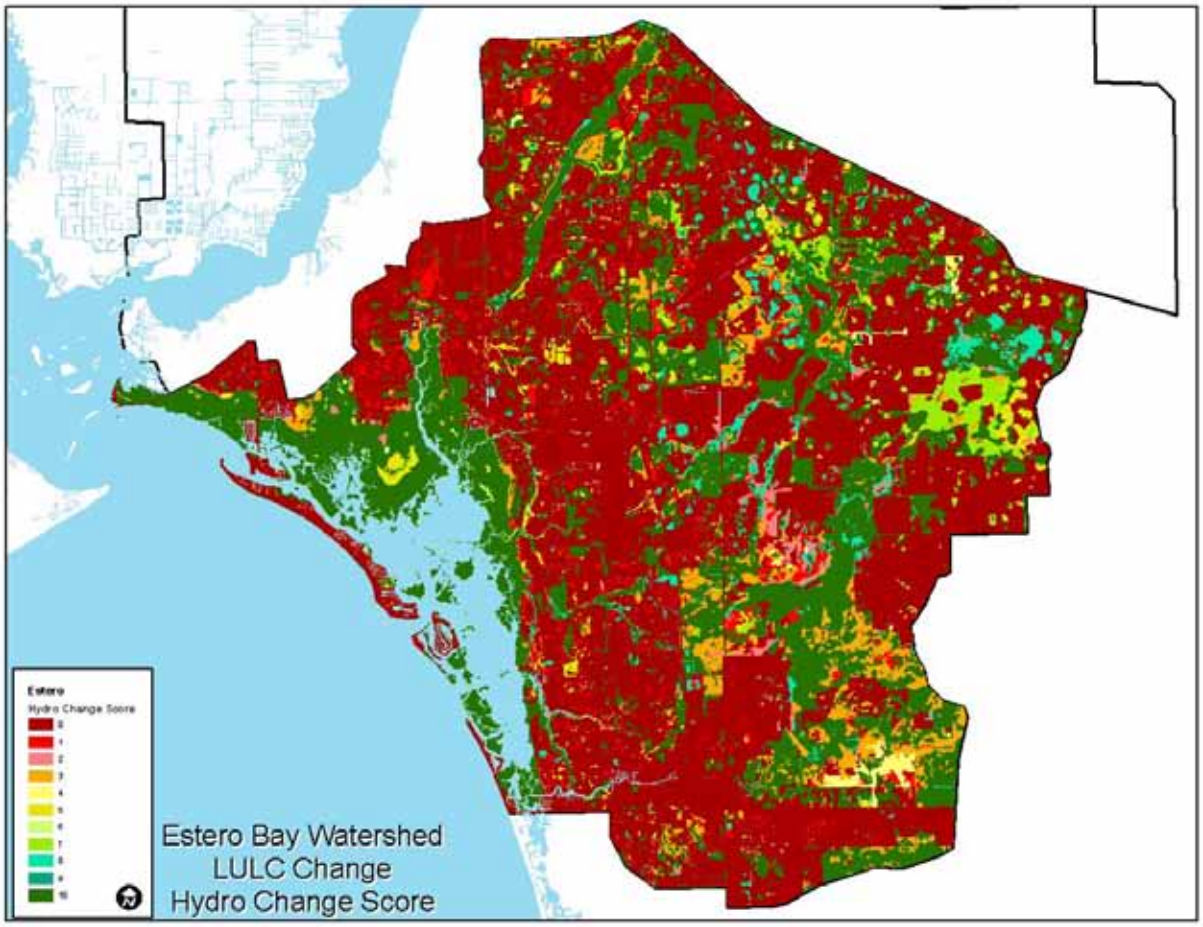
- If PDVM vegetation = FLUCCS vegetation, then Score = (Model Hydro/Max PDVM Hydro)*10
- If PDVM vegetation < or > FLUCCS vegetation, then Score = (Model Hydro/Min PDVM Hydro)*10
- Tidal marshes and mangroves = 8
- Combined Hydrology Score = (hydroperiod + depth)/2
- Recognizing that a score of 10 represents target conditions, all scores greater than10 were set to 10.

In these formulae:

- Where: "Model Hydro" is a cell's average depth or hydroperiod in the MIKE SHE/MIKE 11model;
- "Max PDVM Hydro" or "Min PDVM Hydro" is the top or bottom value, respectively, of the typical average range of depth or hydroperiod for a vegetation community, as estimated in Table 40.

SW Florida Plant Communities	Hydroperiod	Seasonal Water Level in inches	
	(months)	Wet	Dry (1,10)*
Xeric Flatwood	0	<-24	-60, -90
Xeric Hammock	0	<-24	-60, -90
Mesic Flatwood	less than or equal to 1	<2	-46, -76
Mesic Hammock	less than or equal to 1	<2	-46, -76
Hydric Flatwood	1 to 2	2 to 6	-30, -60
Hydric Hammock	1 to 2	2 to 6	-30, -60
Wet Prairie	2 to 6	6 to 12	-24, -54
Dwarf Cypress	2 to 6	6 to 12	-24, -54
Freshwater Marsh	6 to 10	12 to 24	-6, -46
Cypress	6 to 8	12 to 18	-16, -46
Swamp Forest	8 to 10	18 to 24	-6, -36
Open Water	greater than 10	>24	< 24, -6
Tidal Marsh	tidal	tidal	tidal
Mangrove	tidal	tidal	tidal
Beach	tidal	tidal	tidal
* 1 = average year low water			
10 = 1 in 10 year drought			

Table 40: Hydrologic regimes of major southwest Florida plant communities
Source: Duever 2002



Map 97: Hydrologic Change Score for UMAM in the Estero Bay Watershed

As defined by UMAM, the hydrologic change score values all uplands as having a 0 value. Similarly any wetland that is converted to an upland is given a 0 score. In the course of this study we decided to evaluate a finer scale of hydrologic change for the Estero Bay watershed using n alternative score method that looked at the number of hydrologic steps either up or down the hydrologic scale set in Table 40 that a habitat has moved from the pre-development to current conditions to develop a picture of full hydrologic change in uplands as well as wetlands in the watershed. We issue a caveat that this method is not UMAM and we are not proposing it as a wetland function assessment method. Instead, we are looking at this as a means to assess hydrologic change on a full habitat scale, not just wetlands.

The scoring for changes is shown on Table 41. This method smoothes the abrupt edges between uplands and wetlands, reflecting the natural ecotonal position of Florida habitats that serve as uplands in the dry season and wetlands in the wet season.

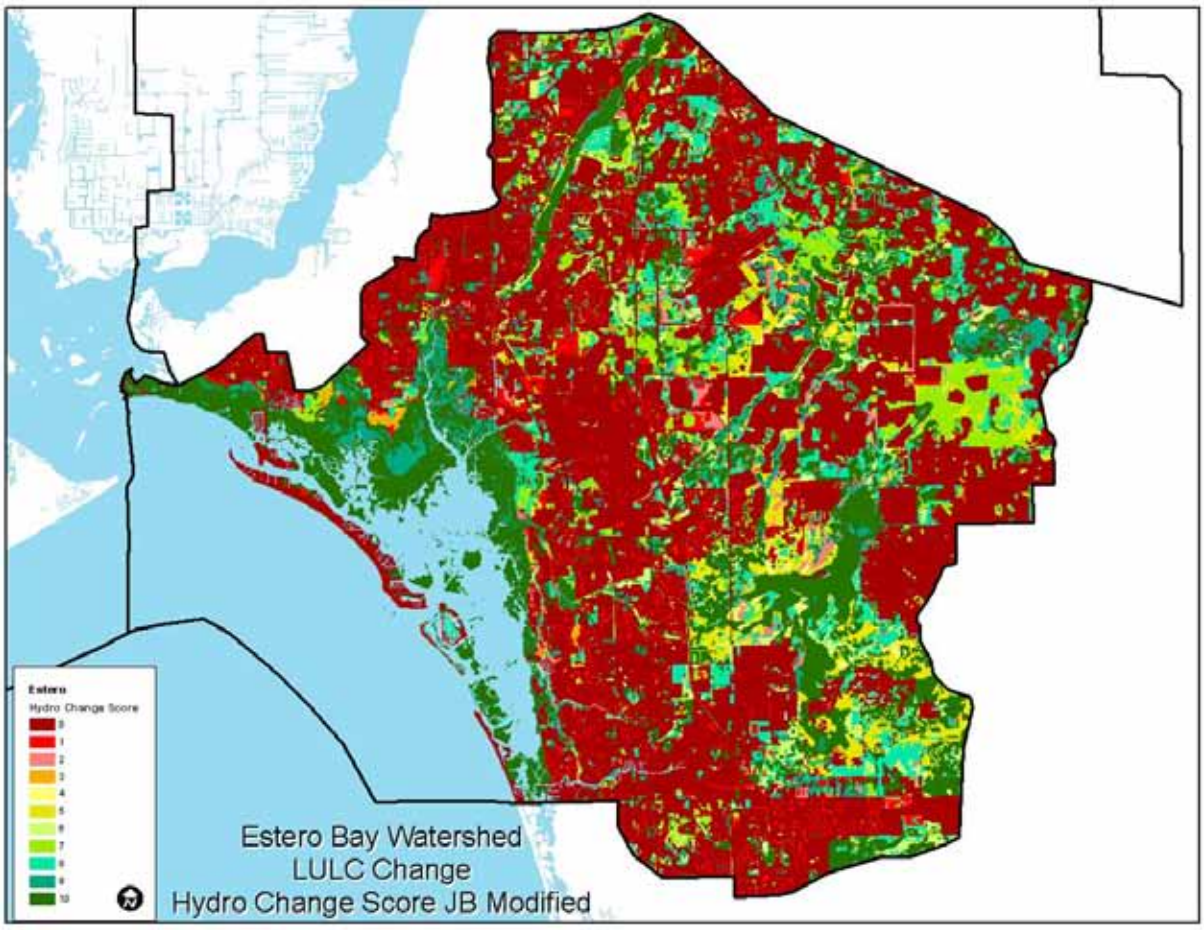
Estero Pre Development Vegetation Map	Estero SFWMD Land Use Map	Acres in Estero Watershed	UMAM Hydrologic Change Score	Shift in Hydrology Score
Beach	Beach	131.2	10	10
Beach	Disturbed	16.7	0	0
Beach	Mangrove	1.9	1	8
Beach	Mesic Hammock	2.9	10	2
Beach	Tidal Marsh	17.3	1	8
Beach	Water	87.6	1	1
Cypress	Cypress	13,120.9	10	10
Cypress	Disturbed	7,720.7	0	0
Cypress	Hydric Flatwood	3,199.2	10	6
Cypress	Hydric Hammock	1,253.7	10	6
Cypress	Mangrove	77.9	10	6
Cypress	Marsh	2,693.2	8	9
Cypress	Mesic Flatwood	790.3	10	2
Cypress	Mesic Hammock	170.8	10	3
Cypress	Scrub	126.1	0	1
Cypress	Swamp Forest	1,231.5	8	9
Cypress	Tidal Marsh	18.6	10	7
Cypress	Water	825.6	8	7
Cypress	Wet Prairie	490.7	10	6
Cypress	Xeric Flatwood	413.0	0	1
Hydric Flatwood	Cypress	4,867.1	3	5
Hydric Flatwood	Disturbed	27,339.9	0	0
Hydric Flatwood	Hydric Flatwood	4,760.4	10	10
Hydric Flatwood	Hydric Hammock	1,173.1	10	9
Hydric Flatwood	Mangrove	11.0	5	1
Hydric Flatwood	Marsh	681.7	2	6
Hydric Flatwood	Mesic Flatwood	3,203.1	10	8
Hydric Flatwood	Mesic Hammock	391.7	10	7
Hydric Flatwood	Scrub	550.0	0	6
Hydric Flatwood	Swamp Forest	1,050.2	2	5
Hydric Flatwood	Water	2,133.2	0	1
Hydric Flatwood	Wet Prairie	1,344.3	4	8
Hydric Flatwood	Xeric Flatwood	1,026.4	0	2
Mangrove	Beach	27.2	10	9
Mangrove	Cypress	0.5	6	6
Mangrove	Disturbed	1,210.7	0	0
Mangrove	Hydric Flatwood	7.1	10	2
Mangrove	Hydric Hammock	57.5	10	3
Mangrove	Mangrove	9,995.8	10	10
Mangrove	Marsh	1.3	5	5
Mangrove	Mesic Flatwood	7.5	10	1
Mangrove	Mesic Hammock	44.7	10	1

Mangrove	Scrub	5.0	0	1
Mangrove	Swamp Forest	46.8	5	7
Mangrove	Tidal Marsh	1,122.3	10	9
Mangrove	Water	950.2	5	9
Mangrove	Xeric Flatwood	2.1	0	1
Marsh	Cypress	76.3	10	9
Marsh	Disturbed	45.6	10	0
Marsh	Hydric Flatwood	2.3	10	6
Marsh	Mangrove	2.6	10	9
Marsh	Marsh	211.4	10	10
Marsh	Mesic Flatwood	2.9	10	5
Marsh	Scrub	0.0	0	2
Marsh	Swamp Forest	4.9	10	8
Marsh	Water	3.8	10	7
Marsh	Wet Prairie	2.6	10	9
Mesic Flatwood	Cypress	1,312.8	1	4
Mesic Flatwood	Disturbed	44,417.9	0	0
Mesic Flatwood	Hydric Flatwood	3,389.4	3	8
Mesic Flatwood	Hydric Hammock	1,332.8	3	7
Mesic Flatwood	Mangrove	159.8	2	1
Mesic Flatwood	Marsh	531.2	1	2
Mesic Flatwood	Mesic Flatwood	6,178.1	10	10
Mesic Flatwood	Mesic Hammock	1,176.1	10	9
Mesic Flatwood	Scrub	1,000.5	0	8
Mesic Flatwood	Swamp Forest	916.4	1	2
Mesic Flatwood	Tidal Marsh	174.8	2	1
Mesic Flatwood	Water	3,054.2	1	1
Mesic Flatwood	Wet Prairie	510.1	1	6
Mesic Flatwood	Xeric Flatwood	1,739.1	0	8
Swamp Forest	Cypress	18.9	10	9
Swamp Forest	Disturbed	70.5	0	0
Swamp Forest	Hydric Flatwood	4.1	10	1
Swamp Forest	Hydric Hammock	3.1	10	5
Swamp Forest	Marsh	6.5	10	8
Swamp Forest	Mesic Flatwood	0.3	10	2
Swamp Forest	Swamp Forest	0.4	10	10
Swamp Forest	Water	6.9	10	9
Swamp Forest	Wet Prairie	4.2	10	6
Swamp Forest	Xeric Flatwood	3.8	0	1
Tidal Marsh	Disturbed	195.8	0	0
Tidal Marsh	Hydric Flatwood	4.1	10	2
Tidal Marsh	Hydric Hammock	76.2	10	3
Tidal Marsh	Mangrove	636.1	10	9
Tidal Marsh	Marsh	19.8	5	6
Tidal Marsh	Mesic Flatwood	4.9	10	1
Tidal Marsh	Mesic Hammock	26.7	10	1

Tidal Marsh	Scrub	11.1	0	1
Tidal Marsh	Swamp Forest	5.9	5	8
Tidal Marsh	Tidal Marsh	1,001.3	10	10
Tidal Marsh	Water	71.7	5	9
Tidal Marsh	Wet Prairie	0.2	9	4
Tidal Marsh	Xeric Flatwood	1.0	0	1
Water	Beach	100.7	10	1
Water	Disturbed	139.5	0	0
Water	Hydric Flatwood	0.4	10	0
Water	Hydric Hammock	0.0	10	0
Water	Mangrove	523.1	10	8
Water	Marsh	0.5	6	0
Water	Mesic Flatwood	1.6	10	0
Water	Mesic Hammock	18.0	10	0
Water	Scrub	0.4	0	0
Water	Swamp Forest	0.0	6	0
Water	Tidal Marsh	595.6	10	8
Water	Water	27,476.0	6	10
Wet Prairie	Cypress	3,531.4	7	7
Wet Prairie	Disturbed	8,379.7	0	0
Wet Prairie	Hydric Flatwood	1,687.2	10	7
Wet Prairie	Hydric Hammock	490.9	5	7
Wet Prairie	Mangrove	19.3	10	3
Wet Prairie	Marsh	1,305.9	5	8
Wet Prairie	Mesic Flatwood	1,105.7	10	7
Wet Prairie	Mesic Hammock	232.4	10	7
Wet Prairie	Scrub	404.1	0	1
Wet Prairie	Swamp Forest	572.2	5	5
Wet Prairie	Tidal Marsh	232.1	10	3
Wet Prairie	Water	674.8	5	1
Wet Prairie	Wet Prairie	493.4	10	10
Wet Prairie	Xeric Flatwood	427.9	0	5
Xeric Flatwood	Disturbed	2,247.6	0	0
Xeric Flatwood	Hydric Flatwood	8.4	0	6
Xeric Flatwood	Hydric Hammock	5.4	0	5
Xeric Flatwood	Mangrove	6.5	0	1
Xeric Flatwood	Marsh	3.8	0	1
Xeric Flatwood	Mesic Flatwood	293.2	0	8
Xeric Flatwood	Mesic Hammock	110.8	0	7
Xeric Flatwood	Scrub	68.8	0	10
Xeric Flatwood	Swamp Forest	80.6	0	1
Xeric Flatwood	Tidal Marsh	2.4	0	1
Xeric Flatwood	Water	72.4	0	0
Xeric Flatwood	Xeric Flatwood	37.0	0	10
Xeric Flatwood	Xeric Hammock	6.9	0	9
Xeric Hammock	Beach	75.5	0	1

Xeric Hammock	Cypress	1.6	0	1
Xeric Hammock	Disturbed	1,993.7	0	0
Xeric Hammock	Hydric Flatwood	0.4	0	5
Xeric Hammock	Mangrove	62.5	0	1
Xeric Hammock	Marsh	0.9	0	2
Xeric Hammock	Mesic Flatwood	95.2	0	8
Xeric Hammock	Mesic Hammock	108.8	0	8
Xeric Hammock	Scrub	55.7	0	10
Xeric Hammock	Swamp Forest	47.4	0	1
Xeric Hammock	Tidal Marsh	23.1	0	1
Xeric Hammock	Water	92.6	0	0
Xeric Hammock	Xeric Flatwood	11.7	0	9
	Total Acres	**216,745.1**		

Table 41: Hydrologic change scores for the Estero Bay watershed using HGM and "shift in hydrology" method



Map 98: Shift in Hydrology method Score in the Estero Bay Watershed

In the Estero Bay Watershed comparison between the predevelopment landscape hydrologic condition and the 2004 hydrologic condition utilizing the unmodified UMAM method, 22,078.14 hectares (54,556.2 acres) of habitats (25%) remained in the original hydrologic condition type, 41,621.09 hectares (102,847.8 acres) of habitats (48%) have the hydrologic condition changed to zero by conversion to development or uplands by human activities, and 24,014.53 hectares (59,341.1 acres) (27%) of predevelopment hydrology changed to another hydrologic wetland type.

Comparing the predevelopment landscape hydrologic condition and the 2004 hydrologic condition utilizing the modified method, 25,709.8 hectares (63,530.2 acres) of habitats (29%) remained in the original hydrologic condition type, 38,026.02 hectares (93,964.2 acres) of habitats (44%) have the hydrologic condition changed to zero by conversion to development or uplands by human activities, and 23,977.94 hectares (59,250.7 acres) (27%) of predevelopment hydrology changed to another hydrologic wetland type.

Recommendations

We have the following ten recommendations for improving the mitigation of coastal wetland impacts in the CHNEP study area and answering some questions generated by the study.

1. Use of a handheld GPS device (such as the TRIMBLE) with GIS capability and a digital Functional Assessment Program (FAP) for Functional Assessments of Coastal Wetlands
The speed and accuracy of all utilized wetland functional assessment methods can be improved with the use of the handheld field GPS/ GIS unit record and link the field-collected data to the site data point. This system of field-based electronic collection coupled with the in-office pre-site visit review and post-site visit processing using a spreadsheet designed to calculate the functional assessment scores can reduce the time spent in functional assessment and generate a permanent documentation of the functional assessment for the site. The time needed to perform UMAM, WRAP, and HGM is significantly reduced and qualitative errors will be reduced. Utilizing this method, the time to employ HGM is in the range of a rapid assessment.

2. Use the HGM Functional Assessment Method
The Hydrogeomorphic Method is the most objective, complete, replicable, and accurate of the three available functional assessment methods. Based alone on the level of review and science involved in the development of HGM assessment methods, it should be the method utilized for functional assessments for regulatory purposes. Unfortunately, in Florida, replacing UMAM with HGM in the CHNEP study area is unlikely principally for non-scientific reasons unrelated to the issues of the utilization of the best measures to provide a wetlands functional assessment.

If UMAM is to be continued to be utilized, an additional set of weighing factors need to be employed to attain a more accurate functional assessment than what is being achieved currently.

3. Include a real mitigation success level weighting factor in calculating the UMAM.
A major problem with functional assessment imbalance is the assumption that the completed mitigation area will perform as well as natural un-impacted locations for the same desired type. There is no reason to expect that a mitigation area will achieve the same level of functions as an area that has never been disturbed. The scores utilized in the calculation for the future mitigated wetland need to be based on empirical evaluation of real completed wetland mitigation areas. This is possible, given that many mitigation wetlands now exist both from on-site and off-site efforts, including mitigation banks (Rowe et al. 2009).

The real functional assessment values of real mitigation sites need to be determined and set as the measure by which mitigation is balanced in the functional assessment permit review process. This would mean that if the mitigation area proposed to be used is performing at a 0.9 UMAM functional assessment level, then in order to off-set the impacts to 10 acres of a pre-project wetland with a UMAM score of 0.62 that will be impacted, then a total of 6.9, not 6.2, functional assessment units of mitigation would be needed to offset the functional wetland loss if there was no time lag or uncertainty associated with the mitigation site.

4. Do not give wetland functional mitigation credit solely for the establishment of a preservation or conservation easement. Incorporate the value of a conservation easement for a mitigation area into the actual physical mitigation credit unit.
The practice of granting mitigation credit solely for the filing of a conservation easement encourages net wetland loss in both function and area. Conservation easement mitigation credits do not increase wetland functions, increase area of wetlands, or offset the permanent loss of wetland area. The conservation of a mitigation effort designed to offset a wetland impact to functions and area in perpetuity must by design include the conservation of that area and this is not a separate component of the physical mitigation activities whether the goal is enhancement, restoration or creation. The value of the permanent conservation should be incorporated into the real physical mitigation activity and not treated as though it were a accomplishment that provides real physical functions, This may increase the cost of a mitigation credit but it will eliminate a cause of net wetland function loss associated with both on-site and off-site mitigations that rely solely on preservation as the mitigation method.

5. Require that all in-watershed mitigation options be examined first before going outside of the watershed in order to reduce in-watershed loss of wetland acres and wetland functions.
There are strong hydrologic, water quality, biological, social, and environmental justice issues associated with keeping mitigation in the same watershed as the impacts it off-sets. This sequencing of "in-watershed first" should also enhance avoidance and minimization of impacts during the project design phases since there is likely to be a less abundant source of credit available for large scale wetland impacts.

6. A full tracking system of mitigation credits needs to be implemented and audited regularly to ensure that promised mitigation is actually performed for both on-site and off-site mitigation plans.
This recommendation is clear from a number of current and long-term projects particularly for mitigation plans that are approved for a permit by one agency in an area reviewed and regulated by another agency. There is not specific linkage between a mitigation need and the credit that was generated or purchased at a bank to satisfy that need. This recommendation has been identified by USACOE, USFWS, university and legal experts and studies before, but has not yet been addressed.

7. Adjust functional assessment methods to create equivalent or positive ratios of wetland acreage post-project.
The analysis of functional assessment scores being balanced does not equate to the number of wetland acres lost in a permitting process to being balanced

An even balance sheet of functional assessment scores pre and post is not equivalent to a balance of wetland acreage mitigation and does not achieve a goal of no net wetland acreage loss. Functional assessment scores are not equivalent to acres.

The use of ratios in wetland mitigation permitting prior to the development of functional assessment tools was not arbitrary. These ratios were based on time lag, probability of success in achieving performance criteria, distance from the location of the impacted wetlands and the

understanding that wetlands exist in a landscape context and are not black boxes that functions can be stuffed into or extracted from. When in use, the greater-than-one-to-one ratios actually achieved a no-net-loss of wetlands for the projects subject to review. Significant areas of wetlands were protected, restored, and put into management in the ratio methods. In contrast the inverse ratios generated by the functional assessment methods, particularly when the effects of exotic plant cover in the pre-project wetlands are over-stated in best professional judgment weighting assessments, results in a net loss of wetland area.

If a no net loss of wetlands goal or an increase in wetlands acreage to restore the landscape balance of past wetland loss is the goal, then functional assessment methods need to be adjusted to increase, not decrease, the total number of acres of mitigation.

8. Require that all permit applications involving shoreline alteration include photographic evidence of the absence of wetlands, both in aerial and ground-level view, and from the water.

Most applicants and reviewers correctly identify the presence of wetlands and the potential impacts of project activities to these wetlands. However, we found that 5.9% of the projects we reviewed did not indicate that wetlands were present, did not consider those wetlands in the permitting process, and so, no mitigation was subsequently required for those losses of wetland functions.

9. Activities such as mangrove trimming should cease in conservation easement mitigation areas.

A major reason long-term mangrove mitigation areas are not achieving functional success is because of trimming for aesthetic views in the mitigation areas. This practice needs to be stopped for the benefit of the water quality, fish and wildlife resources of the CHNEP. If the regulatory agencies will not stop the activity, then the lost mitigation area needs to be offset by an alternate mitigation in an area that will truly be protected.

10. The value of rip-rap as an alternate shoreline habitat needs to be examined scientifically and comparatively to natural and other types of shorelines including living shorelines with vegetation.

The shoreline of the CHNEP was not naturally hard rock and the native invertebrate communities of nearshore bottoms are adapted to soft bottoms, seagrass beds, algae beds and oyster bars. There has been a regulatory presumption that rip-rap provides valuable hard surface habitat for coastal benthic organisms, the fish and wildlife that feed upon them, and water quality benefits from filter feeding. In our review of these shoreline settings, we did not observe the predicted communities. We did observe a variety of negative effects including providing habitat for non-native invertebrates, inadequate rooting areas for emergent vegetation, stunted growth in those mangroves that tried to grow in pure rip-rap without planter boxes or soil features, and habitat for drift and filamentous algae representative of high nutrient conditions. In contrast, the healthy and active hard bottom communities observed in estuarine sites occurred as small patch clusters on shallow unvegetated bottoms away from rip-rap and sea walled shorelines. In some locations vertical seawalls displayed a higher abundance and diversity of encrusting invertebrates than adjacent rip-rap shorelines.

Conclusions

This project implements the CHNEP CCMP Quantifiable Objective FW-2: restore and maintain saltwater and freshwater wetland systems, and Priority Action FW-C: restore freshwater and estuarine wetlands areas. This project directly addresses the national priority to improve the effectiveness of compensatory mitigation. The outputs of this project can directly inform the development of mitigation performance standards for south Florida. In addition, this project will assist in determining the adequacy of compensatory mitigation for managing cumulative wetland impacts under the Federal CWA 404/401 program in Southwest Florida. Finally, the project provides a unified evaluation of wetlands impacts within the CHNEP Study Area which can then be presented to all partner organizations in a non-regulatory environment.

There is a substantial amount of healthy, fully functioning wetland habitats in the coastal CHNEP area. By far, the majority of the watersheds are in a native, relatively undisturbed condition. To a large extent, this is the result of long-term conservation efforts initiated and championed by the citizens of the CHNEP communities that was translated through private, state and federal efforts into conservation lands, parks, National Wildlife Refuges, Aquatic Preserves, and conservation easement areas. Local, state and to a lesser extent federal land acquisition, conservation, and restoration efforts have borne the fruit of a large functional estuarine ecosystem.

While the ecosystem has suffered substantial perturbation from natural climatic events including major hurricanes, record freezes and record high water temperatures, the resilience of subtropical wetlands is in evidence as the mangrove forests are regrowing. Substantial human impacts to water quality in hydrologically regulated rivers and creeks has generated currently non-recoverable losses in submerged aquatic vegetation and living oyster resources. The extreme dredging and filling (principally in the later 1960's and 1970's) on the shorelines of the estuarine rivers has also generated large non-recoverable losses of salt marsh, mangroves, oyster bars, and submerged aquatic vegetation. As result the Peace River and the Caloosahatchee River watersheds can be expected to retain the status of minimal representation of coastal estuarine wetlands in the lower urban reaches unless substantial policy changes regarding seawalls are implemented.

The most recent assessment of the CHNEP estuarine habitats from CHNEP, FDEP, SFWMD, SWFWMD, Mote Marine Laboratory and other sources gathered in this report shows that there are

- 456 hectares (1,126 acres) of sandy beach,
- 25,831.92 hectares (63,831.96 acres) of mangroves,
- 6,196.15 hectares (15,310.99 acres) of salt marsh,
- 100 hectares (247 acres) of oyster bars,
- 26,404.78 hectares (65,247.52 acres) of seagrass,

- 11,054.81 hectares (27,317 acres) of unvegetated tidal flats, and
- 53,225.96 hectares (131,524 acres) of unvegetated shallow subtidal bottoms.

The extent of deep subtidal unvegetated bottoms varies, depending upon the boundary chosen. If the area considered is restricted to within the bays, estuaries and lagoons, there are 28,631.96 hectares (70,751 acres). If it extends out to the mapped boundaries of the watersheds as depicted in the CCMP, the area is 203,463.3 hectares (502,768 acres).

Combining the extents of what is traditionally considered coastal wetland, there are 32,028.02 hectares (79,142.85 acres) of coastal wetlands in the CHNEP. Combining this with resources typically of regulatory concern in submerged areas, there are 58,532.76 hectares (144,637.37 acres) of coastal wetlands, seagrasses and oyster bars combined.

Overall, the Pine Island Sound/ Matlacha Pass Watershed is the healthiest estuarine habitat, containing 50% of the seagrass, 40% of the mangroves, and 16% of the salt marsh of the entire CHNEP. Charlotte Harbor is also in very good condition with 15% of the seagrass, 22% of the mangroves, and 28% of the salt marsh of the entire CHNEP. Estero Bay contains 7% of the seagrass, 18% of the mangroves, and 12% of the salt marsh. Together these three watersheds encompass 72% of the seagrass, 80% of the mangroves, and 56% of the salt marsh in the entire CHNEP.

During the 2004-2008 study period, 10,186 ERP permit actions occurred in the total CHNEP boundary. Of these ERP permit actions, 1,834 occurred on the coast of the CHNEP, on the shoreline, and/or in emergent estuarine wetlands. The majority of the total ERP permit actions occurred in the Peace River, Caloosahatchee River, and Estero Bay watersheds. The majority of the Coastal Permit ERP actions occurred in the Caloosahatchee River, Pine Island Sound/ Matlacha Pass and Estero Bay Watersheds.

We examined in the field 118 sites utilizing the three wetland functional assessment methods, WRAP, UMAM, and HGM. Of the three functional assessment methods examined in the field for ERP (WMD and FDEP) projects in the CHNEP southwest Florida counties of Charlotte, Lee and Sarasota Counties, the Hydrogeomorphic Method was the most effective in identifying the wetland functions of the coastal wetland ecosystems (mangroves, salt marsh, intertidal and subtidal) located in the CHNEP study area. The UMAM and WRAP provided to be of utility but generally deliver a mitigation ratio in both functions and area that is less than one; so that net loss of both wetland function and acreage systemically occurs.

For the 118 evaluated projects, a total of 199.07 hectares (491.9 acres) of coastal wetlands were subject to review for potential impacts. The largest area of coastal wetlands on a project site was 30 hectares (74.08 acres). Some submerged bottom sites had no emergent wetlands. A total of 21.48 hectares (53.08 acres) of on-site coastal wetland loss was permitted. This is a 10.79% of on-site loss of wetlands between the pre-project condition and post project condition. The largest on-site wetland loss for a single project site was 4.5 hectares (11.12 acres). On average, a permit included 0.19 hectares (0.46 acres) of coastal wetland loss. This fits with a general pattern of

many projects having an apparently small wetland impact of less than 0.2 hectares (½ acre) contributing to a cumulative effect that can sum to more substantial acreage.

All three wetland functional assessment methods function as designed, and produce results that are similar if not exact in their assessment of coastal wetlands but yield somewhat different mitigation results.

The actual measured rate of wetland loss in this study from the 118 projects reviewed is 4.3 hectares (10.62 acres). This is 0.013 percent of the 32,028.02 hectares (79,142.85 acres) of coastal wetlands in the CHNEP. If the average rate of real wetland acreage loss of 0.19 hectares (0.46 acres) per project is applied to the total 1,834 coastal ERP Permit Actions over the five year study period, this could hypothetically be projected to result in a wetland area loss rate of approximately 68.4 hectares (169 acres) per year, while the wetland functional assessment balance would indicate no loss of wetland functions, since enhancements and preservations were occurring in other already extant wetlands at on-site and off-site mitigation areas.

This projected hypothetical loss rate is 0.21% of the total current wetlands habitat extents in the CHNEP or 0.12% of total wetland and submerged seagrass and oyster bar habitats extents in the CHNEP. This is below the margin of error in aerial photography mapping of these habitat resources. Since this loss is principally occurring in areas with already urban landscapes, such as the urban Caloosahatchee, urban Peace River, and Captiva Island, the relatively small wetland loss may already be blocked out in the land use/land cover mapping method utilized to map these resources.

While the total area of wetlands and the functional decrease can appear relatively small over the five-year period examined in comparison to the total extent of wetlands resources that continue to exist, it is important to understand that this permitted wetland elimination is gradually reducing the total extent of coastal wetlands in watershed of the CHNEP when it is the general perception both by the public and the regulatory entities that there is no wetland functional loss occurring in the balancing process of the use of functional assessment tools.

Additionally, wetland functions are being relocated out of impacted watersheds and into the singular watershed that is able to provide the approved off-site mitigation in the category of coastal wetland habitats that are being impacted. While the functional assessment evaluation shows a mathematical balance sheet for the total service area that is equal to or better than parity for a project that utilizes a mitigation bank, with rare exception, there is a real loss of wetland area and function in the donor watershed and potentially an increase in function, but not new area of wetlands created in the receiving watershed.

Estuarine environments require careful management. The estuaries in the CHNEP study area are heavily influenced by fresh water regulation and intense human use. Restoration and maintenance of high environmental quality should sustain the coastal economic base for tourism, fishing, recreation and the quality of life for area residents. It is essential that the wetland regulatory process maintain and protect these resources.

The pace of these changes in the coastal wetlands of the CHNEP is not distinguishable with large scale mapping tools and requires close examination of the wetland regulatory and wetland mitigation process to be observed and measured.

It was envisioned during the initial development of wetland functional assessment theory that wetland functional assessment methods would result in an improved wetland regulatory process over the ratio/area methods that mandated multiple acres of mitigation in return for a single acre of wetland loss. It was hoped that the result would be that more wetlands would be protected and that the goal of no-net-loss of wetland functions would be attained. While functional assessment methods do work, the results generate a condition of status quo, or even a slow, gradual loss of wetland area and functions in the donor watershed, with a slow, gradual improvement in wetland functions, but not wetland area, in receiving watersheds.

We believe that, by following the above recommendations, the original intent of wetland functional assessment may be achieved, and that the coastal wetlands of the CHNEP may be maintained, or perhaps even improved, as a result.

Appendices

The following Appendices can be found on the compact discs accompanying this study. Additional copies of the discs may be obtained by contacting the Southwest Florida Regional Planning Council:

Southwest Florida Regional Planning Council
1926 Victoria Avenue
Fort Myers, Florida 33901

Phone: (239) 338-2550
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Appendix 1: Local Government Rules
Appendix 2: Wetland Regulatory Entities and Offices in the Coastal CHNEP
Appendix 3: Contacts for Functional Assessment Methods
Appendix 4: Species Lists for Coastal Wetlands of Southwest Florida
Appendix 5: Functional Assessment Methods
Appendix 6: Permit Data by Watershed
Appendix 7: Functional Assessment Results
Appendix 8: Historic Mitigation Sites
Appendix 9: GIS Resources – This separate disc contains the ArcGIS files, maps and metadata associated with the project.

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