Surface Water Improvement and Management Plan for the Perdido River and Bay Watershed

Draft

Northwest Florida Water Management District
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Program Development Series 2012-04

PERDIDO RIVER AND BAY WATERSHED
SURFACE WATER IMPROVEMENT AND MANAGEMENT PLAN

Developed by the Northwest Florida Water Management District under the auspices of the Surface Water Improvement and Management Program

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Leigh Brooks (2010) – Perdido Bay

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1.0 INTRODUCTION

1.1 Purpose and Scope

The Perdido River and Bay Watershed Surface Water Improvement and Management (SWIM) plan provides a framework for watershed resource protection and restoration, encompassing programs and statutory responsibilities of the Northwest Florida Water Management District (NWFWMD or "District"). The planning area encompasses the Perdido River and Bay watershed within Florida, including a portion of Escambia County. The scope of the plan includes strategic management actions needed to address water quality, natural systems, and floodplain protection and management issues. The plan also identifies possible funding sources for implementation.

The SWIM plan has been developed pursuant to the Surface Water Improvement and Management Act, as enacted through sections 373.451-373.459, Florida Statutes (F.S.). Through this act, the Legislature recognized threats to the quality and function of the state's surface water resources. The act directs the five water management districts to develop plans and programs for improvement and management of surface waters and to conduct research in order to improve scientific understanding of the causes and effects of the degradation of surface waters and associated natural systems.

The purposes of the Perdido River and Bay SWIM plan are to identify major issues affecting watershed resources and functions, to prescribe a set of responsive management strategies, and to provide a funding framework for implementing them. The actions proposed are limited to those within the mission and scope of the NWFWMD SWIM program, while recognizing the initiatives of local communities and other agencies. Successful watershed management requires coordination and implementation of complementary programs under the purview of all jurisdictions and agencies involved in the watershed. Among these are local, state, and federal regulatory agencies; conservation land acquisition and management programs; and other public and private initiatives (Appendix A). Examples of implementing actions include stormwater retrofits for water quality improvement and floodplain protection, wetland and aquatic habitat restoration, resource assessments, monitoring, and public outreach and awareness activities. The actions taken, when funded, are monitored to provide feedback to determine if strategies are working, need adjustment, or if they need to be changed.

1.2 Vision for the Perdido River and Bay Watershed

The natural systems of the Perdido River and Bay watershed provide important ecosystem functions and associated economic and quality of life benefits for the community. The vision and goal of the SWIM plan is that Perdido River and Bay watershed shall be managed to ensure long-term sustainability of watershed resources, values, and functions. This encompasses preservation and, where necessary, restoration of ecosystem health and integrity. The District's vision for this plan recognizes important and interlinking hydrologic and ecological functions and processes at work in the watershed that affect water quality and natural systems.

2.0 PERDIDO RIVER AND BAY WATERSHED DESCRIPTION

The Perdido River watershed (Figure 1) extends from southeastern Alabama, through westernmost Florida, to the Gulf of Mexico. The watershed covers approximately 1,140 square miles (729,328 acres). Approximately 69 percent of the watershed is in Alabama and 31 percent is in Florida (348 square miles or 222,804 acres). The Perdido River serves as the state line. Counties in Alabama are Escambia and Baldwin, and in Florida solely Escambia.

The Perdido River is approximately 70 miles in length, 58 of that along the Florida-Alabama border (USGS, 2009). Major surface water features include the main stem of the river and major tributaries Brushy Creek, Boggy Creek, McDavid Creek, and Jacks Branch in Florida and Dyas Creek, Hollinger Creek, Styx River, and Blackwater River in Alabama. Other notable streams in Florida discharging to Perdido Bay are Elevenmile Creek and its tributary Eightmile Creek, Tenmile Creek, Bayou Marcus Creek, and Turner Creek. Other major surface water features within the watershed are Perdido Bay, Big Lagoon, Tarkiln Bayou, and Wolf Bay (FDEP, 2006; USGS, 2009). Surface water features of the watershed are shown in Figure 2.

Perdido Bay covers an approximately 50 square mile area oriented in a southwest-northeast direction. The length of the bay is about 17 miles, and its width varies from two to four miles. The only direct outlet to the Gulf of Mexico is at Perdido Pass. The Gulf Intracoastal Waterway allows for inland passage of watercraft between Pensacola Bay and Mobile Bay via Big Lagoon and Wolf Bay.

There are no major cities in the watershed, although unincorporated portions of the Pensacola metropolitan area do fall within the watershed. Municipalities in Alabama include Atmore, Bay Minette, Elberta, Foley, Gulf Shores, Loxley, Orange Beach, Perdido Beach, Robertsdale, Silverhill, and Summerdale.

2.1 Physiography and Ecoregions

The watershed encompasses two physiographic regions in Florida: the Western Highlands and the Gulf Coastal Lowlands (Wolfe et al., 1988; Pratt et al., 1996; Rupert, 1993; Purdum & Penson, 1998). The highlands encompass most of the watershed and extend from a 378 foot elevation high in Alabama down to a relict marine escarpment near Perdido Bay at elevation of about 100 to 120 feet (Rupert, 1993). The rolling hills of the Western Highlands have sandy soils and dry conditions, often with groundwater emerging from lower slopes to create hillside seepage bogs (Wolfe et al., 1988). Pliocene Citronelle Formation soils, topped by variable depth Pleistocene and Holocene undifferentiated sediments, are easily erodible and contribute to sedimentation in streams (Rupert, 1993; FDEP, 2006). A series of gently sloping marine terraces make up coastal lowlands around Perdido Bay and inland from the Gulf of Mexico. Here, sandy soil is underlain by clay resulting in poor drainage (Rupert, 1993). Along the coast is a series of sand dune and beach ridge systems (Rupert, 1993). Perdido Key dunes can reach 45 feet in elevation. Interdunal swales may hold fresh water (Rupert, 1993). Elevation is depicted in Figure 3. U.S. Environmental Protection Agency (EPA) ecoregion mapping classifies almost the entire watershed as Southern Pine Plains and Hills. A limited area of Southern Coastal Plain approaching coastal waters is divided into the Gulf Coast Flatwoods ecoregion around Perdido Bay and Gulf Barrier Islands and Coastal Marshes ecoregion furthest south (Griffith et al., 2001).

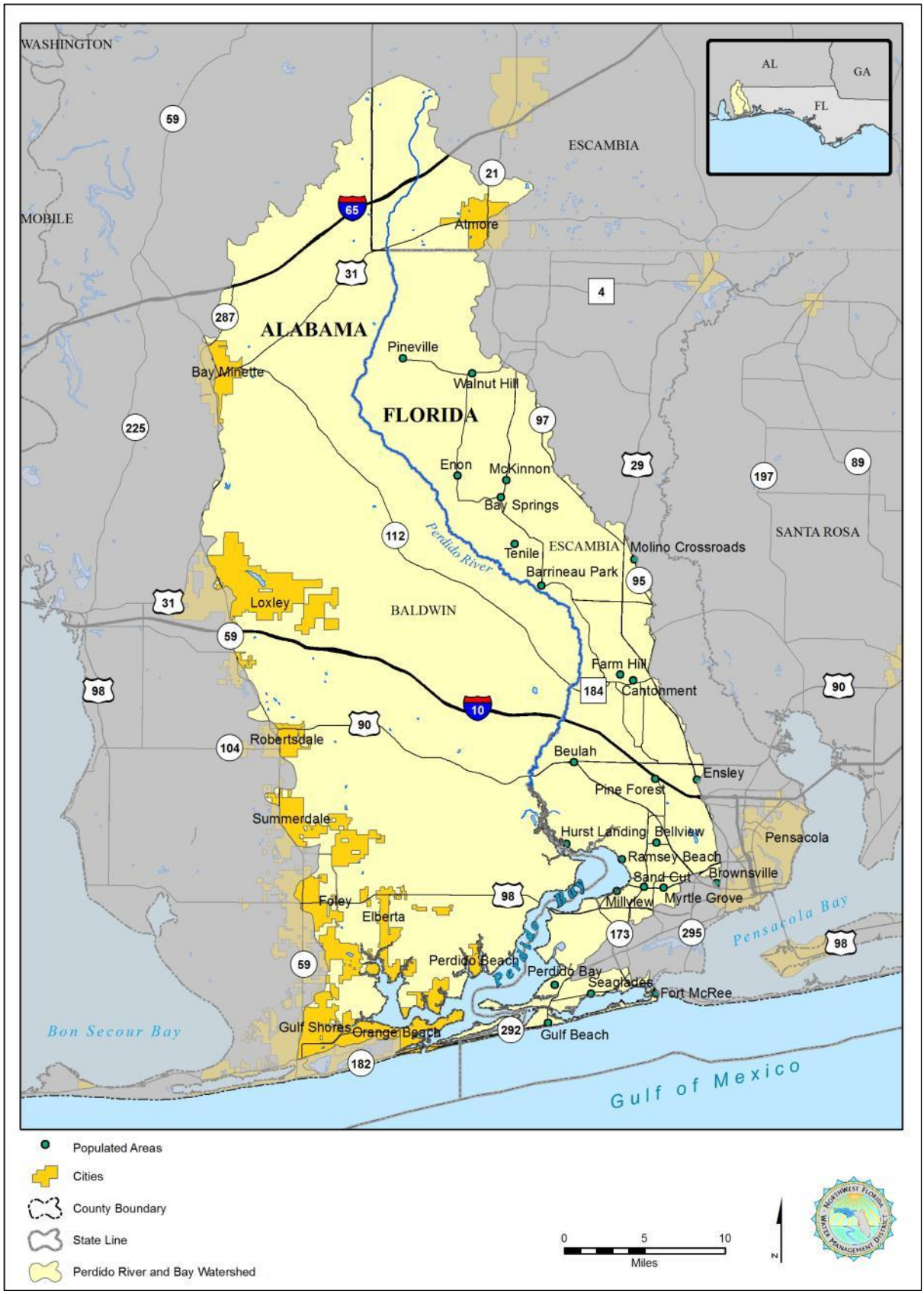


Figure 1. Perdido River and Bay Watershed

Figure 2. Perdido River and Bay Hydrography

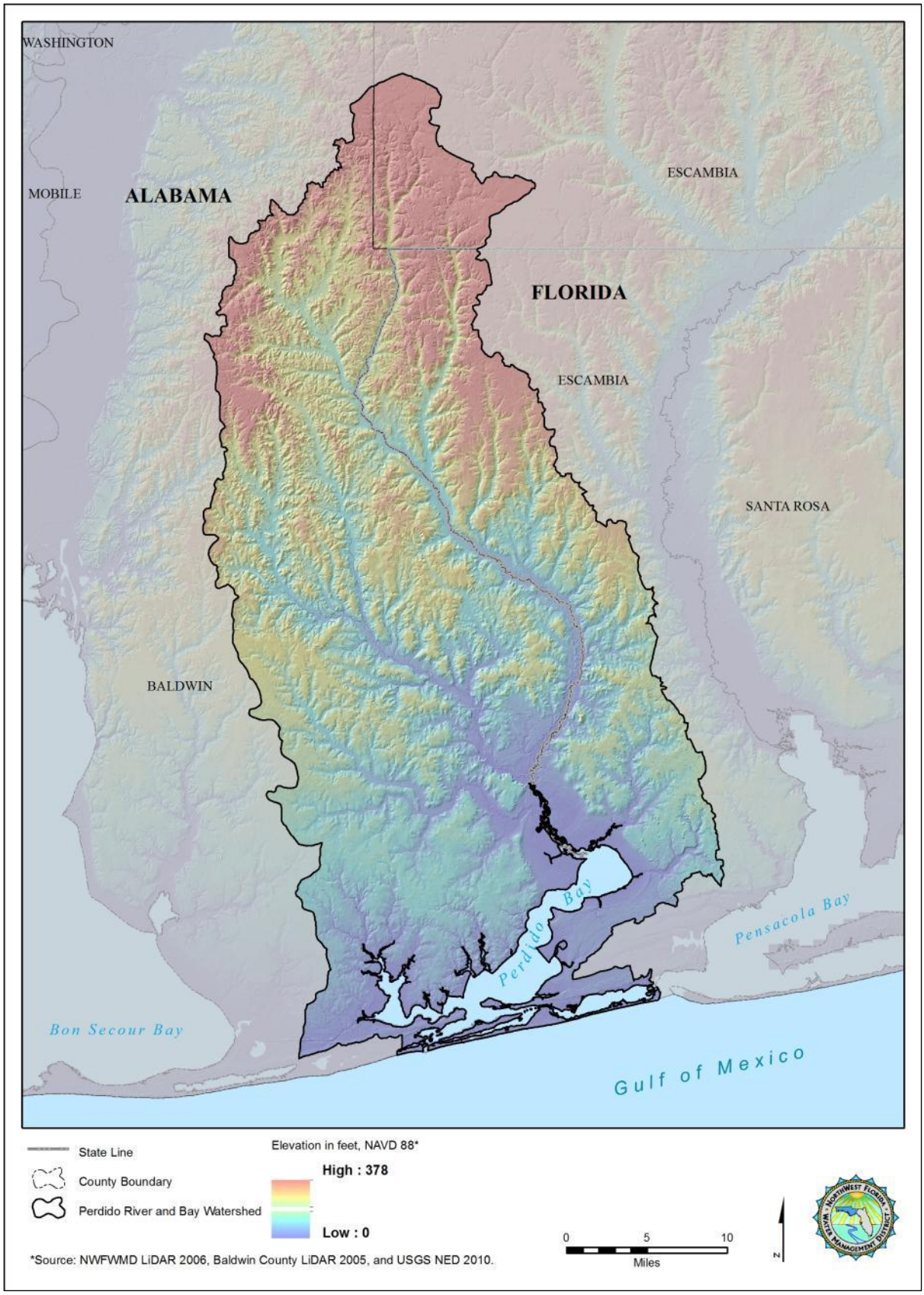


Figure 3. Perdido River and Bay Watershed Topography

2.2 Climate

The climate for north Florida is cool and sometimes cold in winter with appreciable rainfall, while summers are hot, humid, and rainy (Griffin, 2010). For the Pensacola region, the average annual temperature from 1948 to 2010 was 68°F. During this 63 year period, the average monthly temperature ranged from 52.0°F in January to 82.3°F in July. The mean minimum temperature was 42.9°F in January and mean maximum was 90.2 °F in July. Average annual precipitation was 63 inches with July being the rainiest month (mean 7.4 inches) and November being the driest (mean 4.0 inches) (Southeast Regional Climate Center, 2011).

2.3 Hydrologic Characteristics

The Sand and Gravel Aquifer is the geological unit closest to the surface in the Perdido watershed. Soils consist of unconsolidated sands, gravel, and clay lenses. In the northern portion of the watershed the Sand and Gravel Aquifer directly overlies the Floridan Aquifer. In the southern portion, a thick clay confining unit separates the sand and gravel and Floridan aquifers (USGS, 1965). The Sand and Gravel Aquifer is unconfined to semi-confined. Hardpan (hardened beds of consolidated sand and iron oxide) and clay lenses within this aquifer create local confining beds and perched ponds (FDEP, 2006; USGS, 1965). Water in the Sand and Gravel Aquifer is very soft and unmineralized, while water in the upper Floridan Aquifer is harder, more mineralized, and increasingly brackish toward Perdido Bay (USGS, 1965; Ruppert, 1993). The Floridan Aquifer gets progressively deeper in the western panhandle, over 600 feet below the surface in much of Escambia County (Rupert, 1993). With good quality water more readily available in the surficial aquifer, the Floridan is little used in this part of Florida (Rupert, 1993).

The Sand and Gravel Aquifer has three layered zones in Escambia County. The surficial zone is on top, made up of fine sands that are unconfined. Next is a low-permeability zone that acts as a semiconfining layer. The lowermost zone is the main producing zone. It is composed of highly permeable coarse sand and gravel beds interspersed with fine sand and clay-sand beds. This zone is used for most potable water needs in Escambia County. Rainfall recharges the aquifer. Ground water flows to nearby surface waters and to the coast, discharging to streams, bayous, the bay, and the Gulf of Mexico. The aquifer is close to the land surface, making it highly vulnerable to contamination by land use activities and spills (NWFWMD, 1991; FDEP, 2006) and also vulnerable to coastal salt water intrusion (NWFWMD, 1991).

Streams receive high base flow from groundwater seepage, typically 55 to 75 percent of total flow (USGS, 1965). Base flow of the Perdido River at Barrineau Park is estimated to be 290 cfs (NWFWMD, 1991). Elevenmile Creek receives approximately 68 percent of its flow from groundwater (FDEP, 2008). Surface runoff can be high and floods are of short duration due to the steep slopes and hilly terrain (USGS, 1965). The effects of the tide reach up the river about 15 miles to Muscogee (USGS, 1965). The salt wedge extends upstream about seven miles (NWFWMD, 1991).

The Perdido River has a sand and gravel bed that is closely connected to the sediments within the Sand and Gravel Aquifer, from which it receives much of its base flow (FDEP, 2006). It can be swift with shifting bed sands. River bends alternate between sandbars and holes (USGS, 1965). It is a blackwater stream, receiving water that has been darkened and made somewhat acidic from organic detritus as it flows from poorly drained areas.

The river descends rapidly in elevation for the first 12 miles to the state line, dropping approximately 134 feet. Over the next 58 miles to the bay, the river drops 162 feet, descending much more gradually (NWFWMD, 2006; USGS, 2010a). Numerous tributaries contribute flow to the river system, ranging from small intermittent streams to moderate perennial streams.

Steephead streams occur primarily in the upper portion of the watershed where surface streams have eroded into the water table (FDEP, 2006) or where seepage intersects a bluff or hillside (Ruppert, 1993). These streams have water quality characteristics of the aquifer (FDEP, 2006).

A river gage has been operating on the Perdido River at Barrineau Park since 1941. Mean annual discharge for the 70 year period of record is 783 cfs (USGS, 2010c). Stream flow gages are also located at Bayou Marcus Creek, Brushy Creek, Elevenmile Creek, Styx River, and Wolf Creek.

Table 1. Perdido River and Tributary Flow Summary Statistics

River Gage Location	Years of record	Mean annual discharge (cfs)	Mean monthly discharge (cfs)											
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Perdido River at Barrineau Park	70	783	516	616	744	944	957	1089	998	709	677	711	702	744
Bayou Marcus Creek	19	25.8	27.1	25.4	25.9	25.6	26.2	27.3	27.7	23.6	25	28.3	28.7	30.1
Brushy Creek	11	44.8	44.5	45.4	45.1	49.7	52.8	55.4	57.7	32.8	38.1	43.1	31.4	46.1
Elevenmile Creek	23	103	88.6	98.8	100	109	105	122	107	76.8	97.3	113	105	116
Styx River near Elsanor, AL	23	456	312	405	413	593	529	583	482	381	411	484	398	492
Styx River near Loxley, AL	1	-	-	-	-	-	-	-	-	-	-	-	4.17	3.62
Wolf Creek, AL	3	11.9	8.67	11.3	19.2	11.3	12.9	15.7	9.06	10	8.22	7.75	11.8	8.02

Perdido Bay is a relatively small, shallow estuary connected to marine waters at the constricted opening of Perdido Pass and the east and west legs of the Gulf Intracoastal Canal. Circulation is influenced by tides, winds and freshwater flows. There is a marked stratification seasonally with more saline water lower in the water column, causing low oxygen conditions. For a more thorough description see Lewis (draft 2011).

2.4 Natural Communities

Natural communities in the Florida watershed as described by Florida Natural Areas Inventory include seagrass beds, unconsolidated substrate, beach dune, coastal grassland, coastal interdunal swale, scrub, sand pine scrub, salt marsh, slough, wet prairie, shrub bog, depression marsh, basin swamp, dome swamp, gum pond, baygall, bay swamp, seepage slope, seepage stream, bottomland forest, floodplain swamp, blackwater stream, wet flatwoods, scrubby flatwoods, mesic flatwoods, maritime hammock, mesic hammock, xeric hammock, upland hardwood forest, upland mixed woodland, upland pine, and sandhill (FNAI, 2010 and 2011). Seepage slopes, wet prairies and wet flatwoods support many rare and unusual plants such as

carnivorous white top pitcher plants (*Sarracenia leucophylla*) and sweet pitcher plants (*Sarracenia rubra*). Atlantic white cedar is a distinctive component of western Panhandle blackwater and seepage streams such as occur in the Perdido watershed.

Alabama watershed habitats described in the Alabama Comprehensive Wildlife Conservation Strategy (2005) are maritime forest, coastal scrub, beach and dune complexes, salt and brackish tidal marshes, shallow marine waters, and seagrass beds. Communities at risk are East Gulf Coastal Plain Muck Bog, East Gulf Coastal Plain Seepage Bog (Upper Terrace Type), Mississippi Loam Hills Longleaf Forest, Needlerush High Marsh, Panhandle Sand Pine Dune Scrub, Pond-cypress Dome Swamp, and Swamp Blackgum Depression Forest (Alabama Natural Heritage Program, 2011). Additional natural communities may be present.

Approximately 18% of the watershed consists of wetlands as estimated from National Wetland Inventory data (Figure 4). These primarily consist of forested wetlands, including wet pine flatwoods, deciduous swamps and bottomlands, and evergreen swamps or flood-prone woodlands. Wetland habitats in Perdido Bay are mainly salt marshes and seagrasses.

Rare fish reported in Florida for the Perdido River are saltmarsh topminnow (*Fundulus jenkinsi*), goldstripe darter (*Etheostoma parvipinne*), striped bass (*Morone saxatilis)*, state threatened crystal darter (*Crystallaria asprella*), and federally threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*) (FDEP, 2006; FWC, 2011).

Other listed species in Florida include the black skimmer (*Rynchops niger*), little blue heron (*Egretta caerulea)*, snowy egret (*Egretta thula)*, white ibis (*Eudocimus albus)*, alligator snapping turtle (*Macrochelys temminckii),* state threatened least tern (*Sterna antillarum*), snowy plover (*Charadrius alexandrines),* and piping plover (*Charadrius melodus*). Perdido Key provides habitat for the federally endangered Perdido Key beach mouse (*Peromyscus polionotus trissyllepsis*), and estuarine waters support the green (*Chelonia mydas*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and loggerhead (*Caretta caretta*) sea turtles. (FDEP, 2006; FWC, 2011; USFWS, 2011).

The Alabama portion of the watershed has 58 native species of freshwater fishes. Three are considered of Greatest Conservation Need in Alabama: ironcolor shiner (*Notropis chalybaeus*), Gulf sturgeon, and Alabama shad (*Alosa alabamae*) (Alabama CWCS, 2005). Banded sunfish (*Enneacanthus obesus*), a critically imperiled species, is tracked by the Alabama Natural Heritage Program. State-protected lake sturgeon (*Acipenser fulvescens*) is presumed extirpated from the watershed.

Other Alabama species of Greatest Conservation Need are two amphibians - river frog (*Rana heckscheri*) and one-toed amphiuma (*Amphiuma pholeter*), and two state-protected reptiles - rainbow snake (*Farancia erytrogramma*) and alligator snapping turtle (*Macrochelys temminckii*) (Alabama CWCS, 2005). Also of concern is Southern dusky salamander (*Desmognathus auriculatus)*. Additional federally endangered species in the watershed are Mississippi sandhill crane (*Grus canadensis pulla*), red-cockaded woodpecker (*Picoides borealis*), and chaffseed (*Schwalbea Americana*). Additional state-protected species are snowy plover, Southern hog-nosed snake (*Heterodon simus*), mimic glass lizard (Ophisaurus mimicus), Florida pine snake (*Pituophis melanoleucus mugitus*), gopher tortoise (*Gopherus polyphemus*), and Mississippi diamondback terrapin (*Malaclemys terrapin pileata*). Aquatic invertebrates in the river include mayflies, caddisflies and blackflies (FDEP, 2006).

The U.S. Fish and Wildlife Service has designated critical habitat on coastal beaches for piping plover, Alabama beach mouse, and Perdido Key beach mouse and in Big Lagoon for Gulf sturgeon. Perdido Bay provides habitat for important species including the dwarf seahorse, dolphin and bald eagle (Mobile Bay NEP, 2006).

2.5 Special Designations

Under Florida's surface water quality standards as described in Chapter 62-302 of the Florida Administrative Code (F.A.C.), all surface waters in the Florida portion of the Perdido River watershed are classified as Class III, suitable for recreation, fish and wildlife.

Several waterbodies within the Perdido River and Bay watershed have been recognized and receive additional regulatory protection through designation as Outstanding Florida Waters (OFW), per Section 62-302.700, F.A.C. Designated OFWs are:

- Big Lagoon State Recreation Area
- Fort Pickens Aquatic Preserve
- Gulf Islands National Seashore
- Perdido Key State Recreation Area
- Perdido River

Fort Pickens Aquatic Preserve in Florida is a Gulf Ecological Management Site (GEMS) of the U.S. Environmental Protection Agency's Gulf of Mexico Program, as are Lillian Swamp and Orange Beach Maritime Forest in Alabama. In Alabama, Wolf Bay is recognized as an Outstanding Alabama Water.

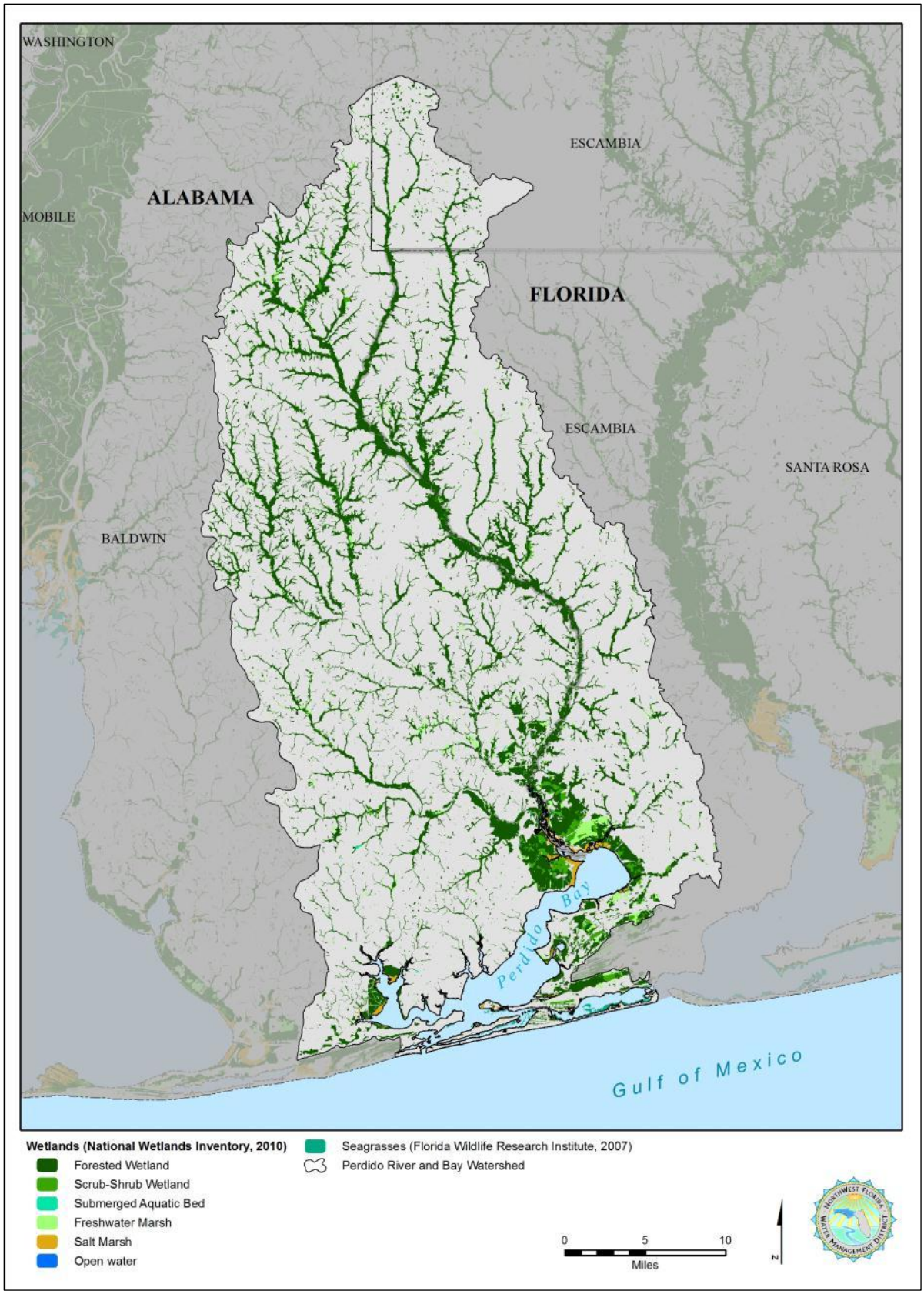


Figure 4. Perdido River and Bay Watershed Wetland and Aquatic Habitats

2.6 Population, Land Use, and Land Cover

Table 2 provides recent population estimates and the growth rate for the Florida watershed and the state as a whole. The estimates were derived from U.S. Census Bureau data, applying a GIS analysis of individual census blocks located within or mostly within the watershed. A growth rate of 9 percent in the last census period for Escambia County compares to a statewide growth rate of about 18 percent.

Table 2. Population Estimates for the Florida Perdido River and Bay Watershed

County	Census Population[1]		% Change
	2000	2010	
Escambia [2, 3]	108,732	118,853	9.3%
State of Florida [4]	15,982,824	18,801,310	17.6%

[1] *Watershed population derived from Census block data using GIS spatial analysis.*
[2] *Source: U.S. Census Bureau, Census 2000.*
[3] *Source: U.S. Census Bureau, Census 2010.*
[4] *Source: University of Florida, Bureau of Economic and Business Research, Population Program, Census Population Counts by County and City in Florida, 2000 & 2010.*

The predominant land cover in the watershed is upland forest consisting of managed and natural pinelands with a smaller portion of mixed and upland hardwood forest (Figure 5). Agricultural land is the next most common land cover. Agricultural use is heaviest in the southern portion of the Alabama watershed but is also significant in the Florida highlands. Land use in the lower portion of the watershed is more heavily developed towards the coast and urban centers, especially near Pensacola. Florida has much more developed land than Alabama. While only 10 percent of the total watershed is developed, developed land in Florida accounts for 20 percent of that state's watershed area. Land use was once heavily industrialized in the lower watershed with production of synthetic fibers, chemicals and paper (Marsh, 1966), but industrial use has since declined.

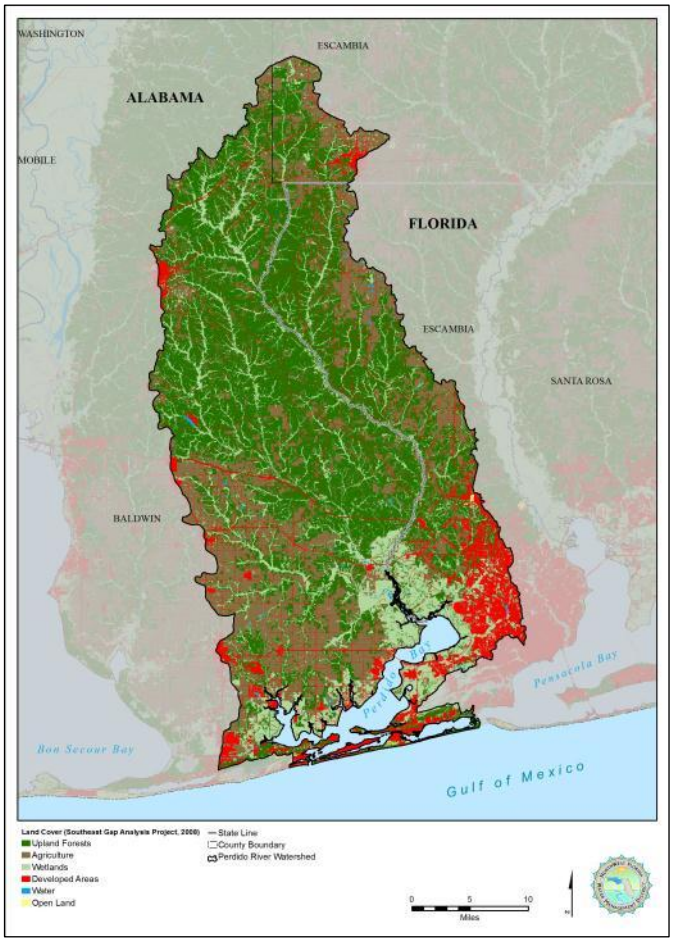


Figure 5. Perdido River and Bay Watershed Generalized Land Use and Land Cover

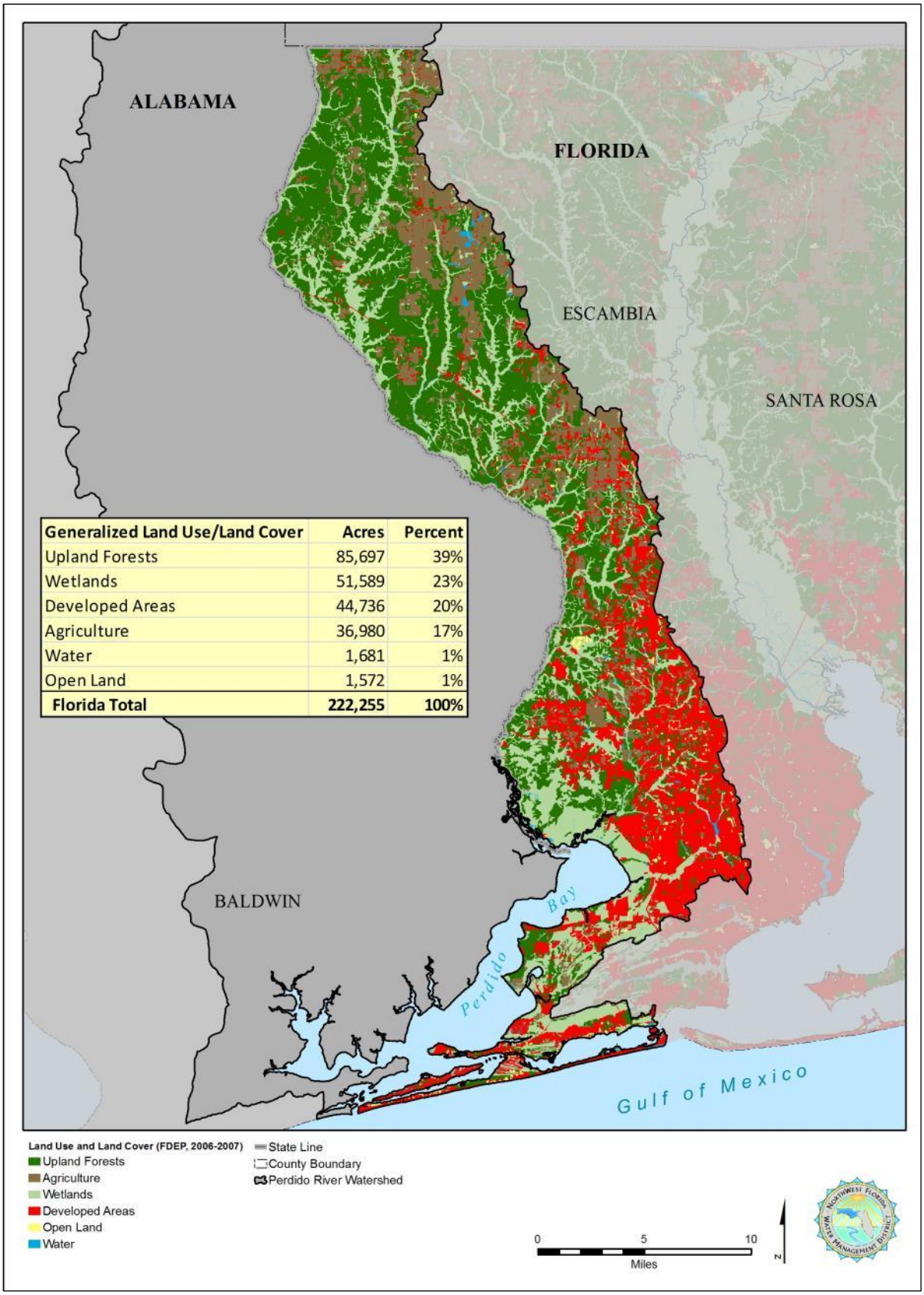
Mining for sand, gravel, and clay is done in open pits in Escambia County, Florida (Rupert, 1993). Three permitted sand mines are operating in Florida: Clark Site Contractors, Clark Sand Company - East Fence Pit, and Greens Fill Dirt - Blossom

Trail Pit. Several inactive pits are visible in remotely sensed data, including Belview Pit, one of two located about 1.5 miles northeast of Perdido Bay. In Alabama, there are three permitted sand and clay mines in Baldwin County and one that is inactive (ADIR, 2010; ADEM, 2011) .

The Gulf Coast oil region extends across Alabama about to the Florida state line. Oil fields exist in the Alabama watershed at South Carleton (Marsh, 1966). Test wells on the Florida side of the Perdido watershed found dry holes (FDEP, 2002).

The US Navy has six facilities in the Florida watershed encompassing over 3,000 acres. They are Naval Education and Training Professional Development & Technology Center, Saufley Field, Bronson Outlying Landing Field, Site 8A Outlying Landing Field, Naval Air Station Pensacola, Blue Angel Recreation Park, and Naval Technical Training Center Corry Station. There are two military landing fields in the Alabama portion of the watershed.

In Florida, urban development is concentrated in the southern portion of the watershed, within the Pensacola metropolitan area. This development extends north from the city, as well as south to Perdido Key, Big Lagoon, and Innerarity Point (Figure 6).



Generalized Land Use/Land Cover	Acres	Percent
Upland Forests	85,697	39%
Wetlands	51,589	23%
Developed Areas	44,736	20%
Agriculture	36,980	17%
Water	1,681	1%
Open Land	1,572	1%
Florida Total	**222,255**	**100%**

Figure 6. Perdido River and Bay Watershed Generalized Land Use and Land Cover for Florida

Lands protected for conservation purposes in Alabama and Florida cover over 37,000 acres of the Perdido River and Bay watershed (Figure 7). In Florida, conservation lands are not as extensive as in other panhandle watersheds, in part because the watershed is relatively small. The largest public conservation property is the District's Perdido River Water Management Area at 6,229 acres. The property is made up of land along the Perdido River corridor and 810 acres on Perdido Bay. The latter is a wetland mitigation area, established to compensate for FDOT roadway impacts. The goal of this project is to restore the site to pre-disturbance conditions including hydric pine flatwoods and savanna.

Escambia County has a noteworthy conservation area in the Jones Swamp wetland preserve. This preserve provides a greenway extending from the Bayou Chico basin in the Pensacola Bay watershed to state conservation lands within the Perdido River and Bay watershed. In addition to protecting an ecologically significant corridor in an expanding area, the preserve protects water quality and provides important public recreation lands and greenspace.

There are three state parks within the Florida watershed: Perdido Key, Big Lagoon, and Tarkiln Bayou Preserve. Gulf Islands National Seashore encompasses the east side of Perdido Key. Private conservation properties include Betty and Crawford Rainwater Perdido River Nature Preserve and Perdido Bay/Crown Pointe Preserve. The Bayou Marcus Wetland is a wastewater treatment wetland for Emerald Coast Utilities Authority. The Roy L. Hyatt Environmental Center is an environmental education facility serving the Escambia County School District.

Table 3. Conservation Land Ownership in the Florida Perdido River Watershed

Owner	Acres*
Northwest Florida Water Management District	6,229
Trustees of the Internal Improvement Trust Fund	4,347
The Nature Conservancy	2,308
Emerald Coast Utilities Authority	1,001
US Dept. of the Interior, National Park Service	994
Coastal Plains Institute	168
Escambia County	124
Total	**15,172**

**Based on GIS analysis.*
Source: Florida Natural Areas Inventory, June 2011

There are approximately 22,500 acres of conservation lands on the Alabama side, including Baldwin State Forest, Gulf State Park, Splinter Hill Bog, Lillian Swamp, and Perdido River Wildlife Management Area (USGS, 2010b). The Mobile Bay NEP (2006) identified four projects for acquisition: the AIG Baker/Reeder Lake Tract, 2,124 acres of longleaf pine flatwoods and wetlands scheduled for development; IP Perdido River Tracts, 30,000 acres of longleaf pine of which 20,000 have been purchased; Lillian Swamp pine savanna wetlands, a portion of which has been acquired; and Perdido River Delta LLP Connector, an area of longleaf pine and upland hardwood forest near the top of the watershed incorporating Dyas Creek.

Figure 7. Perdido River and Bay Watershed Conservation Lands

3.0 WATERSHED ASSESSMENT AND WATER RESOURCE ISSUES

3.1 Water Quality

Overall, water quality in main stem of the Perdido River is good, although water quality problems have been observed in several tributaries and in Perdido Bay. The major surface water quality issues identified in the Perdido Bay Cooperative Management Project and Perdido Ecosystem Management Strategies Plan (FDEP, 2006) have been nutrient pollution in Perdido Bay, discharge of International Paper effluent on Elevenmile Creek and Perdido Bay, unpaved road soil erosion and sedimentation in streams, loss of seagrasses, non-point stormwater runoff, and agriculture and forestry runoff.

In Alabama, almost all of the impairments of the Perdido River and its tributaries relate to mercury levels, with the exception of Brushy Creek which is impaired due to organic enrichment (ADEM, 2010). Water quality degradation, particularly sedimentation and nutrient enrichment related to agriculture, silviculture and urbanization of the watershed, has been identified in the Alabama Comprehensive Wildlife Conservation Strategy (2005) as a major problem affecting species and habitat. Sub-basins covering approximately 17% of the Alabama watershed are listed as impaired.

In Florida, there are 33 verified water quality impairments among 27 waterbodies in the Perdido watershed under DEP's TMDL program (FDEP, 2009). Impairments pertain to levels of mercury in fish, fecal coliform, dissolved oxygen, turbidity, biological oxygen demand, unionized ammonia and nutrients (FDEP, 2009). Mercury was the most common exceedance, occurring in 22 waterbodies. Impaired sub-basins cover about 79,918 acres of land, which amounts to 36% of the Florida of the watershed. The verified list will be revised in December 2011 (Espy, 2011). Six additional waterbody segments containing eight impairments are proposed to be added, while 15 impairments are proposed to be delisted (FDEP, 2011). TMDLs have been developed for Tenmile Creek and Elevenmile Creek for fecal coliform. These waterbodies do no yet meet water quality standards. Figure 8 depicts impaired waterbodies and lists waterbodies and their impairments.

There are no verified impairments for biology; however, very low Stream Condition Index (SCI) scores indicate that Dry Creek and McDavid Creek have very poor habitat quality (FDEP, 2005). Agricultural land use practices are described as having degraded these stream corridors (FDEP, 2005). Agricultural conversion of riparian headwaters is clearly visible on aerial photographs, particularly in the vicinities of Walnut Hill and Molino.

FDEP (2006, 2008) conclude that elevated nutrient levels in groundwater may be contributing to nutrient enrichment within nearby surface waterbodies, particularly within Perdido Bay. The 2008 Integrated Water Quality Assessment for Florida (FDEP 2008) indicates that ground water in the unconfined aquifer of the Perdido Bay planning unit is high in nutrients. Values exceed surface water criteria or guidance levels for nitrate+nitrite, total nitrate, and orthophosphate. High phosphorous and low dissolved oxygen were found in unconfined groundwater in the Perdido River planning unit. The sampling distribution for these observations, however, was limited. Sources of the high nutrients in groundwater have not been determined. Potential nutrient sources are agricultural and silvicultural land uses, stormwater ponds, septic tanks, wastewater discharges, and landfills. Natural conditions may contribute to elevated phosphorus and low dissolved oxygen.

There are close to 14,000 on-site sewage treatment and disposal systems, or septic systems, in the Florida watershed (Figure 10). They may be contributing to reduced water quality in the unconfined aquifer, in streams, or in Perdido Bay.

The Florida Department of Health has issued a fish consumption advisory for the Perdido River. Meals consisting of Bluegill, redear sunfish, largemouth bass, bowfin, and gar should be limited as recommended due to the presence of mercury in fish. The advisory also covers many species of fish from all coastal waters (FDOH, 2011).

Point source discharges are regulated by FDEP in Florida. There are currently eight permitted point source facilities operating in the Perdido watershed, two of which discharge to surface water. Five are industrial facilities, and three are domestic wastewater facilities. Permitted wastewater facilities are mapped and listed in Figure 9.

International Paper's pulp and paper mill in Cantonment is a major source of industrial wastewater discharged to surface waters. The facility has had a long history of water quality violations (FDEP, 2006). Discharge of up to 28 mgd of untreated wastewater to Elevenmile Creek has caused water quality problems in the creek and Perdido Bay. In March 2010 a new permit and consent order were issued requiring corrective actions to comply with water quality standards. International Paper is to upgrade its treatment facility, install a 10-mile pipe system to a 1,381 acre treatment wetland, and conduct long-term monitoring of Elevenmile Creek, Perdido Bay, and the wetlands. This new treatment system is to start no later than March 2012 and be fully phased in by March 2013 (Evans, 2011). As this facility has been generally regarded as the most substantial single pollutant source affecting Perdido Bay, the degree to which the upgraded treatment system succeeds may be among the most important near-term factors affecting water quality in the bay.

The Bayou Marcus Water Reclamation Facility, owned by Emerald Coast Utilities Authority, is also permitted to discharge 10.25 MGD of treated wastewater to a wetland along the upper eastern shore of Perdido Bay.

Figure 8. Perdido River and Bay Watershed Impaired Waterbodies

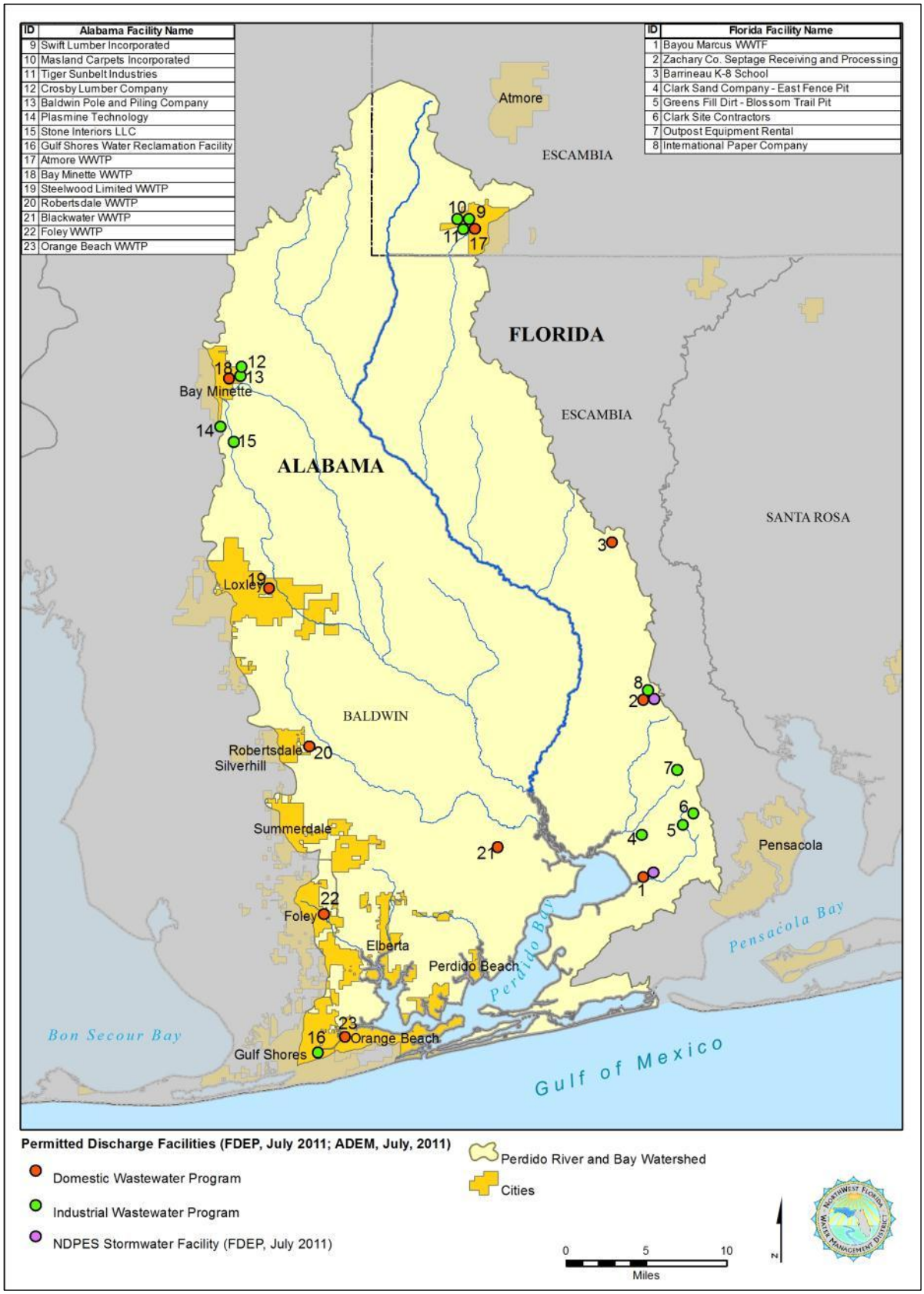


Figure 9. Perdido River and Bay Watershed Point Source Discharges

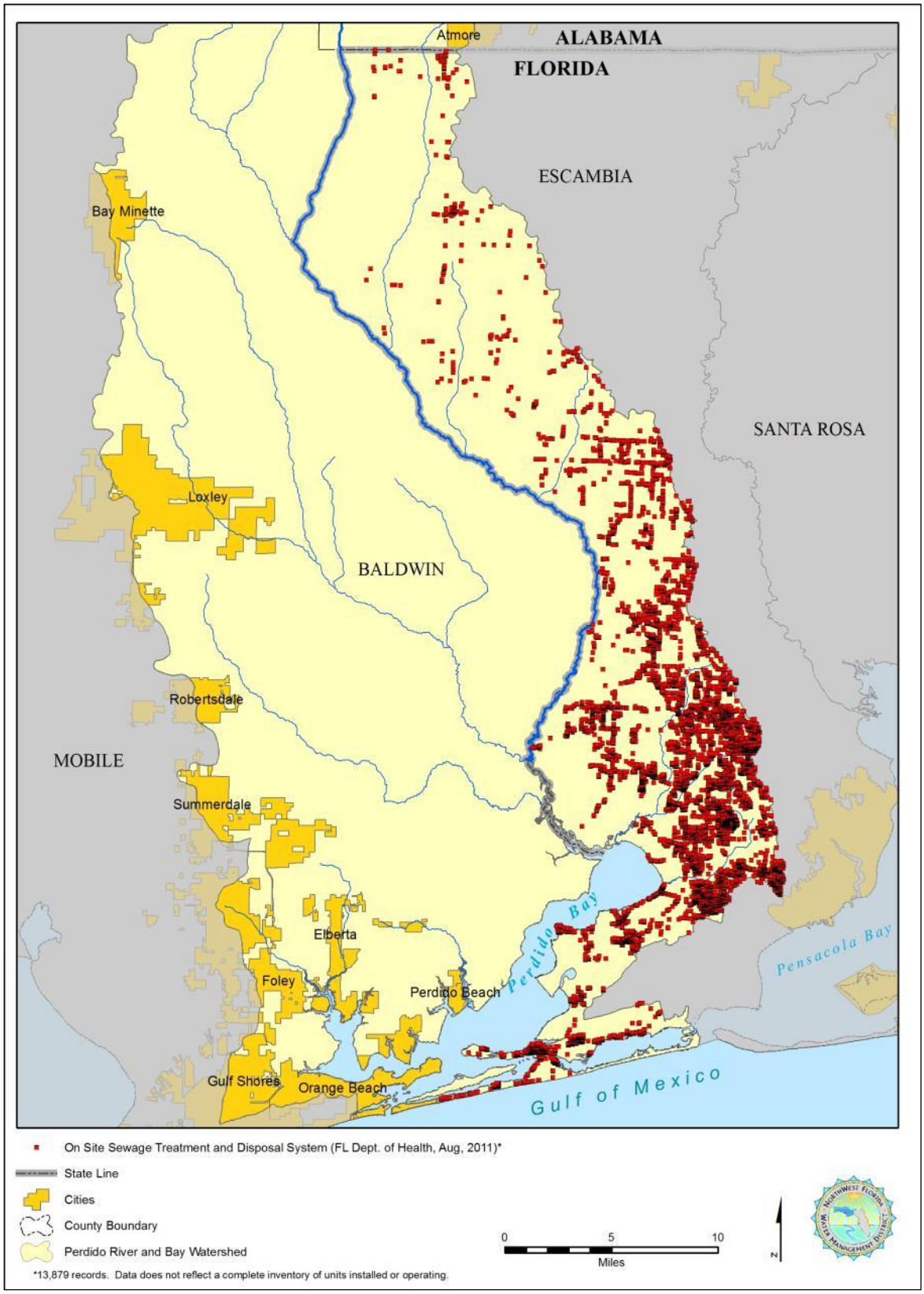


Figure 10. Distribution of On-Site Sewage Treatment and Disposal Systems in the Florida Perdido River and Bay Watershed

Nearshore waters and the entrance to Perdido Bay were impacted by oil following the blowout of BP's Macondo well and explosion of the Deepwater Horizon oil rig in the Gulf of Mexico on April 20, 2010. Over the course of five months, five million barrels of oil were discharged into the Gulf of Mexico. Oil impacted sensitive coastal areas in Texas, Louisiana, Mississippi, Alabama, and the western panhandle of Florida. In the Perdido watershed, impacts in Terry Cove and Bayou Saint John at the mouth of Perdido Bay were for the most part light, while impacts to Perdido Key were generally heavy (NOAA, 2011). Submerged tar mats have been found along Perdido Key (NOAA, 2011).

The lower portion of the watershed is more heavily developed than the upper watershed and is more affected by urban stormwater runoff and associated nonpoint source (NPS) pollution. Runoff from new development is regulated under the Environmental Resource Permit (ERP) program, although historically developed urban areas may need retrofits to provide water quality treatment and appropriate management of stormwater flows. There is also a National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system permit for Escambia County and co-permittees City of Pensacola, Town of Century, and FDOT (FDEP, 2006; Richey, 2011).

Unpaved roads cause sedimentation into streams and stormwater drainages. Escambia County is working to address this with a program to pave dirt roads from hilltop to hilltop. Baldwin County, Alabama has also been addressing this and expects most dirt roads to be paved by 2020 (FDEP, 2006).

Escambia County's Stormwater Master Plan Program was established in 1991 to reduce the frequency of flooding and to improve the water quality of runoff reaching surface waterbodies. Under this program, the county has developed stormwater studies for 11 of 23 basins in the Perdido watershed: Eleven-Mile Creek, Eight-Mile Creek, Beverly Parkway, Bayou Marcus, Millview, Bronson Field, Paradise Beach, Sandy Creek Weekly Bayou, Tarkiln Bayou, Perdido River South, and Jack's Branch (Curb, 2011). Studies are to be developed for the remaining basins as funding is available. These studies incorporate detailed modeling and prioritize capital improvement projects to reduce nonpoint source pollution, reduce flooding, and enhance transportation (Hatch Mott MacDonald, 2003; Curb, 2011). A variety of project needs have been identified, including dirt road paving, restoring streams, constructing stormwater ponds, and installing stormwater retrofits in established neighborhoods. Projects are funded mostly through the county's local option sales tax (LOST). Water quality is monitored to calculate pollution reductions achieved. To date, 247 capital improvement projects have been completed under this program at a cost of $53 million in LOST revenues plus other funding sources. This includes 129 drainage projects and 118 dirt road paving projects on 44 miles of dirt road. LOST funds alone will not be enough to implement all of the identified projects and conduct the remaining basin studies. The urbanized basins have over $100 million in unmet project needs.

3.2 Natural Systems

Perdido Bay is affected by water quality problems described above, as well as by shoreline development. According to Lewis (draft 2011), the extent of seagrass coverage in estuarine and nearshore areas associated with the watershed has been shrinking for many years. Seagrass acreage declined 76 percent in Perdido Bay since 1940, dropping from 1,162 acres to 277 acres in 2002. In Big Lagoon, seagrasses declined 20 percent between 1960 and 1992, from 670 to 538 acres. Combining those areas, seagrass habitat has been reduced 44 percent over the period 1972 to 2008, with acreage estimated at 750 in 2008 (Lewis, 2011). FDEP (2001) found that seagrass communities in Big Lagoon continue to be impacted by poor water quality, as indicated by epiphytic algae and reduced light penetration.

Alteration and hardening along the shoreline of Perdido Bay affects water quality, intertidal habitats, and shoreline stability. High-density residential development and numerous docks on the lower bay are apparent in aerial photography. Affected areas are in the upper part of Wolf Bay at Moccasin Bayou and Hammock Bay, Bayou La Launch, Arnica Bay, Terry Cove, Cotton Bayou, Bayou Saint John, Big Lagoon and water side areas of Lillian, Perdido Beach, Josephine, Orange Beach, Innerarity Point, the bay side of Perdido Key, and the entire shoreline of Ono Island. Such development is more prevalent in Alabama than in Florida.

Substantial physical impact and alteration to tributary stream systems is evident in the Perdido River and Bay watershed. These include direct effects from impoundments, which results in loss and fragmentation of stream habitat and altered flow patterns. Additionally, scouring and bank destabilization result from urbanization within the stream catchments. Development within the Ten Mile Creek basin, for example, has resulted in pronounced stream degradation, bank destabilization, and water quality impacts. The basin has thus been the focus of recent stormwater retrofit and stream restoration activity on the part of the county. In addition to increasing storm flows, headwater development with substantial impervious surface area can also depress stream base flows. This, in turn, can further impact the viability of the habitat.

Remote sensing analysis of tributaries suggests that many headwaters and associated downstream reaches no longer have typical stream or wetland signatures. Clearing and impoundment and/or fire suppression and large-scale appear to have affected most headwater streams in the landscape. Land clearing increases runoff, erosion potential and reduces natural filtering of runoff. Stream impoundments and clearing severely alter hydrology and native habitat, reducing recharge and stream flow and compromising the water cleansing capacity provided by headwaters. Cleared riparian areas are often vulnerable to colonization by invasive non-native species such as Chinese privet (*Ligustrum sinense*) and Chinese tallow (*Sapium sebiferum*) (Ray, 2011).

Logjams appear to have become more prevalent in recent years. As of 2010, there were nine different logjams visible on aerial photographs along the Perdido River, distributed from a few miles upstream of Brushy Creek down to almost US Highway 90. There we none visible on 2004 aerial photographs, taken just before Hurricane Ivan. Several historic and current factors may contribute: large scale land clearing, harvest of Atlantic white cedar, conversion to pine plantation, and boat wakes on the lower to middle river. These actions may decrease bank stability, resulting in is loss of riparian vegetation, vertical banks with exposed soil, and a wider and shallower river channel. These conditions may increase the destabilizing effects of tropical storms and hurricanes. While log jams may span the width of the river and impede navigation, they also provide habitat for flora and fauna. They provide structural habitat for fish and wildlife,

provide substrate for wood-degrading microorganisms which in turn are prey for a host of species, and cause riffles which aerate the water, thereby increasing oxygen content (Ray, 2011; Albrecht, 2011).

Severe bank erosion and resulting stream sedimentation is a problem at recreational sites on the Perdido River. The District is in the process of stabilizing the river bank and restoring riparian vegetation at a public use site known as "The Pipes" on the District's Perdido River Water Management Area.

The Alabama Comprehensive Wildlife Conservation Strategy (2005) recognized habitat degradation and alteration from river dredging and drainage of bottomland forests and swamps as significant problems affecting species and habitats. The report *Conserving Alabama's Coastal Habitats: Acquisition and Restoration Priorities of Mobile and Baldwin Counties* (2006) identifies threats to the Perdido River and Bay conservation area as altered hydrologic regime, degraded water quality, altered fire regime, incompatible forestry practices and urbanization/development. Restoration opportunities mentioned were prescribed fire, exotic/invasive species control, dirt road mitigation, and restoration of submerged aquatic vegetation (seagrasses).

3.3 Floodplain Protection and Management

Digital flood data indicate that 49,845 acres (22 percent) of Florida's portion of the watershed are delineated as Special Flood Hazard Area (in Figure 11). Lands prone to flooding that have the greatest potential for economic damage are developed areas in the lower watershed around Perdido Bay and the Gulf of Mexico, including Perdido Key and neighborhoods along Bayou Marcus Creek, Eightmile Creek, and Elevenmile Creek. Virtually all of the Perdido River's major tributaries and many feeder streams are vulnerable to flooding. Storm surges from tropical storms and hurricanes could potentially inundate areas on the coast and surrounding Perdido Bay, and the lower portions of Elevenmile, Eightmile, and Bayou Marcus creeks.

To facilitate protection of floodplain, wetland, and coastal resources, improved flood maps and elevation data are being developed by the District under the Risk Mapping, Assessment, and Planning (Risk MAP) program, in cooperation with the Federal Emergency Management Agency (FEMA). Under Risk MAP, the District is developing a watershed level plan in cooperation with Escambia County, Florida, and the State of Alabama to identify flood hazard mapping needs, flood risks, and, to a limited extent, projects to mitigate flood hazards. The plan developed under Risk MAP will be linked to this SWIM plan. The primary products developed through Risk MAP will be more detailed flood maps for priority areas based on an assessment of community mapping needs, although other possible outcomes include future flood hazard mitigation plans as specific flood hazards are identified through mapping. This process and SWIM are mutually supportive, with complementary objectives, such as avoidance of adverse impacts and development of multipurpose stormwater facilities, among others.

Land acquisition programs, as noted above, protect important riverine and coastal floodplain functions, as well as habitat and water quality. Restoration efforts implemented through SWIM and wetland mitigation have helped restore natural hydrology, with benefits for flood protection, habitat, and water quality. The new ERP program also addresses flood protection by protecting natural flows in an integrated manner with water quality. Escambia County has been addressing urban flooding through its stormwater management program (Hatch Mott MacDonald, 2003). Since 1991, 129 local flood problems have been alleviated in the Perdido watershed at a cost of approximately $30 million (Curb, 2011).

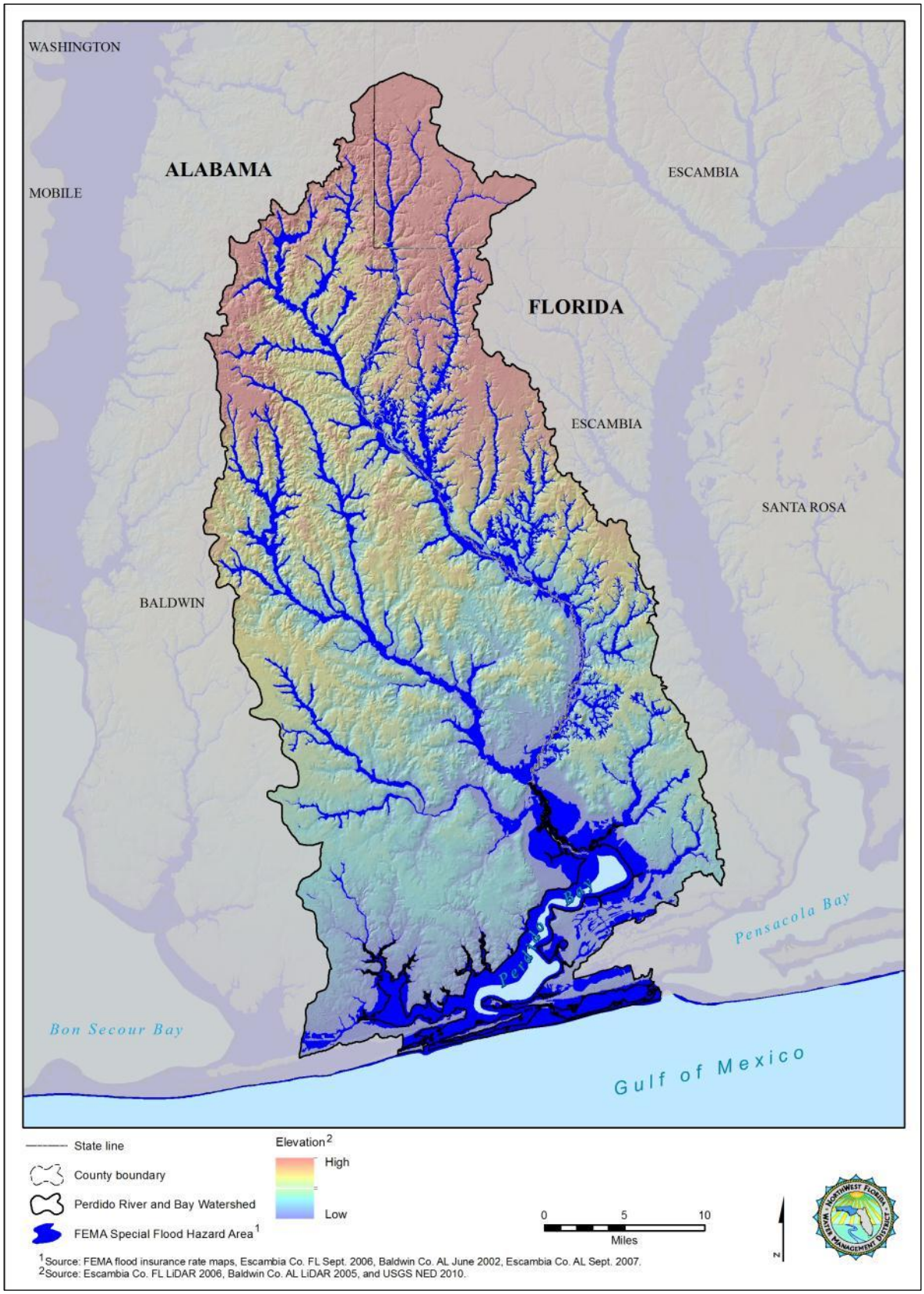


Figure 11. Perdido River and Bay Watershed Flood Prone Areas of Florida

4.0 MANAGEMENT ACTIONS

This section provides a program of management strategies that could be implemented under the auspices of the SWIM program should program or grant funding become available. As described further below, SWIM lacks a dedicated source of funding. Thus, implementation depends on funding being made available from state, federal, or local sources. In practice, this often results in incremental implementation, responding to current priorities as identified through program and project funding. Thus the utility of the current plan is primarily to provide guidance to those District programs which are funded to help integrate them as best as practical to ultimately improve and manage surface water in the basin.

Absent current implementation funding the SWIM plan may still provide a watershed-based planning framework and coordinated support to help direct related District programs in other areas of responsibility, including regional wetland mitigation, flood map modernization and Risk MAP, water quality and hydrologic monitoring, water supply capital improvement projects, land acquisition, stormwater retrofit and Efficient Transportation Decision Making (ETDM program).

4.1 Management Objectives

The preceding chapter describes a series of problems and challenges affecting the health and function of the Perdido River and Bay watershed. Those directly within the purview of the SWIM program include:

- Continuing stormwater runoff and nonpoint source pollution;
- Resulting nutrient enrichment in Perdido Bay;
- Continuing seagrass losses;
- Water quality and habitat impacts from unpaved road sedimentation;
- Degraded tributary stream conditions;
- Remnant oil spill impacts in coastal waters;
- Stream bank erosion; and
- Coastal and riverine flooding.

Considering these challenges, three priority objectives for the Perdido River and Bay watershed SWIM plan are outlined below. These, in turn, correspond with three of the District's statutorily defined areas of responsibility:

- Water quality protection and improvement, focusing on prevention and abatement of NPS pollution;
- Natural systems protection, enhancement, and restoration, including estuarine, stream, wetland, and riparian habitat restoration; and
- Protection and, as necessary, restoration of floodplain functions.

To achieve these three objectives, a series of strategies are described below. Note that all of these strategies are to some extent being carried out through to some degree without SWIM funding. This is due to the interrelated nature of the underlying challenges and the District's AORs as well as activities of Escambia County and state agencies.

4.2 Management Strategies

Retrofit of Stormwater Treatment and Management Systems – This is inclusive of a wide array of urban, agricultural, and silvicultural BMPs; stormwater retrofit facilities, land use planning

techniques for water resource protection; as well as other techniques for water quality protection and improvement. Improved stormwater treatment and management helps implement all three of the objectives outlined above. Potential related SWIM activities include:

- Support and assistance for stormwater master planning;
- Retrofit design and construction assistance; and
- Planning and implementation of stormwater best management practices (BMPs).

Widespread implementation of BMPs, ideally implemented through a treatment train approach, maintains localized hydrology and water quality and cumulatively benefits conditions watershed-wide. Structural and nonstructural approaches to resource protection are incorporated, depending on landscape characteristics, existing land use, and approved future land uses. These retrofit activities have very long lasting positive cumulative impacts on water quality. They complement ERP which improves stormwater management for new development. They will also contribute to overall state Total Maximum Daily Load (TMDL) limits.

The SWIM program encourages and emphasizes retrofit of existing stormwater systems urban watersheds to provide both water quality treatment and flood protection. Retrofit opportunities and priorities may be identified through monitoring, local knowledge of hydrology and land use, and site assessments. Implementation actions, which may include mitigation for new development, which may be accomplished in cooperation with local governments, state programs, as well as federal flood mitigation programs under Risk Map (see discussion below) and other more specific federal grant or loan programs intended to improve water quality. Success is evaluated through actual construction and implementation of facilities.

Protection of Critical Lands and Habitats – Protection of water management lands and critical habitats also help achieve water quality, natural systems, and flood protection objectives. Through SWIM and in cooperation with other agencies and private initiatives, District staff may identify and map priority areas for land acquisition and protection of water habitat. Protection of wetlands, floodplains, riparian zones, buffer areas, and ground water recharge areas would help sustain and enhance the quality and natural function of water resources and their benefits for the community. While implementation funding is limited the SWIM program has helped to:

- Identify priority parcels for protection and restoration of water resources;
- Provide internal and external coordination of acquisition planning and funding; and
- Provide technical or planning level assistance with private or local government initiatives.

Success is evaluated through land area held for conservation or otherwise mapped as riparian land or land within the flood plain receiving some level of regulatory protection.

Ecological Restoration – The key to ecological restoration is to first identify coastal, stream, estuarine, wetland, and riverine floodplain in need of restoration and enhancement. A number of priorities for the District are identified through its in-lieu fee wetland mitigation plan (http://www.nwfwmdwetlands.com) and may further be coordinated through SWIM as additional restoration needs are identified. Potential projects identified through the SWIM program in other basins have included restoration of coastal habitats, restoration of wetlands, removal of degraded sediments, and stabilization of eroded sites and unpaved roads. Restoration may also be an important component of urban retrofit and greenway development in the future.

Monitoring – Monitoring conditions and trends provides an improved understanding of resource characteristics and facilitates plan assessment and adaptive management. Monitoring includes water quality, flow, biology, stream conditions, and land cover. Where ever possible ongoing monitoring programs are integrated with or guided by the SWIM watershed planning process.

Analytical results are applicable to project development and prioritization, assessment and feedback, and plan updates. Planning for hydrologic monitoring is an ongoing effort being addressed through the District's Hydrologic Monitoring Plan (NWFWMD, 2011b). Specific water quality or biological monitoring efforts of the District planned through SWIM would be designed to avoid duplication of effort or use other agency data wherever possible.. SWIM monitoring is generally geared towards synoptic monitoring to characterize the health of natural water resources rather than compliance monitoring related to specific permitted activities. However, data from other monitoring programs are often useful and relied upon for identifying water quality problems within larger systems.

Floodplain Management – Naturally functioning floodplains are important for water quality and integral to the character and quality of stream and estuarine habitats. They affect the timing and velocity of stream flows, regulate discharge from the watershed during major storm systems, protect lives and property, preserve water quality, protect bank stability, and sustain instream and downstream habitats. Floodplains and their functions are protected through a variety of strategies, including land use planning, land acquisition, wetland regulatory programs, and delineation of flood hazard areas for flood insurance purposes. Accurate elevation data and digital floodplain maps are particularly important for both public sector and private sector decision-making. Opportunities may also exist to restore natural floodplain functions, such as through reconnection of floodplain area. In addition to enhancing flood protection, such efforts also improve water and habitat quality. The District implements Floodplain mapping through FEMA's new Risk Map program and its business plan for flood hazard mapping which is more fully described on its flood hazard mapping web portal (http://www.nwfwmdfloodmaps.com). Targeted land acquisition for protection of water resources is also addressed under another program in the District's current Land Acquisition Work Plan (www.nwfwmd.state.fl.us/pubs/consolidatedAR/CAR2011.pdf). Activities that affect floodplain functions are also addressed through Environmental Resource Permitting (http://www.nwfwmd.state.fl.us/permits/permits-ERP.html).

Public Education and Outreach – Public education and outreach are tools for all aspects of watershed resource protection. Information may be provided at a very low cost through a variety of media, including the Internet, brochures, documents, presentations, and participation in public events. Topics that have been included are often related to personal practices for preventing NPS pollution and preservation of critical habitats on private lands. Additionally, public education and awareness efforts concerning watershed management help develop public support for watershed initiatives through enhanced understanding of the issues involved and management approaches.

Intergovernmental Coordination – This includes coordination with state and local governments and federal agencies to enhance watershed protection and restoration. The District has always been available and will continue to provide guidance, coordination and cooperation for all the agencies actively participating to improve the water resources of the Perdido River Basin. This coordination in turn helps guide the SWIM plan activities and projects the District undertakes.

4.3 Implementation Tactics

Implementation of the strategies summarized above can only be accomplished through numerous projects, activities or specific practices. These become the projects and activities that the District or others undertake to meet the SWIM plan goals of surface water improvement and management. Once the District (or others) undertakes one of them they become a part of the tactical approach taken under one of the strategies of this plan. Although not exhaustive, a number of specific practices, projects and activities are listed in Table 6 to illustrate the type of work planned under this SWIM plan as part of an implementation tactic. Cumulatively and over time the activities the District undertakes would be expected to improve and protect the surface waters of the Perdido River and Bay watershed.

Table 6. Examples of tactics to be employed under this SWIM Plan

Management Strategy	**Specific Practices**	
Stormwater Treatment and Management	- Riparian buffers - Wetland treatment systems - Nutrient management - Treatment ponds	- Exfiltration systems - Grassed swales - -
Protection of Critical Lands and Habitats	- Internal and external acquisition coordination - Assistance with private initiatives	- Identification of priority parcels - Grants for acquisition of conservation easements, fee simple, or restrictive covenants
Ecological Restoration	- Natural channel design/stream restoration - Riparian restoration - Natural Systems Revegetation	- Coastal and inland wetland restoration - Hydrologic restoration
Monitoring	- Water chemistry monitoring - Implementation/program monitoring	- Hydrologic monitoring - Biological monitoring
Floodplain Management and Protection	- Digital Flood Insurance map Development - Public outreach of Flood Maps.	- Digital elevation models data dissemination (using LiDAR). -
Public Education and Outreach	- Internet applications - Public meetings and presentations	- Physical and electronic document development and distribution
Intergovernmental Coordination	- Continue cooperative planning and grant funding initiative with state, local, federal, and private entities where possible.	
Resource Characterization and Assessment	- Continue development resource assessment tools for an enhanced understanding of water resources in the basin.	

The actual tactics the District undertakes under this SWIM plan will be further addressed as future opportunities for funding become available. Ongoing programs and activities the District is currently undertaking as a tactic not funded through SWIM but complement the SWIM program have previously been discussed above.

4.4 Funding

The SWIM program lacks a dedicated source of funding and is thus dependent upon funding by the state, federal agencies, and local governments. Direct funding for SWIM plan development and implementation has in the past been provided from:

- Water Management Lands Trust Fund, s. 373.59, F.S.;
- Water Protection and Sustainability Program Trust Fund, 403.890, F.S.;
- Legislative special appropriations, s. 373.459, F.S.

All of the above funding sources depend on specific legislative appropriations. Near term funding from these sources, however, is not anticipated.

Associated program funding, which complements and furthers implementation of this plan, may be provided by:

- Florida Department of Transportation mitigation funding, s. 373.4137 F.S;
- Federal Emergency Management Agency (FEMA) Risk MAP program;
- Florida Forever Trust Fund (construction only), s. 259.105, F.S.;
- Local government and District general fund activities; and
- Other state and federal grant funds, such as the Clean Water Act Section 319(h) grant program.

To address and compensate for impacts of the recent oil spill, funding provided by BP and coordinated by the Gulf Coast Restoration Task Force may also help to address coastal restoration needs.

The District will continue to seek funding through grants and other sources to implement strategies outlined within this plan. When funding is limited, the District will apply this plan and staff resources to leverage its internal programs to help implement SWIM strategies. This internal leverage includes guidance and coordination of funding for wetland mitigation, FEMA Risk MAP, land acquisition, and review of transportation impacts under the ETDM program.

In addition to public funding, plan objectives may be achieved through private landowner and other nongovernmental actions. Public outreach activities are important for facilitating such efforts and will be integral to SWIM plan implementation.

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5.2 Note on Basin Delineation

The drainage basin delineation used for this report is based on the Watershed Boundary Dataset developed by the USDA Natural Resource Conservation Service, the US Geological Survey, and the Environmental Protection Agency for HUC# 03140106 (Perdido) and HUC# 03140107 (Perdido Bay). Modifications were made in the Florida portion based on NWFWMD staff expertise.

APPENDIX A: RELATED AND SUPPORTING INITIATIVES

NWFWMD Programs and Activities

a) **Environmental Resource Permitting (ERP)** — The ERP program is now fully implemented for northwest Florida. The program handles stormwater and wetland permitting for construction and development activities. www.nwfwmd.state.fl.us/permits/permits-ERP.html

b) **Monitoring** — The District collects monthly surface water quality data at three stations in the watershed through FDEP's Integrated Water Resources Monitoring program. Stations are Perdido River at Barrineau Park, Brushy Creek at Nakomis Road, and Elevenmile Creek at US Highway 90. Streams, rivers, and wells within the watershed are included in the listframe of sites for annual random sampling.

c) **LiDAR** — This District is working with the National Oceanic and Atmospheric Administration (NOAA), Florida Division of Emergency Management, and local governments to acquire detailed topographic data using Light Detection and Ranging (LiDAR) technology. Data will be available for the Florida portion of the basin as well as other areas of the District.

d) **Risk MAP** — National flood maps are being updated by the District through the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (MAP) Program. Flood insurance rate maps are being developed using high resolution aerial photography, LiDAR elevation data, and hydrologic studies, and are now available digitally. nwfwmdfloodmaps.com

e) **Land Acquisition and Management** — The NWFWMD has protected about 6,261 acres to date within the Perdido River and Bay watershed through fee simple and less-than-fee acquisition. The Florida Forever Land Acquisition Work Plan prioritizes additional areas for acquisition to protect river floodplain and areas of the bay important for water quality protection or for wetland mitigation. www.nwfwmd.state.fl.us/pubsdata/generalpubs.html

f) **Regional Mitigation Planning** — The District implements the Umbrella Regional Mitigation Plan (URMP) for mitigation of regional transportation impacts to wetlands as required by state and federal law. The SWIM Plan may identify watershed acquisition and restoration priorities that would be eligible for funding through URMP. The Dutex wetland mitigation site is currently the District's major URMP project in the Perdido watershed. www.nwfwmdwetlands.com

g) **Florida Forever Capital Improvement Program** — Funds were awarded to Escambia County to restore a natural, stable channel to Ten Mile Creek, which is expected to reduce flooding, erosion, and turbidity and improve the quality of receiving waters, Eleven Mile Creek and Perdido Bay. In the same drainage basin, Florida Forever funds helped construct the Blue Pit Wetland Stormwater Retention project to enhance water quality, flood protection, biological diversity, and ground water recharge.

h) **Regulation of Consumptive Use of Water and Wells** — The District regulates the consumptive use of water under Rule 40A-2; wells are regulated under Rule 40A-3. www.nwfwmd.state.fl.us/permits/ruleform.htm

i) **Water Supply Assessment** – In 2008 the District updated its water supply assessment addressing the consumptive demands and the availability of ground water and surface

water resources for the water supply planning region in the basin. www.nwfwmd.state.fl.us/rmd/wsa/WSA%20Updates/WSA_Final.pdf

Federal Initiatives

a) **Gulf of Mexico Restoration** — Several initiatives are underway in response to the BP oil spill. Under the Gulf of Mexico Research Initiative, BP will provide $500 million over ten years for research in the Gulf of Mexico for rapid-response studies as well as longer term monitoring of the ecosystem to understand impacts of petroleum and dispersants (GMRI, 2011). Potentially affected resources are sensitive habitats, fisheries, wildlife, and previous restoration projects (NOAA, 2011). U.S. government agencies, with National Oceanic and Atmospheric Administration (NOAA) as lead, are conducting a Natural Resources Damage Assessment to identify injuries to resources and develop a restoration plan (NOAA, 2011). Up to $1 billion in early restoration projects will begin in 2011 to bridge the gap until the damage assessment studies are complete (BP, 2011). A restoration strategy will be developed by the Gulf Coast Ecosystem Restoration Task Force (EPA, 2011a).

State and Regional Initiatives

a) **Total Maximum Daily Load (TMDL) Program** — The federal Clean Water Act, Section 303(d), is implemented in Florida under FDEP's TMDL program to check that surface waters meet water quality standards. The process includes assessing water quality, listing impaired waters, adopting TMDLs, determining pollutant sources, and implementing strategies to reduce pollution. TMDLs are the thresholds of pollutants that a water body can assimilate and still maintain water quality standards. In Alabama, the Department of Environmental Management administers the water quality monitoring program. www.dep.state.fl.us/water/tmdl/index.htm

b) **The Florida Aquifer Vulnerability Assessment** is a GIS-based model developed by the Florida Geological Survey to show the relative probability that an aquifer could become contaminated from activities on the land surface. The maps are useful in guiding land use decisions and in identifying ground water recharge areas in need of protection.
www.dep.state.fl.us/geology/programs/hydrogeology/fava.htm

c) **State Lands** — FDEP's Florida Forever Five Year Plan has identified two projects in the Perdido watershed for permanent conservation. The Perdido Pitcher Plant Prairie project is ranked under Critical Natural Lands due to the rarity of the biologically diverse wet prairies, and to protect one of the largest stands of white-topped pitcher plants in Florida. The Lower Perdido River Buffer would be a less-than-fee project to prevent development on the river, and could provide public access for small boats through fee-simple access points.
www.dep.state.fl.us/mainpage/programs/florida_forever.htm

d) **Coastal Dune Ecosystem Restoration** — FDEP's Northwest District has a dune restoration program that has been working to improve habitat of coastal dune systems that have been damaged by storms and public use. The program works with Gulf Islands National Seashore and Perdido Key State Park to propagate plants from those sites for use in restoration, including several federally listed plants. Oyster reefs are also used for shoreline erosion control. FDEP partners with schools on environmental education, plant propagation in greenhouses, and out planting. Projects are funded

through various public and foundation grants and are assisted by local businesses and volunteers.
www.dep.state.fl.us/northwest/ecosys/section/restorationdune.htm

e) **Seagrass Restoration** — The Northwest District of FDEP also has a program to restore seagrasses in the panhandle. The program has a tissue culture laboratory for micropropagating local sources of widgeon grass (*Ruppia maritima)*, and salvages seagrasses that would be lost to marine construction projects for transplanting to restoration sites. Aquaculture of salvaged seagrasses in a nursery is also underway. Perdido Bay serves as a donor site for shoal grass (*Halodule wrightii*). Big Lagoon is a donor site for shoal grass and turtle grass (*Thalassia testudinum*) and is a receiver site for both species. The program developed a Seagrass Management Plan for Big Lagoon and Santa Rosa Sound with eight monitoring sites in Big Lagoon. http://www.dep.state.fl.us/northwest/ecosys/section/restorationseagrass.htm

f) **Perdido Bay Cooperative Management Project** — This was an EPA-sponsored project that began in 1988. Pursuant to the project, the Florida-Alabama Water Resources Coordinating Council (FAWRCC) was established and prepared the 1995 report, "Perdido Basin Management Strategies" (FAWRCC, 1995). Then in 1998 FDEP's Ecosystem Management Program developed "Perdido Ecosystem Management Strategies" with assistance of the Perdido Ecosystem Restoration Group, a new incarnation of the FAWRCC (FDEP, 2006; Friends, 2008). Shortly thereafter and following personnel changes in state governments, both parties abandoned the FAWRCC (Lane, 2011). Many of the basin management strategies of the 1995 and 1998 reports have been implemented to varying degrees, namely stormwater management, reduction of direct wastewater discharge into surface waters, paving unpaved roads, land use planning, preservation land purchases, SWIM priority listing, and GIS development.

g) **Coastal Alabama Clean Water Partnership** — The ACWP is a non-profit organization bringing together public and private interest groups to protect Alabama's water resources and aquatic ecosystems and to educate the public. The Coastal Alabama-Escatawpa River Basin is one of 10 basins covered by the ACWP and includes the Perdido River and Bay watershed.
www.cleanwaterpartnership.org/alabama-river-basins/coastal-alabama/

h) **Gulf Coastal Plain Ecosystem Partnership** — This is a consortium of public and private land owners in Florida and Alabama managing conservation lands in the region. The purpose is to collaborate on ecosystem preservation and management, leveraging resources and sharing information for mutual benefit (FDEP, 2006). The Aquatics Subcommittee addresses needs of freshwaters and estuaries.

i) **Center for Environmental Diagnostics and Bioremediation** — Housed at University of West Florida, CEDB serves to integrate several academic disciplines/departments and community organizations in northwest Florida. The program provides research and education for the assessment and improvement of environmental health. A new program addressing water quality and watershed management issues encompassing watersheds from the Perdido Bay to St. Andrew's Bay is currently in the planning stages. www.uwf.edu/cedb

j) **Sustainable Emerald Coast** – This was a time-limited committee enacted by Governor Bush to develop a regional planning framework to manage anticipated growth for the four westernmost Florida panhandle counties. A final report was submitted to Governor Crist at the end of 2007. consensus.fsu.edu/emeraldcoast

Selected Local Initiatives

Escambia County, Florida

a) **Escambia County Optional Sector Plan (OSP)** — The OSP has been developed to provide a more orderly land development pattern for a 15,000 acre portion of central Escambia County bounded on the west by the Perdido River and wholly within the Perdido River watershed. The stream Jacks Branch bisects the northern part of the OSP area. The plan is organized into four broad policy areas pertaining largely to more environmentally sound practices for economic development, transportation, environmental strategies, and community design. An initial agreement on the part of the Board of County Commissioners to develop the OSP was followed by the formulation of broad, long-term goals, objectives and policies for the overall plan. The final phase will be the development of one or more Detailed Specific Area Plans, which will be of much finer detail than the overall plan.
www.co.escambia.fl.us/Bureaus/DevelopmentServices/OptionalSectorPlan.html

b) **Community & Environment Department — The Natural Resources Conservation** division has programs to survey wetlands prior to development, manage a county preserve with prescribed fire, provide emergency watershed protection from natural hazards, and identify soil types. The Water Quality and Land Management division administers an NPDES stormwater permit for the county and co-permittees City of Pensacola, Town of Century, and FDOT. It also administers the TMDL program for the county. www.co.escambia.fl.us/Bureaus/CommunityServices/index.html

c) **Public Works Department** — The Engineering division administers a stormwater management permit program and is developing studies for 41 drainage basins in the county to reduce flooding and improve water quality. The division oversees capital improvement projects for stormwater management and dirt road paving. A local option sales tax helps fund these projects.
www.co.escambia.fl.us/Bureaus/PublicWorks/Engineering.html

City of Pensacola

a) **Public Works Department** — Addresses stormwater relating to both flooding and water quality. Manages 2,100 stormwater inlets and 45 stormwater ponds. Implements stormwater capital improvement projects.
www.cityofpensacola.com/pages/?pageID=1370

Baldwin County, Alabama

a) **Wolf Bay Watershed Watch** — This local community group supported by Auburn University does water monitoring, coastal cleanups, and participated in developing the following report (FDEP, 2006). www.wolfbaywatch.org

b) **Wolf Bay Watershed Project** — This initiative brought forth various agencies to develop a plan to improve and protect Wolf Bay. “Wolf Bay Plan: A Stakeholders Guide to Protecting the Watershed” was funded by an ADEM Clean Water Act, Section 319 grant (FDEP, 2006).