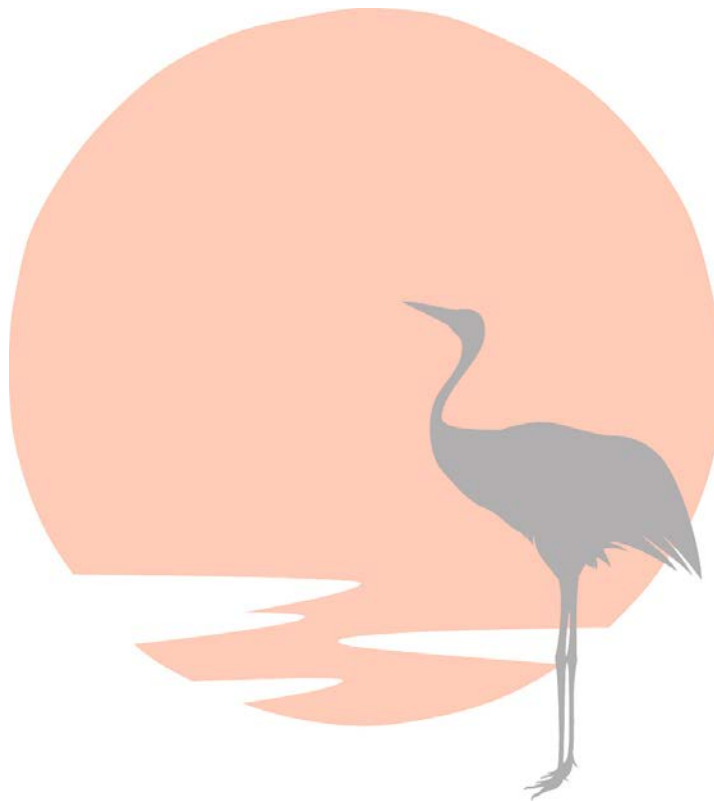


Appendix A

Project Background and Physical Setting



December 2012



TABLE OF CONTENTS

1.0	BACKGROUND	1-1
2.0	PURPOSE AND OBJECTIVE	2-1
3.0	WATERSHED	3-1
3.1	POLITICAL JURISDICTIONS.....	3-1
3.2	WATERSHED HISTORY	3-4
3.3	BOUNDARIES.....	3-8
3.3.1	Whitaker Bayou Basin	3-10
3.3.2	Hudson Bayou Basin.....	3-13
3.3.3	Sarasota Bay Coastal Basin	3-16
3.4	LAND USE.....	3-20
3.5	TOPOGRAPHY	3-23
3.6	SURFACE HYDROLOGY	3-23
3.7	PHYSIOGRAPHIC REGION	3-24
3.8	GEOLOGY AND HYDROGEOLOGY	3-24
3.9	SOILS AND SEDIMENT.....	3-27
4.0	ESTUARY	4-1
4.1	PHYSICAL AND POLITICAL BOUNDARIES.....	4-1
4.2	BATHYMETRY	4-3
4.3	CIRCULATION AND COASTAL PASSES	4-3
4.4	SEDIMENT CHARACTERISTICS	4-6
5.0	PUBLIC LANDS	5-1
6.0	THREATENED AND ENDANGERED SPECIES.....	6-1
7.0	RECREATIONAL FACILITIES.....	7-1
8.0	PUBLIC EDUCATION	8-1
9.0	CONCLUSION.....	9-1



LIST OF TABLES

Table 3-1	Political Jurisdictions	3-3
Table 3-2	Sarasota Bay Current Land Use Classification (FDOT 1999).....	3-20
Table 3-3	Sarasota Bay Watershed Current Land Use (SWFWMD 2008).....	3-22
Table 3-4	Sarasota Bay Watershed Current Soils (NRCS)	3-30
Table 5-1	Sarasota Bay Watershed Public Lands	5-3
Table 7-1	Sarasota Bay Watershed Area Recreational Facilities.....	7-3
Table 8-1	Public Outreach Programs	8-2

LIST OF FIGURES

Figure 1-1	Sarasota County Major Watersheds.....	1-2
Figure 1-2	Sarasota Bay Watershed Segments	1-3
Figure 1-3	Sarasota Bay Water Quality Management Plan Study Area.....	1-4
Figure 3-1	View of Sarasota Bay from Bayfront Park	3-1
Figure 3-2	Political Boundaries in the Sarasota Bay Watershed.....	3-2
Figure 3-3	Sarasota County Citizens Install a Monofilament and Recovery Recycling Bin	3-3
Figure 3-4	Ancient Shell Mound 1 Mile North of Sarasota circa 1907 to 1908 (USGS).....	3-4
Figure 3-5	Routes of European Explorers	3-4
Figure 3-6	Manatee County circa 1865	3-5
Figure 3-7	Whitaker Bayou circa 1910 (Credit: Sarasota Historical Society) vs Whitaker Bayou circa 2004 (Credit: R T Clapp, Sarasota County Water Atlas)	3-6
Figure 3-8	Sarasota Bayfront, looking southwest circa 1935 (Credit: George I. Pete Esthus) vs circa 2000 (Sarasota County Water Atlas)	3-6
Figure 3-9	Sarasota Bay Watershed Age of Development.....	3-7
Figure 3-10	Sarasota Bay Watershed Basins.....	3-9
Figure 3-11	Whitaker Bayou Area Survey Circa 1847	3-11
Figure 3-12	Whitaker Bayou Area 1959 USDA NRCS Soil Survey Map.....	3-11
Figure 3-13	Whitaker Bayou Area Topography Circa 1944	3-12
Figure 3-14	1944 Corps of Engineers, U.S. Army Map Service Topography Map Legend.	3-12
Figure 3-15	Whitaker Bayou Area Circa 2010.....	3-13
Figure 3-16	Hudson Bayou Area Survey Circa 1847.....	3-14
Figure 3-17	Hudson Bayou Area 1959 USDA NRCS Soil Survey Map	3-14
Figure 3-18	Hudson Bayou Area Topography Circa 1944.....	3-15
Figure 3-19	Hudson Bayou Area Circa 2010	3-16
Figure 3-20	Sarasota Bay Coastal Basin Area Survey Circa 1847.....	3-17
Figure 3-21	Sarasota Bay Coastal Basin Area Survey Circa 1944.....	3-17
Figure 3-22	Sarasota Bay Coastal Basin Area 1847 Survey Over 1948 Aerial	3-18
Figure 3-23	Sarasota Bay Coastal Basin Area 1847 Survey Over 2009 Aerial	3-19
Figure 3-24	Sarasota Bay Watershed Land Use Circa 2008	3-21



Figure 3-25	Sarasota Bay Watershed Topography	3-23
Figure 3-26	Aquifers at Land Surface	3-25
Figure 3-27	Hydrogeologic Framework and Geochemistry of the Intermediate Aquifer System in Parts of Charlotte, De Soto, and Sarasota Counties, Florida	3-26
Figure 3-28	Sarasota Bay Watershed Soil Hydrologic Groups	3-29
Figure 4-1	Sarasota Bay Estuary Location and Boundaries	4-2
Figure 4-2	Bathymetry of Sarasota Bay and Roberts Bay North (NGDC, 2010)	4-4
Figure 5-1	Sarasota Bay Watershed Public Lands	5-2
Figure 5-2	South Lido Park	5-4
Figure 5-3	Kayak and Canoe trails in the Mangrove Tunnels near South Lido Beach and Otter Key.....	5-4
Figure 5-4	North Lido Beach Park	5-5
Figure 5-5	Quick Point Nature Preserve Natural Mangrove Lagoon	5-5
Figure 5-6	Quick Point Nature Preserve Habitats	5-6
Figure 5-7	Entrance to Quick Point Nature Preserve	5-6
Figure 6-1	Florida Scrub Jay	6-1
Figure 6-2	Bald Eagle.....	6-1
Figure 6-3	Gopher Tortoise	6-1
Figure 6-4	Loggerhead Turtle.....	6-2
Figure 6-5	West Indian Manatee	6-2
Figure 7-1	Sarasota Bay Watershed Recreational Facilities.....	7-2
Figure 8-1	Florida House.....	8-5



1.0 BACKGROUND

Sarasota County has six major watersheds located wholly or partially within its limits: Sarasota Bay, Roberts Bay North, Little Sarasota Bay, Dona and Roberts Bay, Lemon Bay, and Myakka River ([Figure 1-1](#)). To manage these watersheds, Sarasota County has implemented the Comprehensive Watershed Management Program to address water quality, water quantity, flooding, and natural resources in a comprehensive manner within each of these watersheds. This program is consistent with the Sarasota County Comprehensive Plan ([Chapter 4, Goal, Objective 2.2, Policy 2.2.1](#)) and employs an approach consistent with the Southwest Florida Water Management District's (SWFWMD) areas of responsibilities related to water resource management: Water Quality, Water Supply, and Flood Protection, and Natural Systems. One component of this Comprehensive Watershed Management Program is to develop a Water Quality Management Plan (WQMP) for each of these six watersheds. The Lemon Bay Watershed Management Plan and the Roberts Bay North Watershed Management Plan were completed in early 2011.

The coast of Sarasota Bay spreads across two counties, Manatee and Sarasota. The bay is home to a wide variety of marine life, including dolphins, manatees, loggerhead turtles, black mullet, red drum, spotted seatrout, snook, blue crab, stone crab, oysters, and bait shrimp. Sarasota Bay is bound to the west by stretches of barrier islands, principally Longboat Key, and to the east by the mainland of Manatee and Sarasota Counties. The bay is a subtropical estuary with tidal tributaries and small creeks, coves, inlets, and passes. Sarasota Bay is currently classified as an Estuary of National Significance, Outstanding Florida Water (OFW), and SWFWMD Surface Water Improvement and Management (SWIM) Priority waterbody and is designated as a Florida priority estuarine conservation area by the Fish and Wildlife Conservation Commission (FWC).

Sarasota Bay is divided into four unique segments for planning purposes: Palma Sola Bay, Sarasota Bay, Roberts Bay North, and Little Sarasota Bay ([Figure 1-2](#)). The southern portion of Sarasota Bay, Roberts Bay North, and Little Sarasota Bay are in Sarasota County.

The County and SWFWMD are partnering on cooperative funding projects to develop a management plan for the Sarasota Bay, Roberts Bay North, and Little Sarasota Bay segments. While cooperative-funding is provided by SWFWMD's Manasota Basin Board, the inclusion of proposed projects, corrective actions, and best management practices (BMPs), in this plan does not confer any special status, approval, permitting, standing, or funding from SWFWMD. All proposed projects are subject to regulatory review and permitting. Requests for funding assistance will have to meet the requirements of funding programs and be subject to the SWFWMD's Governing and Basin Boards appropriating funds. This WQMP is for the segment of Sarasota Bay that is within Sarasota County and the watershed area that drains to the Sarasota County portion of Sarasota Bay ([Figure 1-3](#)).

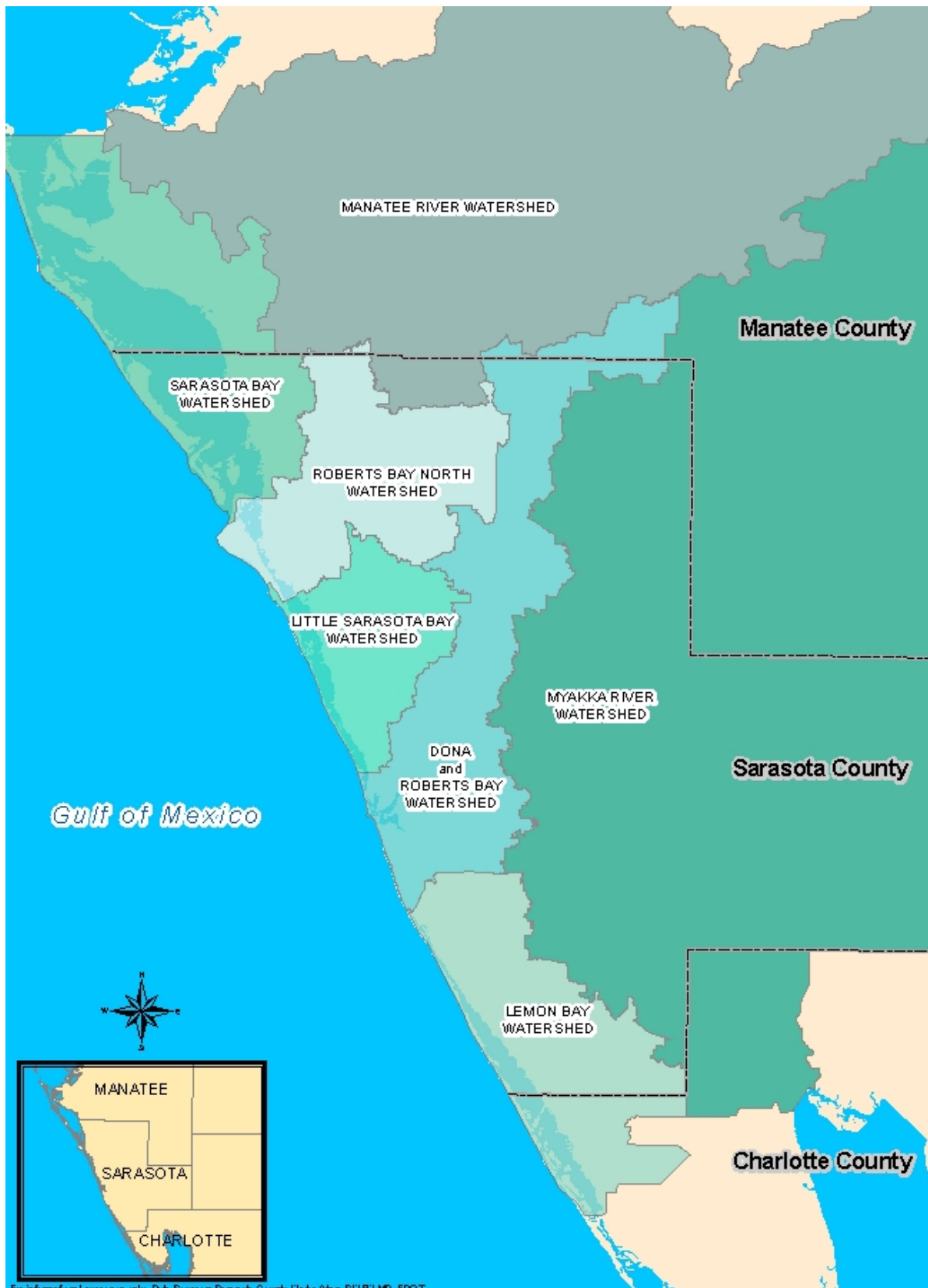


Figure 1-1 Sarasota County Major Watersheds

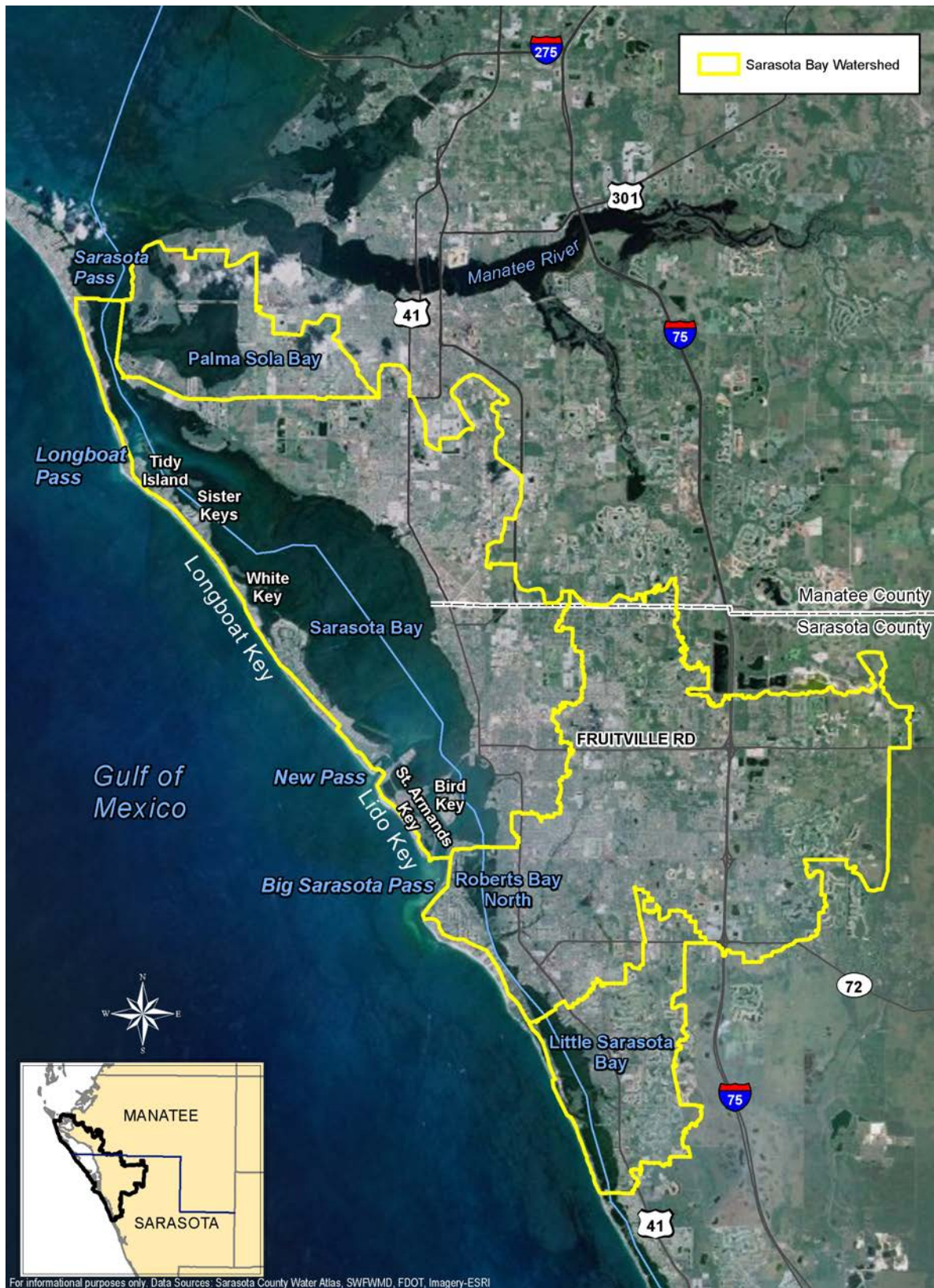


Figure 1-2 Sarasota Bay Watershed Segments

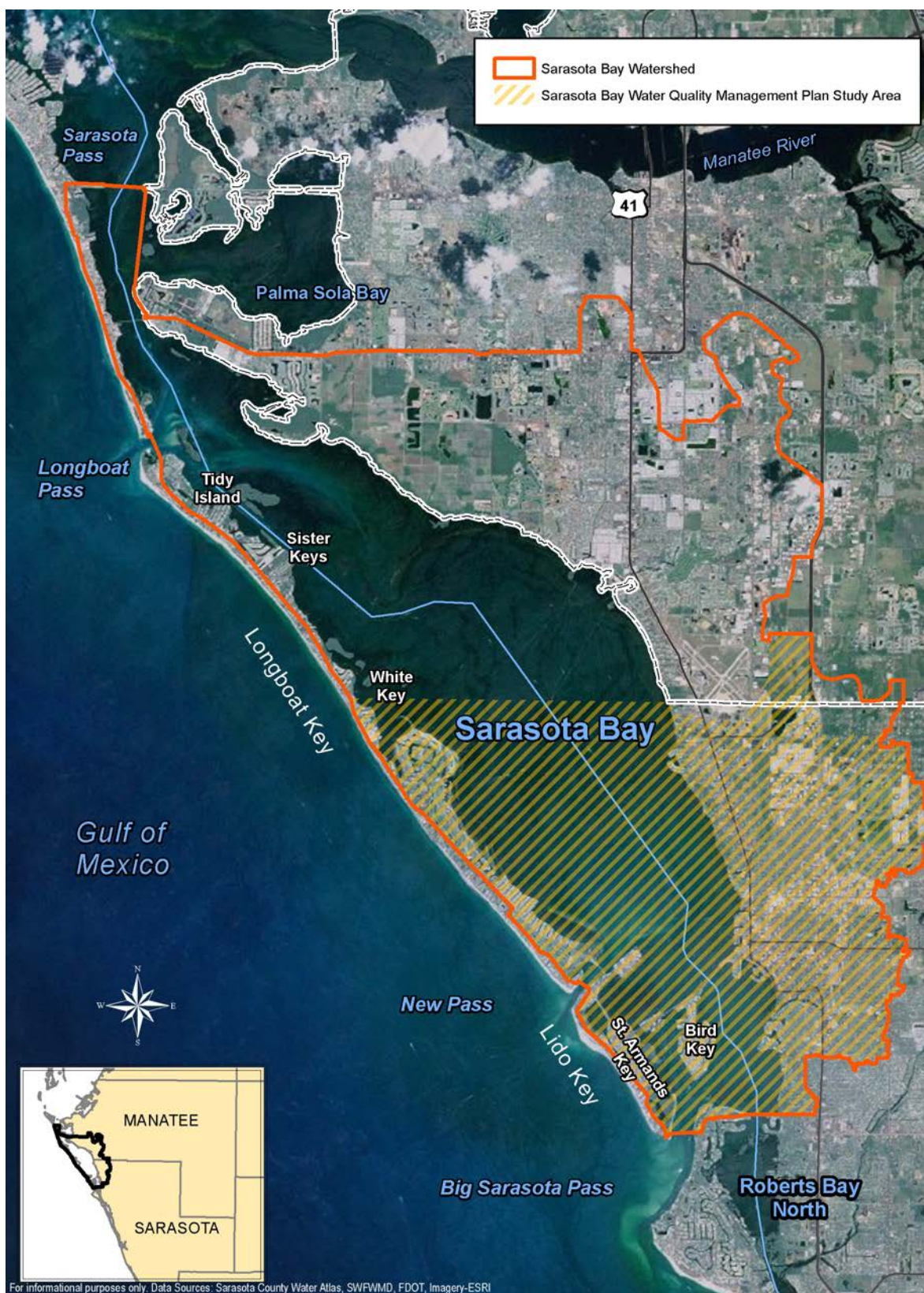


Figure 1-3 Sarasota Bay Water Quality Management Plan Study Area



2.0 PURPOSE AND OBJECTIVE

The Sarasota Bay WQMP is a regional initiative that promotes and furthers implementation of the *Sarasota County Comprehensive Plan*, the Sarasota Bay Estuary Program's (SBEP) *Comprehensive Conservation and Management Plan (CCMP)*, and the SWFWMD's *Southern Coastal Comprehensive Watershed Management Plan*, and the SWFWMD's *Sarasota Bay Surface Water and Improvement (SWIM) Plan*.

The purpose of this initiative is to develop and implement a watershed management plan for Sarasota Bay and its watershed to help achieve the following objectives:

- ❖ Improve water quality.
- ❖ Restore to the greatest extent possible the historic natural hydrologic regime.
- ❖ Protect property owners from flood damage.
- ❖ Develop ecosystem goals and targets based on the needs of environmental and biological indicators.
- ❖ Investigate potential sustainable surface water supply options consistent with and in support of the Goals, Objectives, and Policies of the Sarasota County Comprehensive Plan, SWFWMD's Regional Water Supply Plan, and the Southern Water Use Caution Area (SWUCA) Plan.

Sarasota County has embarked on a proactive approach to develop the proper science and community-based vision as a foundation for formulating, evaluating, prioritizing, and implementing watershed management actions. The following sections summarize physical and societal characteristics of the Sarasota Bay Watershed.



3.0 WATERSHED

Located on the west-central coast of Florida, the Sarasota Bay Watershed is famous for its sandy beaches, keys, and sparkling blue water ([Figure 3-1](#)). The watershed spans from Anna Maria Sound in Manatee County, south to Roberts Bay North in Sarasota County, and includes the City of Sarasota to the east ([Figure 3-2](#)). The bay is bounded to the west by the barrier islands of Longboat Key and Lido Key, which are separated by New Pass. New Pass and Big Sarasota Pass, south of Lido Key, unite the bay with the Gulf of Mexico. Sarasota Bay is a highly productive coastal lagoon that hosts over a thousand different native species, including manatee, mullet, dolphin, spotted sea trout, snook, red drum, stone crab, blue crab, great blue heron, snowy egret, brown pelican, osprey, wood stork, roseate spoonbill, white ibis, and blue heron (SBEP, 2006; SWFWMD Watershed Excursion, n.d.).



Figure 3-1 View of Sarasota Bay from Bayfront Park
(source: Jones Edmunds, 2010)

3.1 POLITICAL JURISDICTIONS

The Sarasota Bay Watershed is regulated by the Florida Department of Environmental Protection (FDEP), SWFWMD, two counties (Sarasota and Manatee), the City of Sarasota, and the Town of Longboat Key. Approximately 55% of the watershed drainage area is in Manatee County and 45% is in Sarasota County. The bay itself is also divided about equally between the counties. [Figure 3-2](#) shows the political boundaries, and [Table 3-1](#) gives the acreage breakdown for each jurisdiction in the study area. Typically, the regulatory agencies with jurisdiction in the watershed coordinate their efforts to comprehensively manage the system.

As of 2000, the total watershed population was almost 110,000. About 40% of this population resided in the Sarasota County portion of the watershed (U.S. Census Bureau, 2000).

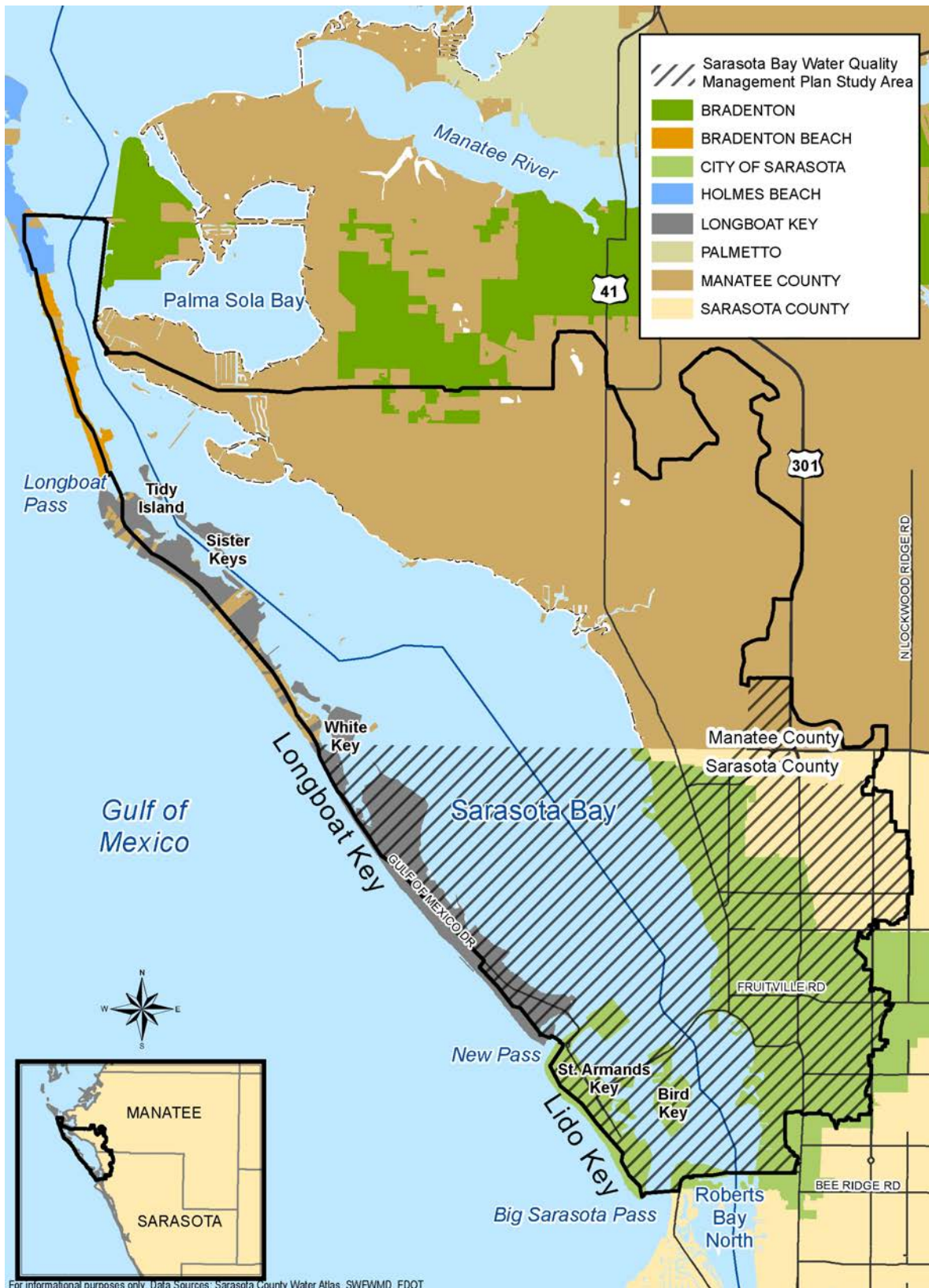


Figure 3-2 Political Boundaries in the Sarasota Bay Watershed



Table 3-1 Political Jurisdictions

	Sarasota Bay Watershed Study Area (21,413 acres)		Sarasota Bay Watershed Total Area (49,913 acres)	
	Acres	Percent	Acres	Percent
Bradenton	0	0%	192	0%
Bradenton Beach	0	0%	180	0%
City of Sarasota	6,634	31%	6,634	13%
Holmes Beach	0	0%	140	0%
Longboat Key	1,102	5%	1,926	4%
Manatee County	440	2%	28,504	57%
Sarasota County	20,974	98%	21,409	43%

Each regulatory agency is responsible for the health of the bay and can regulate specific activities throughout the watershed. In general, State regulations should be followed unless one of the counties has adopted a more stringent rule. The same policy applies to cities within a county boundary; the more stringent regulations always take precedence.

Although each agency is responsible for the health of the bay, each agency's level of responsibility varies by the level of the agency's governing body. At the county level, Sarasota County has taken responsibilities that include:

- ❖ Teaching its citizens what they can do to improve the health of the watershed ([Figure 3-3](#)).
- ❖ Funding and implementing projects to improve water quality, water supply, natural systems, and flood protection.
- ❖ Researching new methods and practices for watershed management.
- ❖ Enforcing existing ordinances and passing additional ordinances to lessen the impacts caused by new developments.



Figure 3-3 Sarasota County Citizens Install a Monofilament and Recovery Recycling Bin

This WQMP discusses the goals and objectives for Sarasota County and the measures the County is taking to meet these goals. This plan does not encompass the portion of the Sarasota Bay Watershed in Manatee County; however, Manatee County is also taking measures to meet similar goals for Sarasota Bay.



3.2 WATERSHED HISTORY



Figure 3-4 Ancient Shell Mound 1 Mile North of Sarasota circa 1907 to 1908 (USGS)

Archaeological evidence suggests more than 10,000 years of occupation in the watershed by native peoples. Large mounds of fish bones and shells indicate that the fish in Sarasota Bay sustained these prehistoric human settlements (Figure 3-4). The first records of the Sarasota Bay Watershed date back to the European explorers in the early 1500s (Figure 3-5). Eventually, fishing camps called *ranchos* were established along the bay by American and Cuban fish and marine traders. These initial settlers were likely attracted to the area by the climate and the bounty of

Sarasota Bay. Although the natural resources of the Sarasota Bay Watershed continued to attract some inhabitants to the coast, the Armed Occupation Act brought a multitude of European settlers to Florida in the late 1840s.

By 1845 Florida had become a state and the U.S. Army had established Fort Armistead on the Sarasota Bay coast at what is known today as Indian Beach. In 1855, the settlers won their war with the Seminole Indian Tribe, and the small rural town of Sarasota, with its nearby ranches, farms, and fishing industry, continued to grow. By the late 1800s, hotel resorts were built and Sarasota Bay was advertised as a place for recreation in the northern states as well as in Scotland. By the beginning of the 20th century, paved streets, sidewalks, an electric plant, water and sewer services, and the Florida West Shore

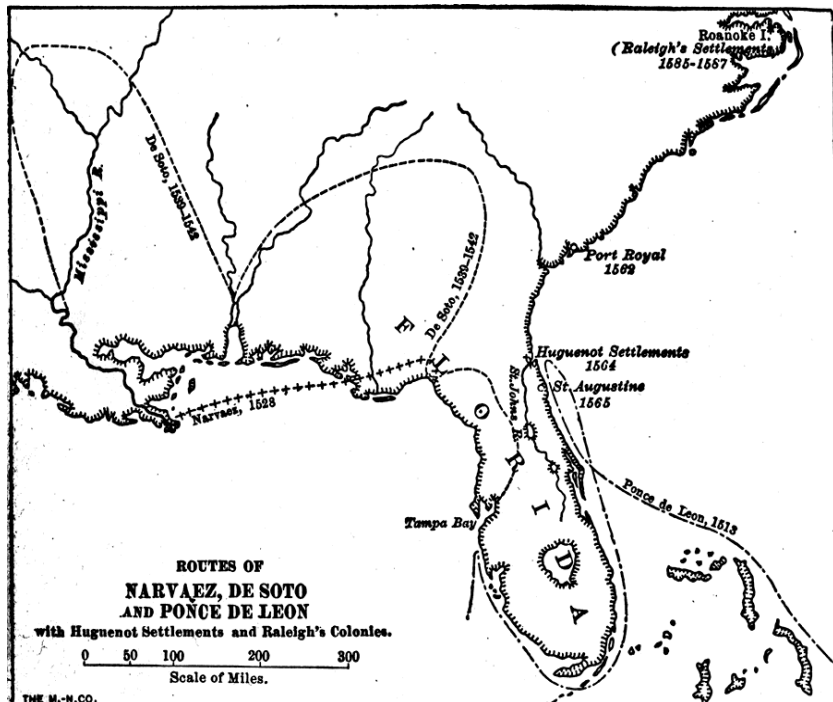


Figure 3-5 Routes of European Explorers
(Map Credit: Courtesy the private collection of Roy Winkelman)



Railway attracted even more settlers. The Town of Sarasota was incorporated in 1902 with John Hamilton Gillespie, a Scottish immigrant who built the first golf course, as mayor. By the early 1920s, John Ringling had purchased Bird Key, St. Armands Key, and a collection of small islands, which he filled with bay bottom dredging to create Lido Key ([Section 3.3.3](#)). He also had a bridge connecting the islands to the mainland constructed.

Originally part of Manatee County, Sarasota Bay and its watershed were divided at the current county line into Manatee County and Sarasota County in 1921 ([Figure 3-6](#)). The area experienced a period of rapid growth, namely along the coast and tributaries, in the early 1920s, tripling the population. As development continued, natural mangrove shoreline was replaced by concrete sea walls, destroying nursery areas essential to many marine species in Sarasota Bay. Ditching within tidal areas, a common mosquito control technique at the time, were constructed. Inland in the watershed, the natural tidal creeks of Hudson and Whitaker Bayous were dredged and extended and wetlands were filled to accommodate agriculture, businesses, and residences.

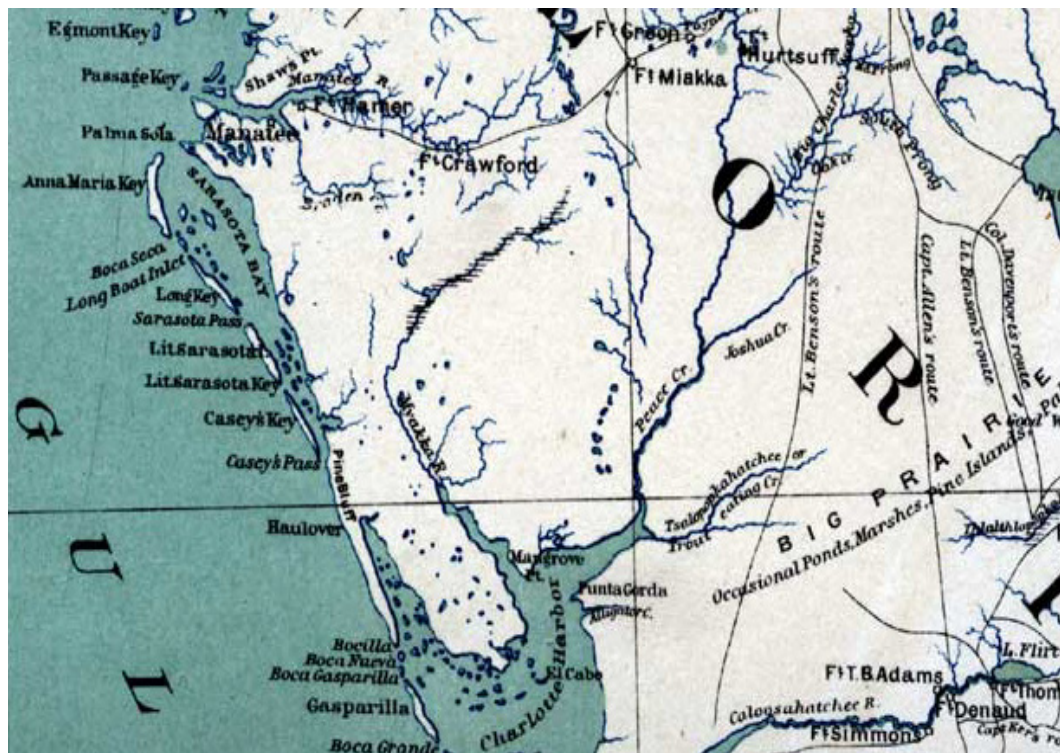


Figure 3-6 Manatee County circa 1865

(source: Julius Bien and Co., General Topographical Map Sheet XI, Atlas to Accompany the Official Records of the Union and Confederate Armies (New York, NY: US Government Printing Office, 1865)) (Florida Center for Instructional Technology, Retrieved 12/01/2010)



As development in the watershed continued, more mangroves, wetlands, and flatwoods that once provided habitat, flood control, and improved water quality were altered and degraded ([Figure 3-7](#)). By the mid-1950s, most of the coastal mainland was developed and growth persisted inland and across the barrier islands. Today, the watershed is almost entirely developed ([Figure 3-8](#) and [Figure 3-9](#)).



Figure 3-7 Whitaker Bayou circa 1910 (Credit: Sarasota Historical Society) vs Whitaker Bayou circa 2004 (Credit: R T Clapp, Sarasota County Water Atlas)



Figure 3-8 Sarasota Bayfront, looking southwest circa 1935 (Credit: George I. Pete Esthus) vs circa 2000 (Sarasota County Water Atlas)

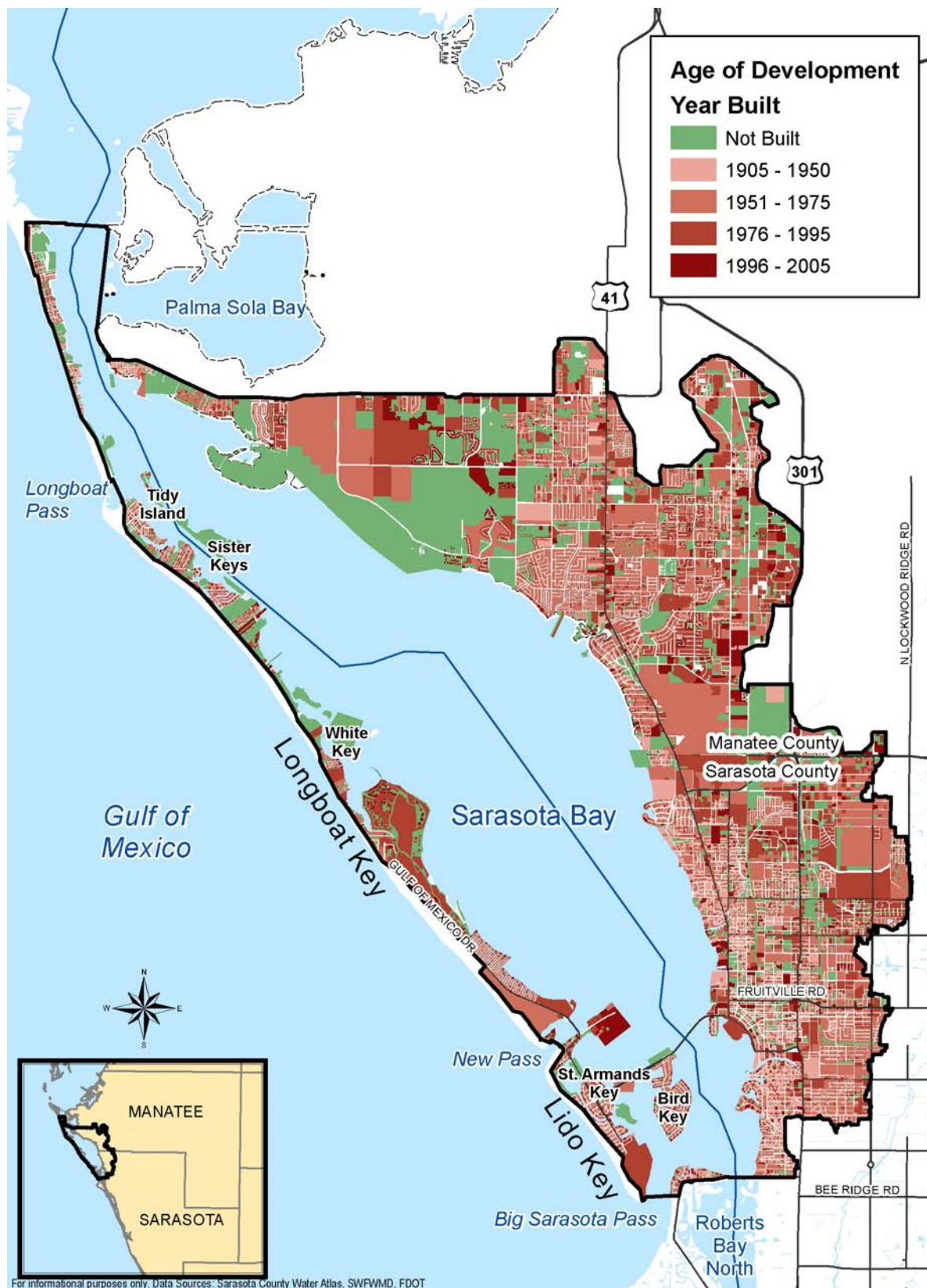


Figure 3-9 Sarasota Bay Watershed Age of Development



Early efforts at watershed management focused solely on flood control wherein the common practices of ditching, channelizing streams, and the use of structural measures hasten drainage. In addition, most of the development in the Watershed occurred before stormwater regulations were implemented in 1982, so stormwater from most of the Watershed's developments flows into the bay without treatment.

In 1989, Sarasota Bay was designated an "estuary of national significance" by the U.S. Congress as part of the Water Quality Act of 1987 and the SBEP was initiated. The SBEP was initially tasked with characterizing the environmental conditions of Sarasota Bay and formulating a comprehensive restoration and protection plan based upon this analysis. The CCMP was formally approved by the Governor of Florida and Administrator of the U.S. Environmental Protection Agency (USEPA) in 1995. The CCMP recommends that specific actions be taken by local governments and State and Federal agencies to improve and protect the bay.

One of the main challenges of protecting the water quality in the Watershed is to decrease the amount of stormwater runoff to limit the amount of freshwater, sediments, and nutrients entering the streams and bay.

Since the late 1980s, wastewater pollution in the watershed has decreased as a direct result of the development of reclaimed water in combination with removing decrepit sewage treatment facilities and replacing leaking septic tanks. As a result, water quality, seagrass beds, and habitat for birds and fish have improved in Sarasota Bay; improvements include decreases in nitrogen levels, fewer impaired areas, and thousands of acres of new or improved seagrass beds. Although the entire bay currently meets State water quality standards, the Watershed still has numerous listed impairments. Appendix C (Water Quality) of this WQMP details the water quality conditions throughout watershed.

The challenge now is maintaining that progress, especially as development and redevelopment throughout the watershed continues. This plan will explore opportunities to implement stormwater treatment in already-developed areas throughout the watershed. Advances in stormwater system technology and building techniques, combined with today's more stringent building codes, can better help balance the needs of the environment with those of the community.

3.3 BOUNDARIES

For the purpose of this plan, the Sarasota Bay Watershed has been divided into four basins: the Whitaker Bayou basin, the Hudson Bayou basin, the Sarasota Bay Coastal basin, and the Sarasota Bay—Manatee County basin ([Figure 3-10](#)). The entire watershed covers an area of 49,913 acres in the southwest portion of Manatee County and the northwest portion of Sarasota County including most of the City of Sarasota. The Sarasota Bay Watershed is generally bounded by Roberts Bay North to the south, Anna Maria Sound to the north, Longboat Key to the west, and Beverly Terrace in Sarasota County and U.S. 301 in Manatee County to the east.

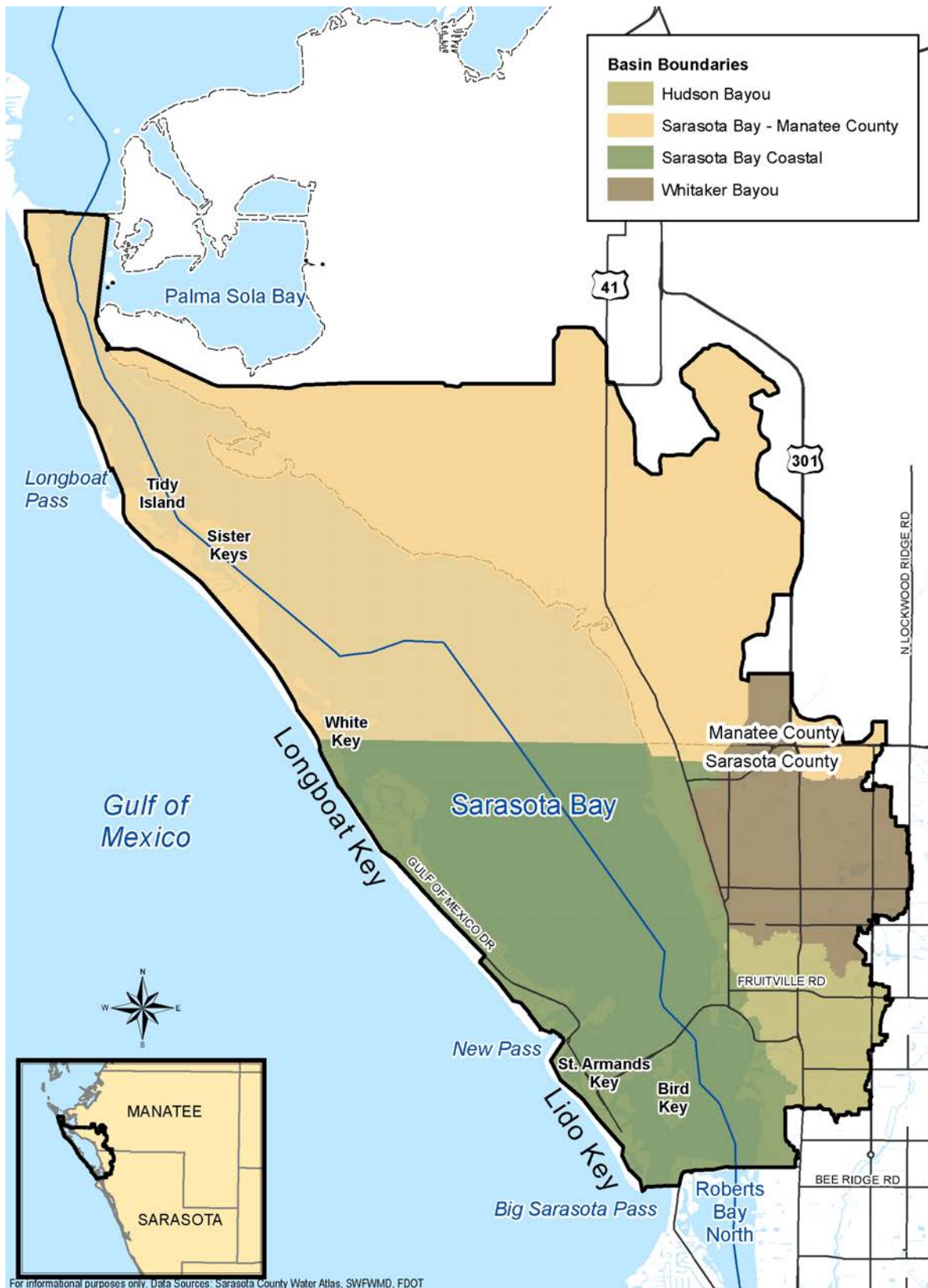


Figure 3-10 Sarasota Bay Watershed Basins



The focus of this WQMP is the Whitaker Bayou, Hudson Bayou, and Sarasota Bay Coastal Basins. The Whitaker Bayou basin consists of Whitaker Bayou, one of three major tributaries to Sarasota Bay, and its drainage basin, which extends from Sarasota County slightly north into Manatee County. The Hudson Bayou basin includes Hudson Bayou, another major tributary, and its drainage basin, which is entirely within the Sarasota City limits in Sarasota County. The Sarasota Bay Coastal basin includes the Sarasota County portion of the barrier islands, such as Lido Key, Bird Key, and southern Longboat Key. This basin also includes the Sarasota County coastal mainland and the Sarasota County portion of Sarasota Bay.

The following three subsections describe the three basins that are the focus of this WQMP—Whitaker Bayou, Hudson Bayou, and Sarasota Bay Coastal Basin.

3.3.1 Whitaker Bayou Basin

The Whitaker Bayou basin covers about 4,667 acres. Its surface water system has undergone significant alteration over the past century. The Sarasota County 1847 General Land Office Survey indicates that Whitaker Bayou only extended about a quarter of a mile inland from the bay ([Figure 3-11](#)). The survey also displays a separate waterway that extends inland from 0.25 mile northeast of the head of Whitaker Bayou. The 1959 U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Soil Survey Map ([Figure 3-12](#)) shows an area of moderately drained soil associated with scrubby flatwoods at the historical extent of the bayou. This survey also shows the second waterway that is illustrated on the 1847 survey extending northeast toward a poorly drained hammock soil, typically found adjacent to ponded areas or sloughs. Between these waterways is a somewhat poorly drained soil associated with flatwoods. Infiltration in this soil is affected by the seasonal fluctuation of the water table. These systems, therefore, could possibly have been joined during the wet season.

The 1944 Corps of Engineers, U.S. Army Map service topography map of Sarasota indicates that much of the watershed was already developed at the time the survey was done. Whitaker Bayou is shown to extend beyond the approximate 1847 location, possibly to include the second 1847 waterway. The bayou continues inland, branching off into several smaller waterways that go on several miles throughout the watershed ([Figure 3-13](#) and [Figure 3-14](#)). Although there are far more ditches and canals today, this demarcation of the basin's major waterways very much resembles many current waterways ([Figure 3-15](#)).

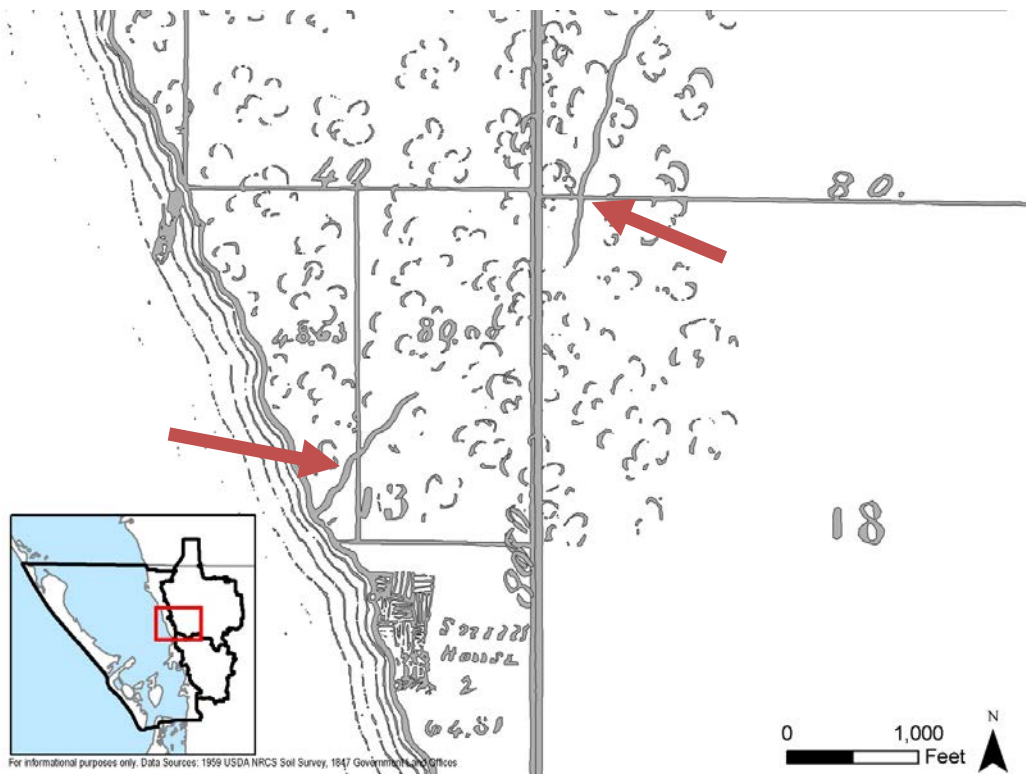


Figure 3-11 Whitaker Bayou Area Survey Circa 1847

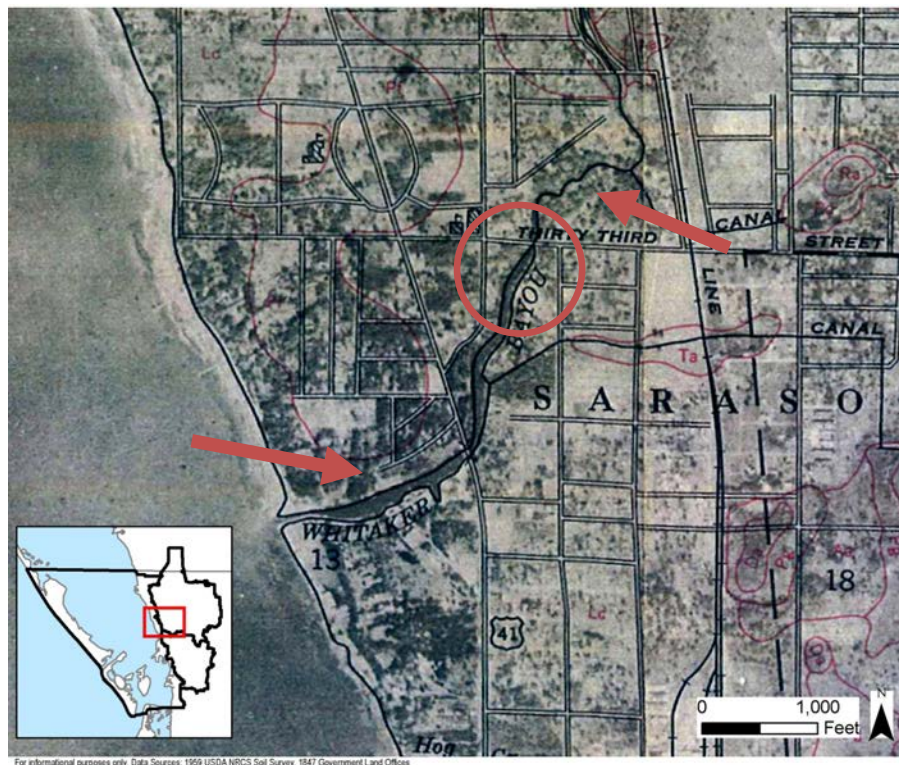


Figure 3-12 Whitaker Bayou Area 1959 USDA NRCS Soil Survey Map

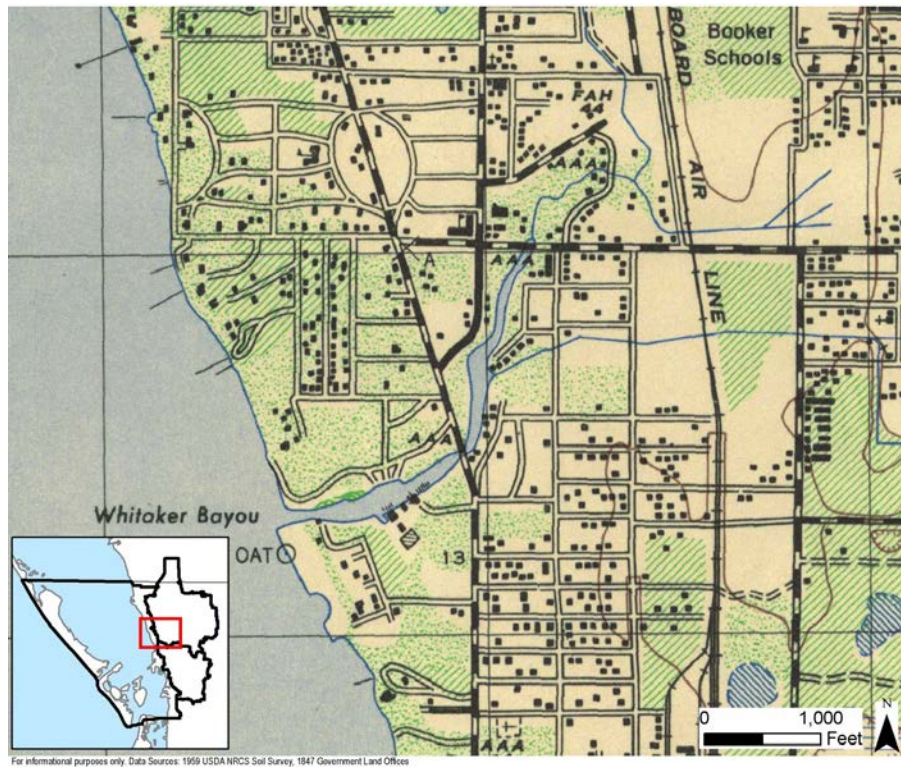


Figure 3-13 Whitaker Bayou Area Topography Circa 1944
(for figure legend see [Figure 3-14](#))

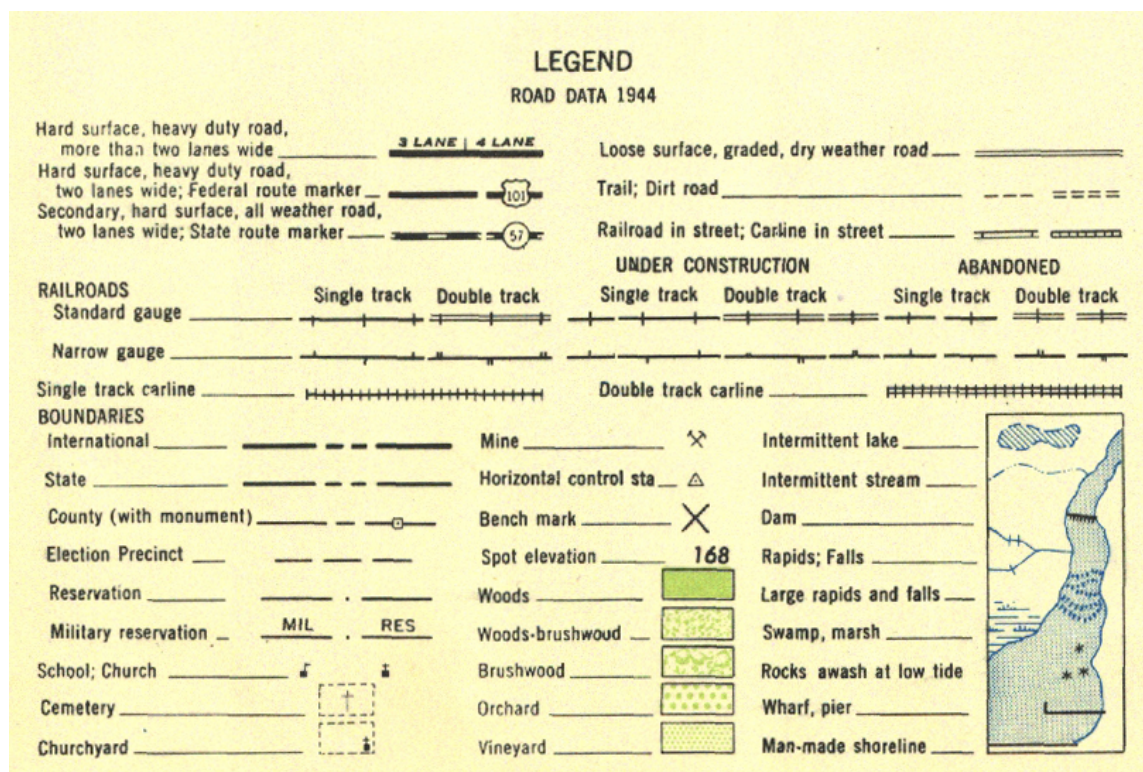
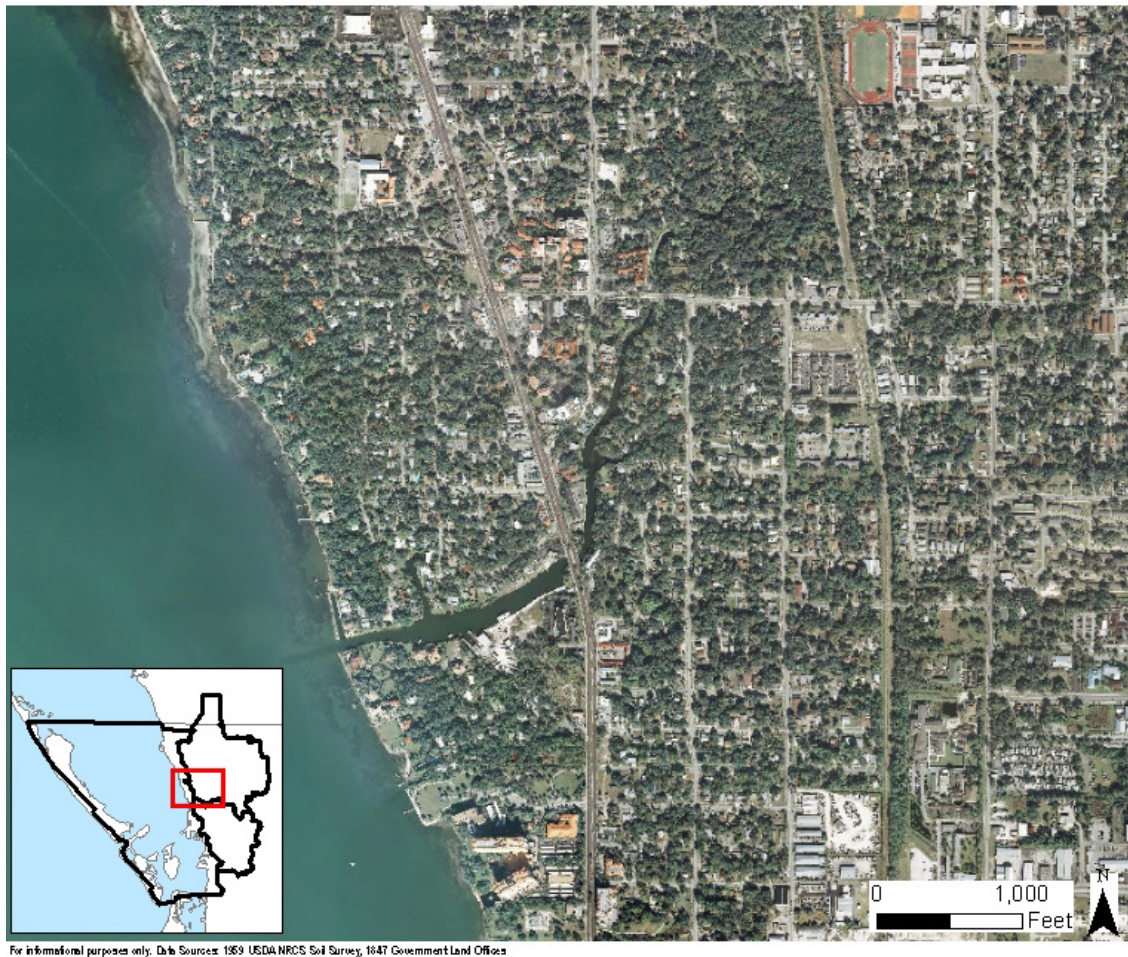


Figure 3-14 1944 Corps of Engineers, U.S. Army Map Service Topography Map Legend



For informational purposes only. Data Sources: 1959 USDA NRCS Soil Survey, 1847 Government Land Offices

Figure 3-15 Whitaker Bayou Area Circa 2010

3.3.2 Hudson Bayou Basin

The Hudson Bayou basin covers an area of 2,392 acres and is entirely within the bounds of the City of Sarasota. Its surface water system has undergone significant alteration over the past century. The Sarasota County 1847 General Land Office Survey does not confirm Hudson Bayou but does show a few inland waterways ([Figure 3-16](#)). The 1959 USDA NRCS Soil Survey Map shows that Hudson Bayou extended about 1 mile inland from the bay through somewhat poorly drained soil associated with flatwoods ([Figure 3-17](#)). The survey also shows an area of well-drained soil likely consisting of scrub land north of the bayou, which continues north along the coast.

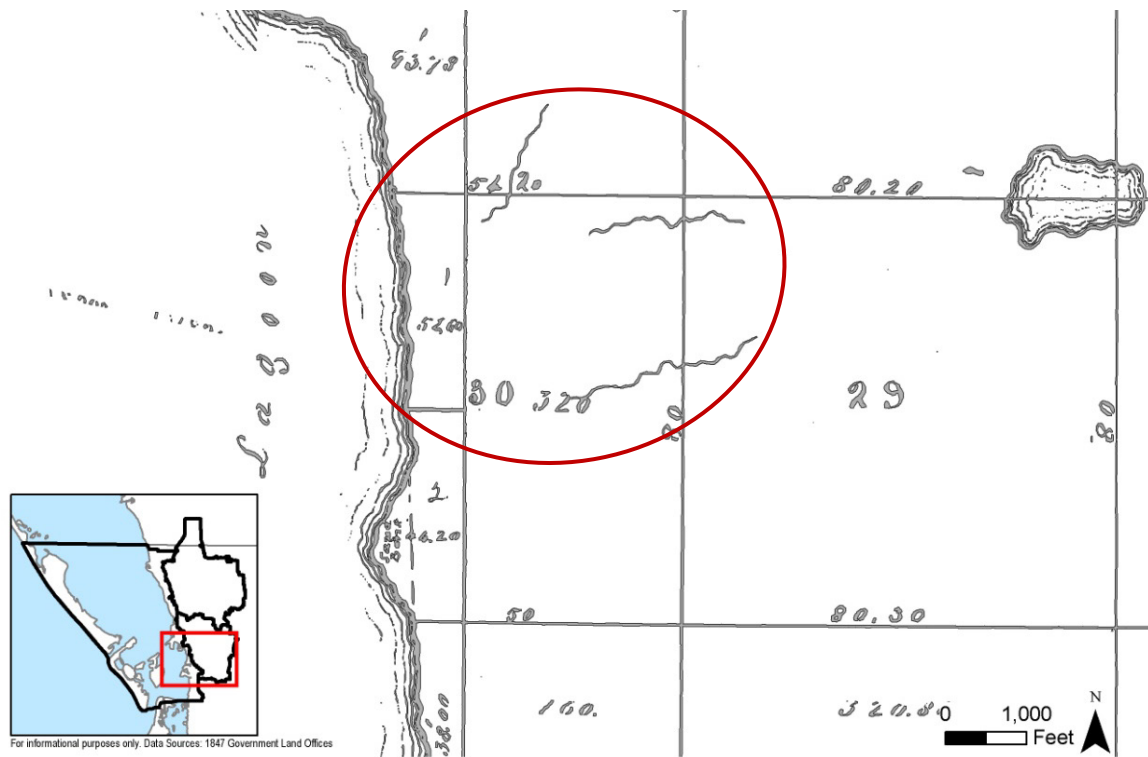


Figure 3-16 Hudson Bayou Area Survey Circa 1847

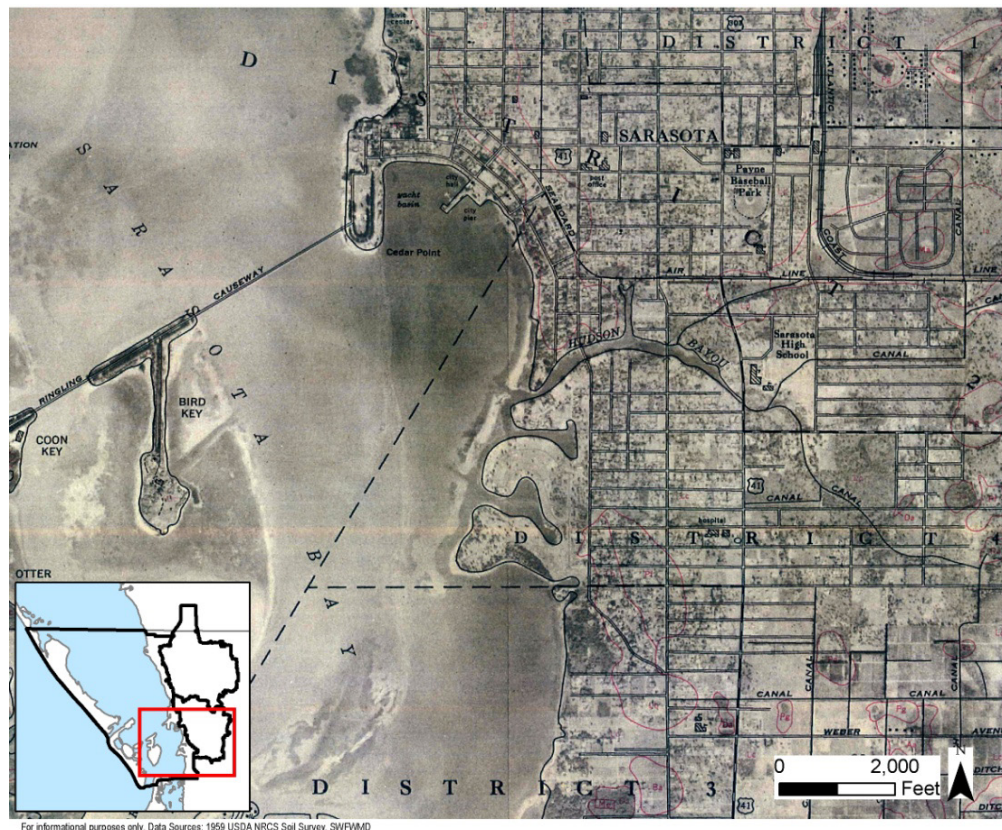


Figure 3-17 Hudson Bayou Area 1959 USDA NRCS Soil Survey Map



The 1944 U.S. Corps of Engineers, U.S. Army Map service topography map of Sarasota indicates that much of the Hudson Bayou basin was already developed at the time the survey was done. The bayou is shown to extend inland from the bay for about 1 mile and then branch out into several smaller waterways that continue several miles inland throughout the watershed ([Figure 3-17](#) and [Figure 3-18](#)). This delineation of the waterways very much resembles the current Hudson Bayou basin waterways ([Figure 3-19](#)).

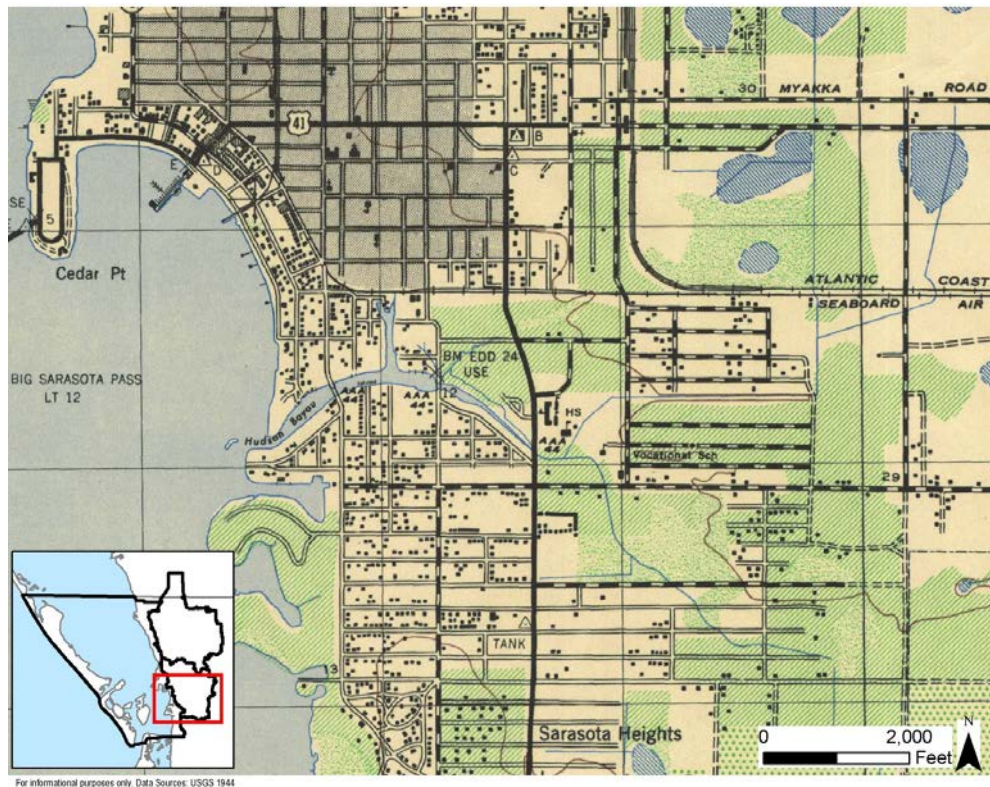
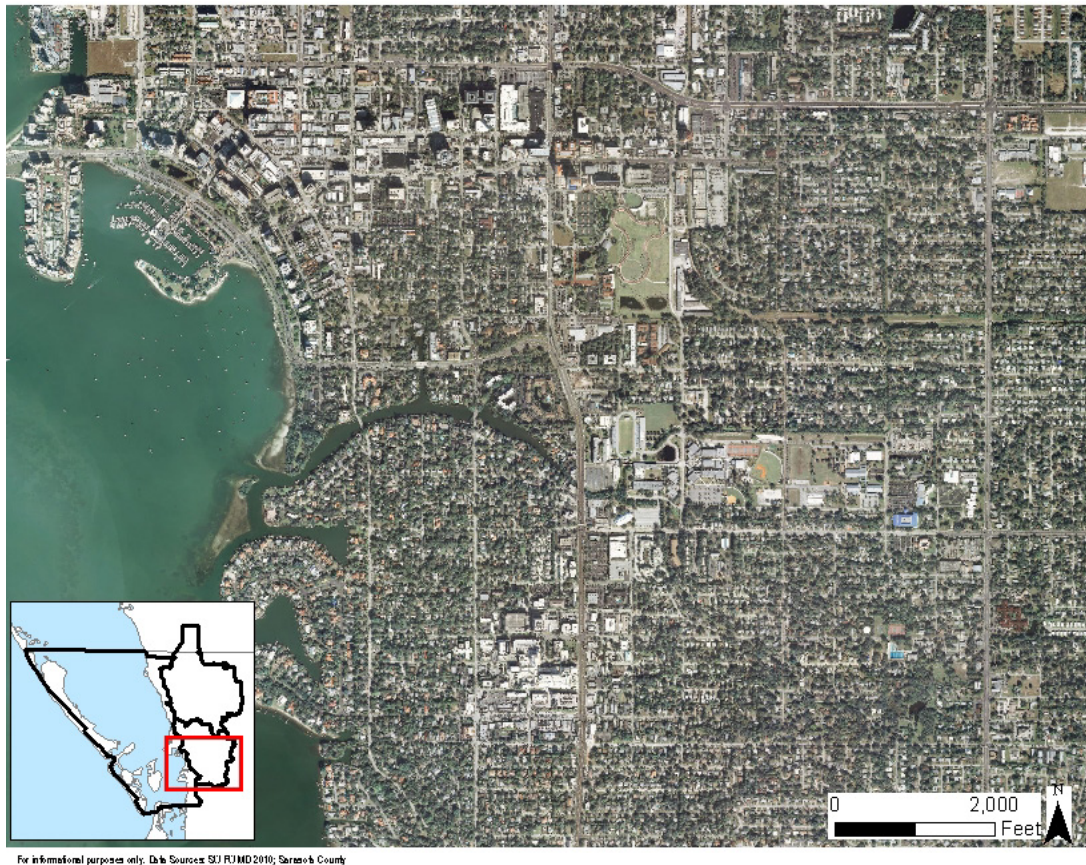


Figure 3-18 Hudson Bayou Area Topography Circa 1944
(for figure legend see [Figure 3-14](#))



For informational purposes only. Data Sources: S37 RJMD 2010; Sarasota County

Figure 3-19 Hudson Bayou Area Circa 2010

3.3.3 Sarasota Bay Coastal Basin

The Sarasota Bay Coastal basin covers 14,963 acres. Sarasota Bay makes up roughly 75% of the basin, and the remainder consists of the barrier islands and coastal mainland that drain directly to the bay. The Sarasota County 1847 General Land Office Survey ([Figure 3-20](#)) shows a system of many barrier islands separated by two passes connecting Sarasota Bay to the Gulf of Mexico; however, drastic changes have occurred in this basin since that time.

In 1890, the U.S. Army Corps of Engineers began dredging what would eventually become the Gulf Intracoastal Waterway (ICW), which spurred development in the area. Shallow parts of the estuary were dredged and deposited to enlarge existing islands or create new ones. In the early 1900s, Lido Key was created from a collection of smaller islands. Shortly after, a bridge connecting the mainland to the islands was constructed. By the mid 1900s most of the coastal mainland had been developed and barrier islands had been enlarged and platted for development ([Figure 3-21](#)). In the late 1950s, the estuary around Bird Key was dredged and filled to create a subdivision more than ten times the size of the original island. These changes can be seen in [Figure 3-22](#) and [Figure 3-23](#).

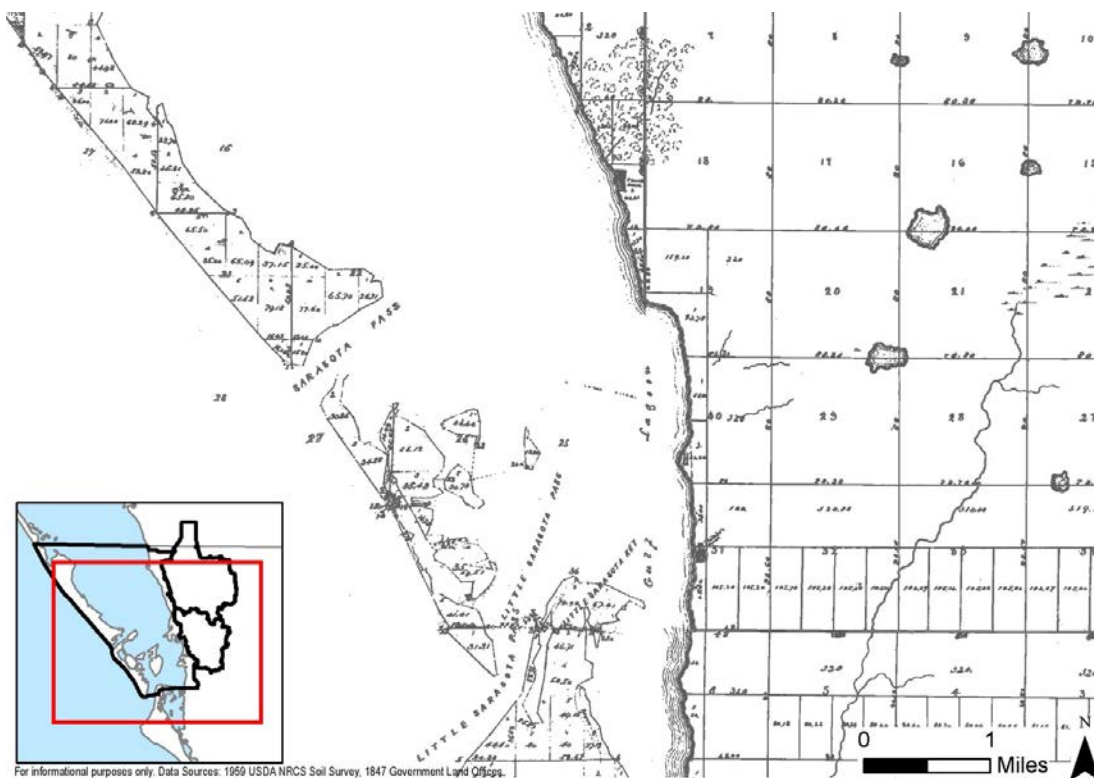


Figure 3-20 Sarasota Bay Coastal Basin Area Survey Circa 1847

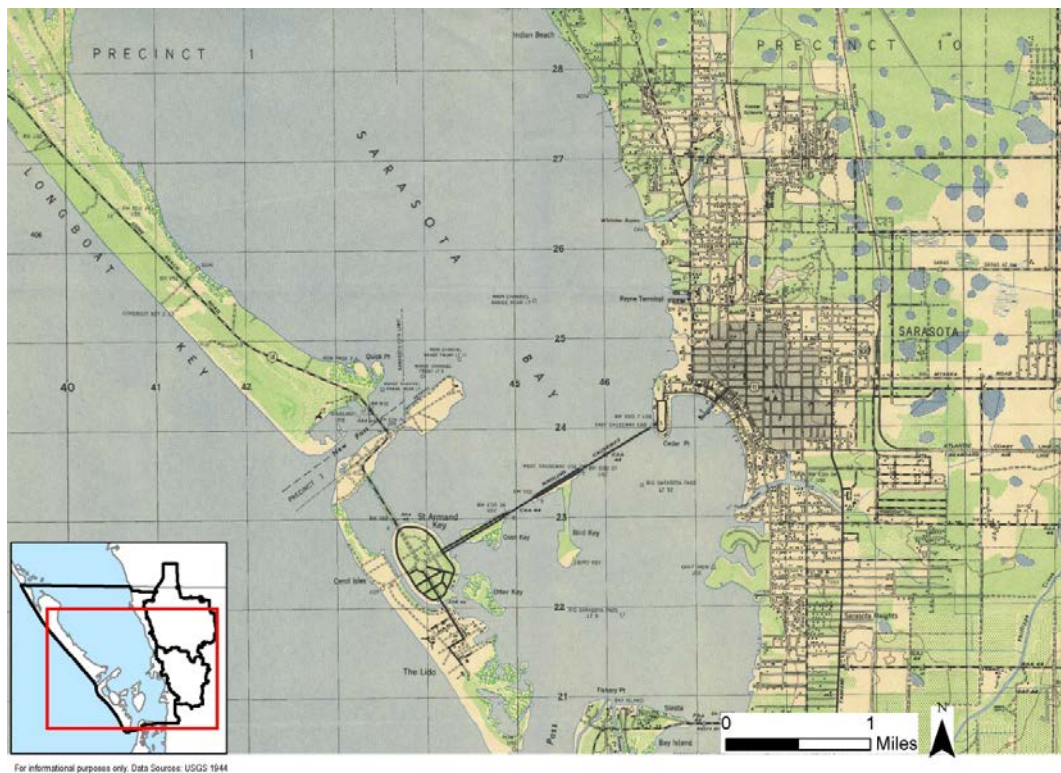


Figure 3-21 Sarasota Bay Coastal Basin Area Survey Circa 1944
(for figure legend see [Figure 3-14](#))

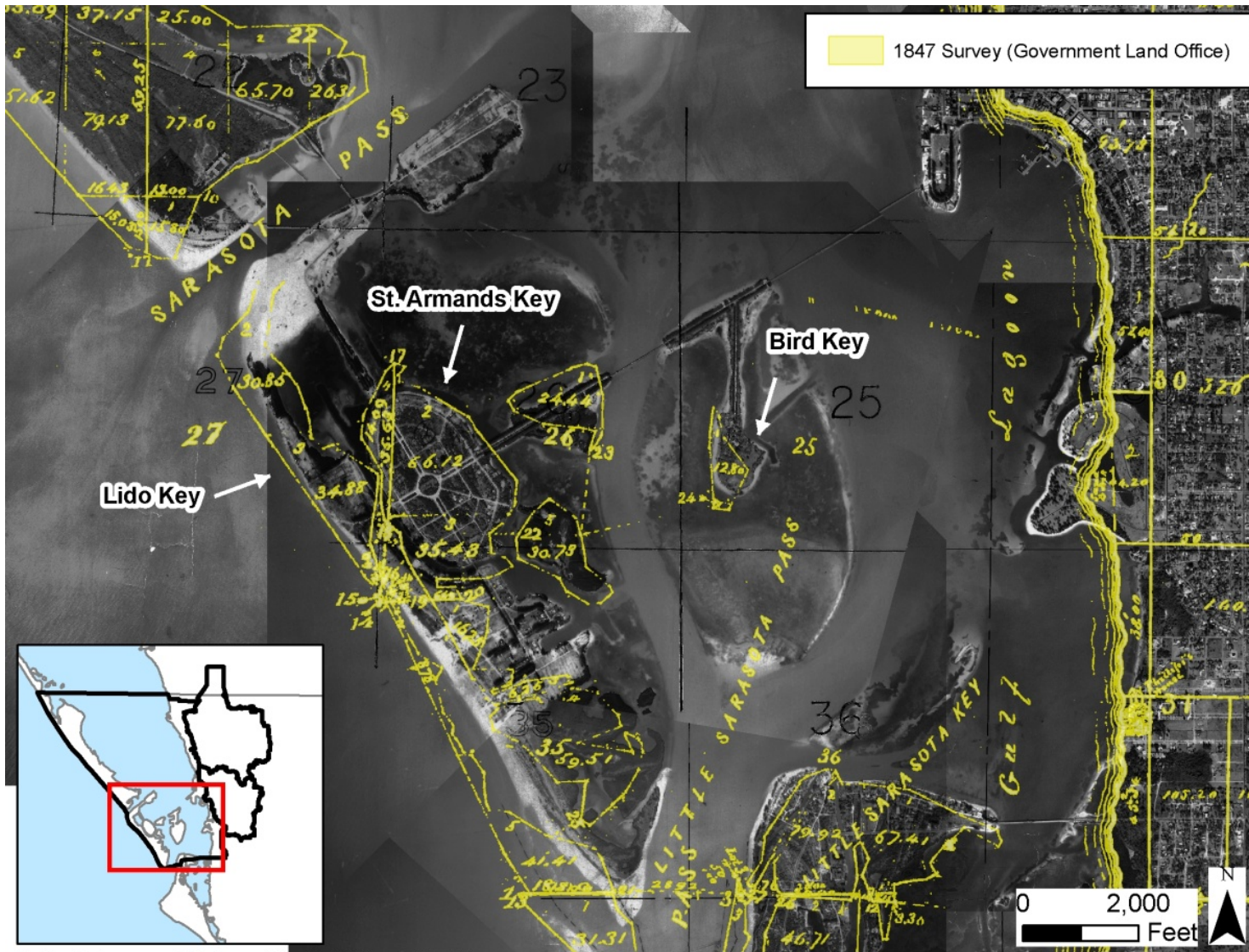


Figure 3-22 Sarasota Bay Coastal Basin Area 1847 Survey Over 1948 Aerial

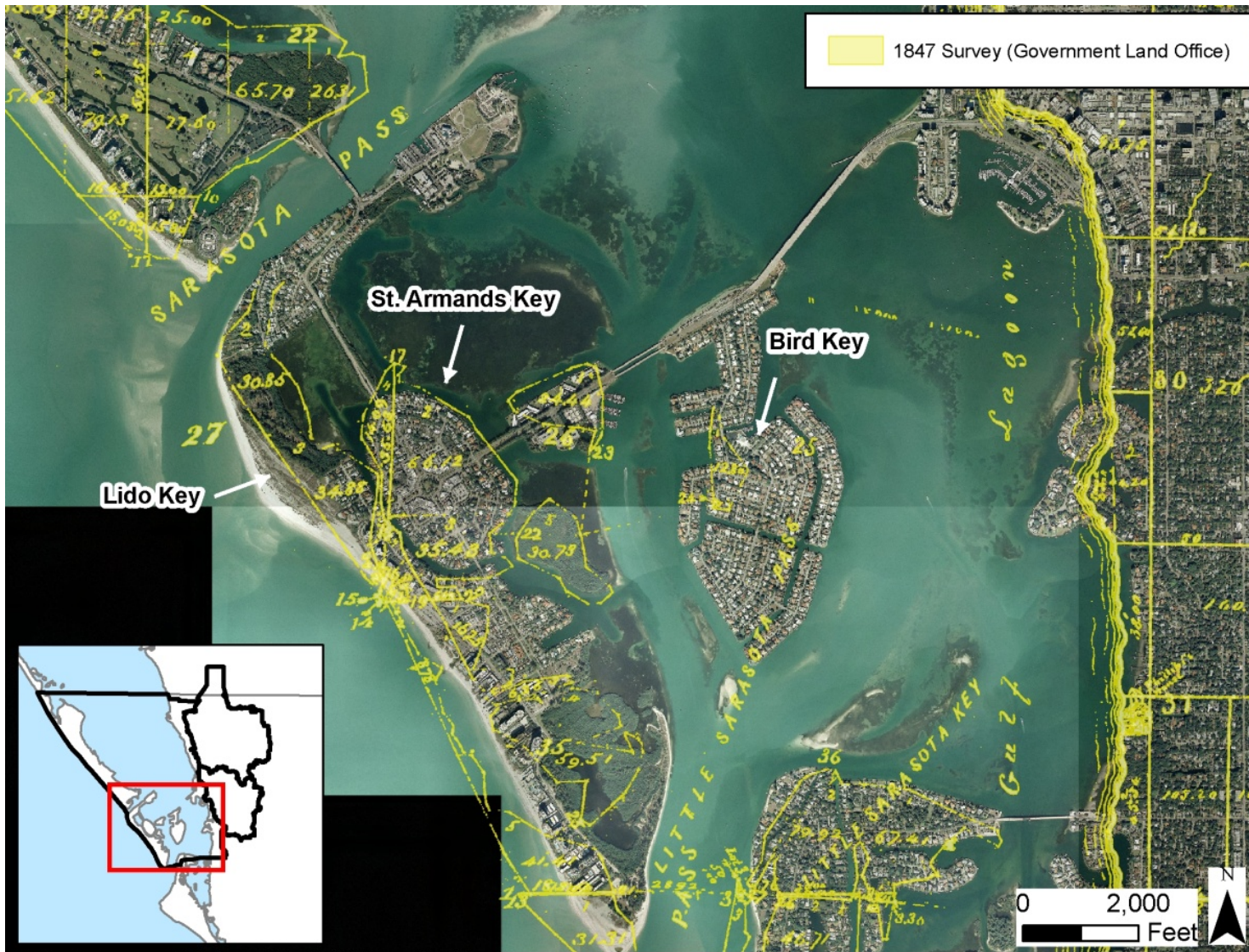


Figure 3-23 Sarasota Bay Coastal Basin Area 1847 Survey Over 2009 Aerial



3.4 LAND USE

Land use characteristics of a watershed significantly affect water quality, water quantity (flow), habitat, and flooding risks. The spatial distribution and acreage of different current land use categories were identified using the SWFWMD's 2008 land use coverage contained in the District's geographic information system (GIS) library. SWFWMD land use data are based on the Florida Department of Transportation (FDOT) "Florida Land Use and Cover Classification System" (FLUCCS). These FLUCCS classes were aggregated into categories, which are presented in [Table 3-2](#). Almost half of the watershed is open water and about a quarter is residential. Only about 10% of the watershed is undeveloped, most of which is in the Manatee County portion of the watershed. Current land use coverage is shown in [Figure 3-24](#) and described in [Table 3-2](#) and [Table 3-3](#).

Table 3-2 Sarasota Bay Current Land Use Classification (FDOT 1999)	
Land Use	FLUCCS
Commercial	1400, 1700
Low-Density Residential	1100
Medium-Density Residential	1000, 1200
High-Density Residential	1300
Golf Course	1820
Pasture	2100, 3300, 7400
Agriculture	2200, 2300, 2400, 2500, 2550
Row Crops	2000, 2140
Light Industrial	1500
Transportation/Utilities	8100, 8200, 8300
Forest, Open area, and Park	1800, 1900, 2600, 3100, 3200, 4000, 4100, 4110, 4120, 4200, 4340, 4400
Wetlands	6000, 6100, 6110, 6120, 6150, 6200, 6210, 6300, 6410, 6420, 6430, 6440, 6450, 6600
Water	1600, 5100, 5200, 5300, 5330, 5340, 5400, 5410, 5720, 6530

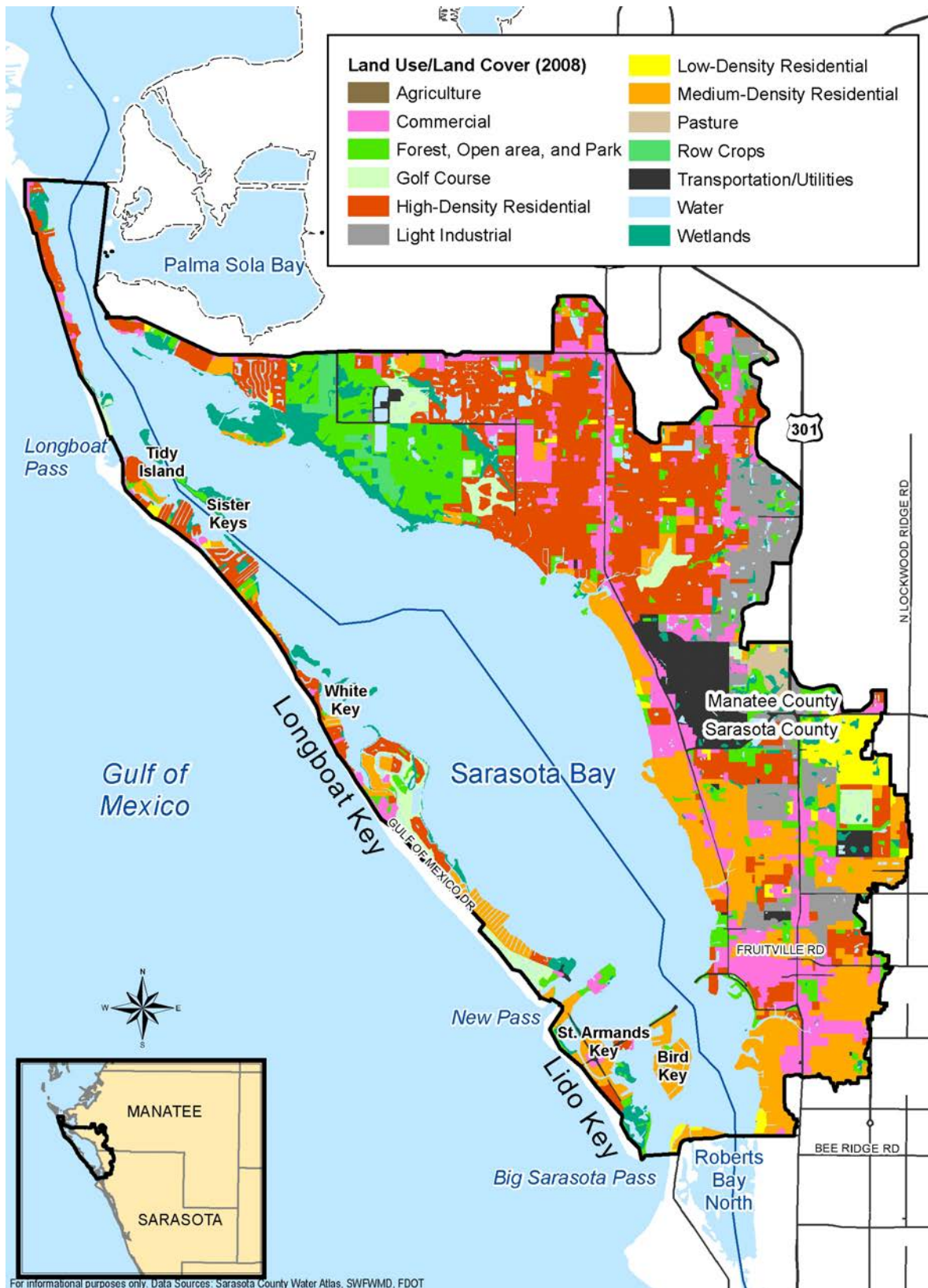


Figure 3-24 Sarasota Bay Watershed Land Use Circa 2008



Table 3-3 Sarasota Bay Watershed Current Land Use (SWFWMD 2008)

Table 3-3 Sarasota Bay Watershed Current Land Use (SWFWMD 2008)										
Land Use	Basin								Sarasota Bay Watershed	
	Hudson Bayou		Whitaker Bayou		Sarasota Bay Coastal		Sarasota Bay - Manatee County			
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Agriculture	0	0%	1	<1%	0	0%	23	0%	25	0%
Commercial	768	32%	409	9%	458	3%	2,012	7%	3,647	7%
Low-Density Residential	0	0%	349	7%	63	0%	369	1%	780	2%
Medium- Density Residential	988	41%	1,227	26%	1,619	11%	811	3%	4,645	9%
High-Density Residential	215	9%	651	14%	436	3%	6,103	21%	7,405	15%
Golf Course	0	0%	127	3%	317	2%	461	2%	905	2%
Pasture	0	0%	181	4%	0	0%	24	0%	205	<1%
Row Crops	0	0%	0	0%	0	0%	291	1%	291	1%
Light Industrial	169	7%	673	14%	0	0%	1,168	4%	2,010	4%
Transportation/ Utilities	109	5%	338	7%	148	1%	1,096	4%	1,691	3%
Forest, Open Area, and Park	121	5%	423	9%	284	2%	2,186	8%	3,014	6%
Wetlands	10	0%	184	4%	218	2%	1,437	5%	1,849	4%
Water	26	1%	103	2%	10,800	75%	12,524	44%	23,453	47%



3.5 TOPOGRAPHY

The Sarasota Bay Watershed is relatively flat and ranges in elevation from sea level in the west to a maximum of approximately 35 feet *National Geodetic Vertical Datum (NGVD)* at the northeast watershed boundary ([Figure 3-25](#)). The average slope of the watershed land surface is approximately 0.004 feet/foot. The barrier islands are low-lying and do not exceed 5 feet NGVD throughout.

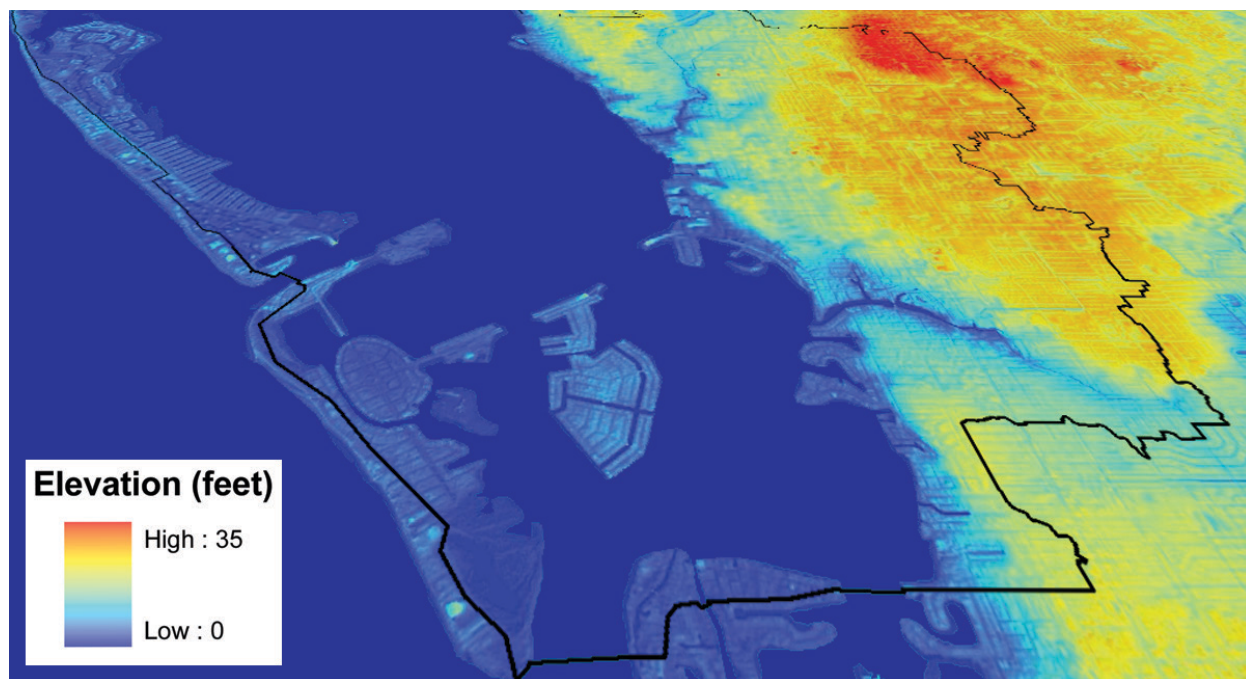


Figure 3-25 Sarasota Bay Watershed Topography

3.6 SURFACE HYDROLOGY

Rainfall and surface water runoff are critical to maintaining the natural resources of any estuarine system and its supporting watershed. Sarasota County's surface water hydrologic setting includes an average annual rainfall of 53 inches, although this depth can vary significantly from year to year (SWFWMD, 2010). Intra-annual variability is also high, with about 61% of a typical annual rainfall occurring during the wet season months of June through September.

The surface water runoff from the rainfall flows across the watershed terrain through ditches, storm drains, creeks, and wetlands, and eventually into Sarasota Bay. Sarasota Bay has three major tributaries that connect to the bay: Hudson Bayou and Whitaker Bayou in Sarasota County and Bowlees Creek in Manatee County.



The Sarasota Bay Watershed once consisted of an expanse of pine flatwoods and other upland systems, numerous wetlands, and marshy tributaries that slowly drained into the bay. These native natural systems provided habitat, flood control, and improved water quality. Many of these natural systems were altered and degraded by urban and agricultural development over the past 100 years, resulting in major changes in the watershed. Drainage activities, flood-control projects, and the construction of impervious surfaces have changed the natural hydrology of the watershed, resulting in higher peaks in the natural flow and increases in the delivery of pollutants to the bay. Hydrologic alterations within the Sarasota Bay Watershed include:

Widespread alterations to the surface hydrology of the watershed have occurred over the past decades, resulting in significant changes to the volume and timing of freshwater inflows to the bay.

- ❖ Reducing on-site rainfall storage by filling and ditching natural depressions and wetlands.
- ❖ Increasing stormwater runoff rates by channelizing natural streams and creating networks of interconnected ditches that flow to the bay.
- ❖ Reducing infiltration by introducing pavement and other impervious surfaces.
- ❖ Altering flow patterns by constructing water control weirs and increasing sedimentation in the channel from upland erosion.

3.7 PHYSIOGRAPHIC REGION

The Sarasota Bay Watershed lies entirely within the Southern Gulf Coastal Lowlands subdivision of the mid-peninsular physiographic region of Florida (White, 1970; SWFWMD, 2000). The Gulf Coastal Lowlands is a broad, gently sloping marine plain characterized by broad flatlands with many sloughs and swampy areas (White, 1970). Some of these areas have been drained by ditches and canals, especially near the coast. Soils in the Southern Gulf Coastal Lowlands are generally unconsolidated sands that increase in clay content with depth. Organic soils are found underlying wetland areas.

3.8 GEOLOGY AND HYDROGEOLOGY

The Sarasota Bay Watershed lies within an area designated by SWFWMD as the Southern Water Use Caution Area (SWUCA) (SWFWMD, 2006). A *Water Use Caution Area* is an area where water resources are or are expected to become critical within the next 20 years. Hydrogeologic features of the SWUCA and the watershed include three distinct aquifer systems: the surficial, intermediate, and the Floridan ([Figure 3-26](#) and [Figure 3-27](#)). The *surficial aquifer* is an unconfined system that overlies the intermediate aquifer system and ranges in thickness from a few feet to over 60 feet in the watershed. Hydraulic properties of the surficial aquifer system



determined from aquifer tests, laboratory tests, and model simulations vary considerably across the study area (Barr, 1996).

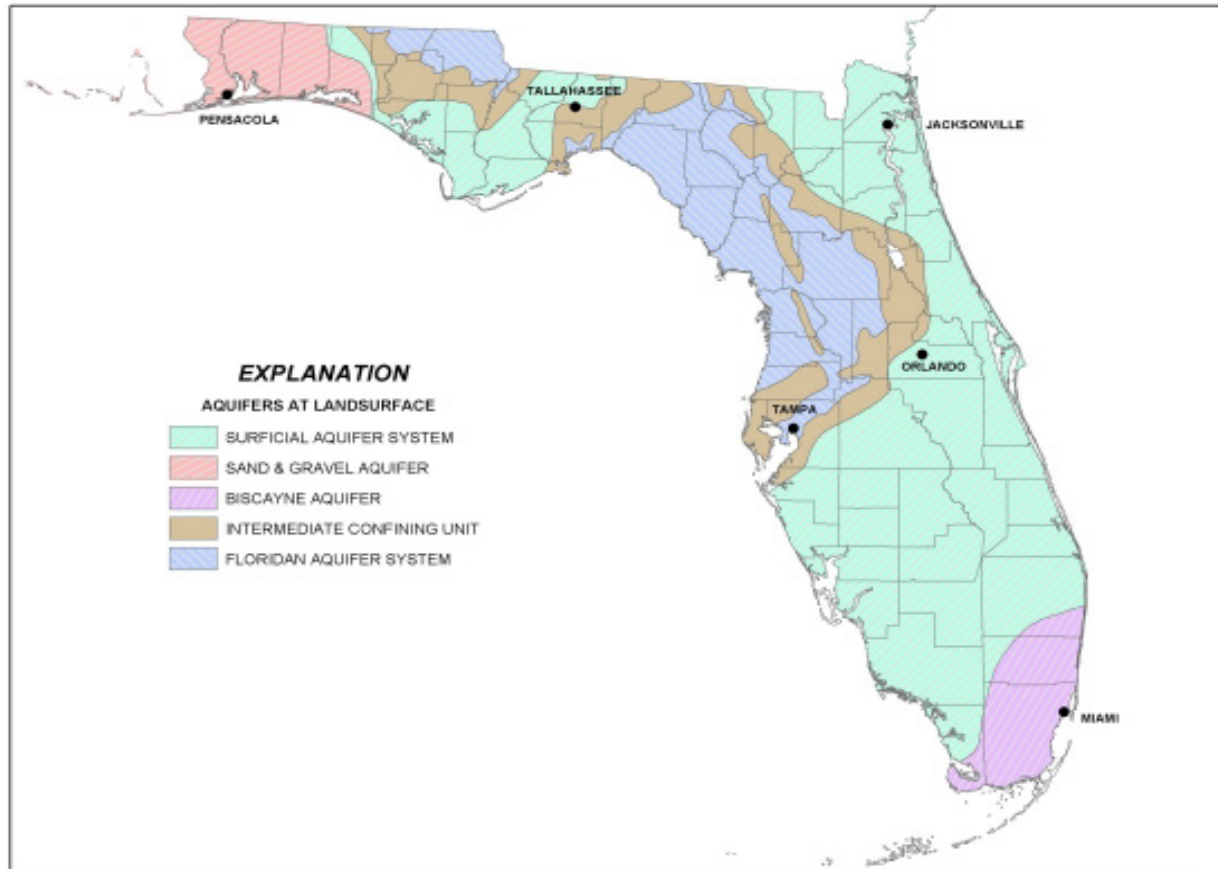


Figure 3-26 Aquifers at Land Surface
(source: <http://www.dep.state.fl.us>, updated 1/3/07)



Series	Stratigraphic unit		Hydrogeologic unit		Lithology	
Holocene and Pleistocene	Undifferentiated surficial deposits (including the Caloosahatchee Formation and the Tamiami Formation)		Surficial aquifer system		Undifferentiated sand with some limestone and shell beds.	
Pliocene			Confining unit	Intermediate aquifer system	Sand, limestone, and shell beds. Thick clay near top.	
Miocene	Hawthorn Group	Tamiami/Peace River zone (PZ1)	Confining unit		Mostly limestone, sandy limestone and sand. Phosphatic in part. Dolomite beds common. Clayey in middle and lower parts.	
		Confining unit				
		Undifferentiated Arcadia Formation	Upper Arcadia zone (PZ2)			
		Oligocene	<div><div>Tampa Member</div><div>Nocatee Member</div></div>			Confining unit
Lower Arcadia zone (PZ3)						
Confining unit						
	Suwannee Limestone		Upper Floridan aquifer		Granular, fossiliferous limestone, with trace amounts of sand and clay in the upper portions. Dense dolostone and indurated limestone, mostly pelletal	
Eocene	Ocala Limestone					
	Avon Park Formation					

Figure 3-27 Hydrogeologic Framework and Geochemistry of the Intermediate Aquifer System in Parts of Charlotte, De Soto, and Sarasota Counties, Florida
(from Torres et al., 2001)

The *intermediate aquifer system* is a confined aquifer system between the surficial and the Upper Floridan aquifers and is composed of alternating confining units and permeable zones. The intermediate aquifer system has three major permeable zones that exhibit a wide range of hydraulic properties. Horizontal flow in the intermediate aquifer system is northeast to southwest. Most of the Study Area is in a discharge area of the intermediate aquifer system, meaning that water pressure is higher at lower elevations, causing net upward flow of groundwater (Barr, 1996).

Under natural conditions, shallow groundwater ranges from fresh in the surficial aquifer system and upper permeable zones of the intermediate aquifer system to moderately saline in the lower intermediate aquifer. Water quality data collected in coastal southwest Sarasota County indicate that groundwater withdrawals from major pumping centers have resulted in lateral seawater intrusion and upconing into the surficial and intermediate aquifer systems (Barr, 1996).



The intermediate aquifer system is underlain by the Upper Floridan aquifer, which consists of a thick, stratified sequence of limestone and dolomite. The Upper Floridan aquifer is the most productive aquifer in the Study Area; however, its use is generally restricted because of poor water quality. Interbedded clays and fine-grained clastics separate the aquifer systems and permeable zones (Torres et al., 2001).

3.9 SOILS AND SEDIMENT

The subsurface geology and subsurface features of Sarasota Bay and its watershed are directly related to historic sea level fluctuations. The underlying geologic formations developed as the result of physical, chemical, and biological processes. These processes included near-shore deposition of sediment, precipitation of chemicals directly from seawater, and accumulation of the skeletal remains of marine organisms. These geologic formations range in age from the Oligocene epoch (38 to 22.5 million years ago) to the Holocene epoch (10,000 years ago to present) (Sarasota County Planning and Development Services, 2007, p. 2-9).

Surface and near-surface sediments consist of quartz sand, consolidated and unconsolidated shell beds, clays, limestone, and dolomite. Stratified layers of relatively pure limestones and phosphatic clays (clays rich in phosphate, salts of phosphoric acid) developed gradually in the watershed. Quartz sands that eroded from exposed higher land were also deposited. These near-surface sediments, which occur within approximately 1,500 feet of ground elevation, were of major importance to settlement because of their capacity to store and/or contain potable water. In addition to supplying water, the marine sediments provide phosphate and other mineral resources (Sarasota County Planning and Development Services, 2007, p. 2-9). The watershed's phosphorus-rich geology and soils significantly influence the total phosphorus concentrations in the Sarasota Bay tributaries and estuary.

Much of the 'soils' in the watershed, generally described as surficial sediments, represent only slightly weathered parent material or modern sediments, some of which are still being formed, rather than layers of mixed mineral and organic materials. The soil types in the watershed include limestone rock, calcareous muds (marls), sands (marine terraces), organic materials (peats and muck), and mixed solids (Duever et al., 1979; SWFWMD, 1980).

An additional substrate is made up of altered or Arent soils, e.g., dredge and fill, shell mounds, and landfills (Herwitz, 1977). Examples are the inland and coastal artificially constructed canals. Modification of natural tidal tributaries to finger canals is prevalent in developments. There is a shift away from autochthonous (local) sediment production in the natural waterways to a primarily allochthonous (transported) source of sediments in the canal system. Marls and sand marls generally range from 6 inches to 3 feet in depth, have low relief, and because of low water permeability are often wet (SWFWMD, 1980).



Each individual soil can be classified into a hydrologic soil group (HSG) based on its runoff-producing characteristics. The most important of these characteristics is the inherent capacity of the soil to permit infiltration when bare of vegetation.

The four major hydrologic soil groups are:

- ❖ **Group A** (low runoff potential)—Soils with high infiltration rates even when thoroughly wetted. The soils are composed primarily of sands and gravel that are deep and well to excessively drained. These soils have a high rate of water transmission. Minimum infiltration rate = 0.30-0.45 inch/hour.
- ❖ **Group B** (low to moderate runoff potential)—Soils with moderate infiltration rates when thoroughly wetted. The soils are typically moderately fine to moderately coarse in texture and have a moderate rate of water transmission. Minimum infiltration rate = 0.15-0.30 inch/hour.
- ❖ **Group C** (moderate to high runoff potential)—Soils with slow infiltration rates when thoroughly wetted, often with a layer of soil that impedes the downward movement of water. The soils typically have a moderately fine to fine texture and a slow rate of water transmission. Minimum infiltration rate = 0.05-0.15 inch/hour.
- ❖ **Group D** (high runoff potential)—Soils with very slow infiltration rates when thoroughly wetted. The soils are primarily clay soils with a high permanent water table or shallow soils over nearly impervious materials, such as a clay pan or clay layer. These soils have a very slow rate of water transmission. Minimum infiltration rate = 0.0-0.05 inch/hour.

Some soils are assigned to two soil groups (e.g., B/D). The first letter applies to the drained condition and the second to the undrained condition. The distribution of HSGs for the Sarasota Bay Watershed is mapped in [Figure 3-27](#). This information was developed based on SCS Soil Survey with Geographical Information Systems (GIS) coverages developed by SWFWMD. The majority of the portion of the watershed that is not open water is classified as HSG B/D—well-drained much of the year but poorly drained due to the high water table during the wet season. Only 1% of the soils in the watershed are classified as very well-drained (HSG A), while about 16% are classified as poorly to very poorly drained (HSG C, C/D, or D) ([Table 3-4](#) and [Figure 3-28](#)).

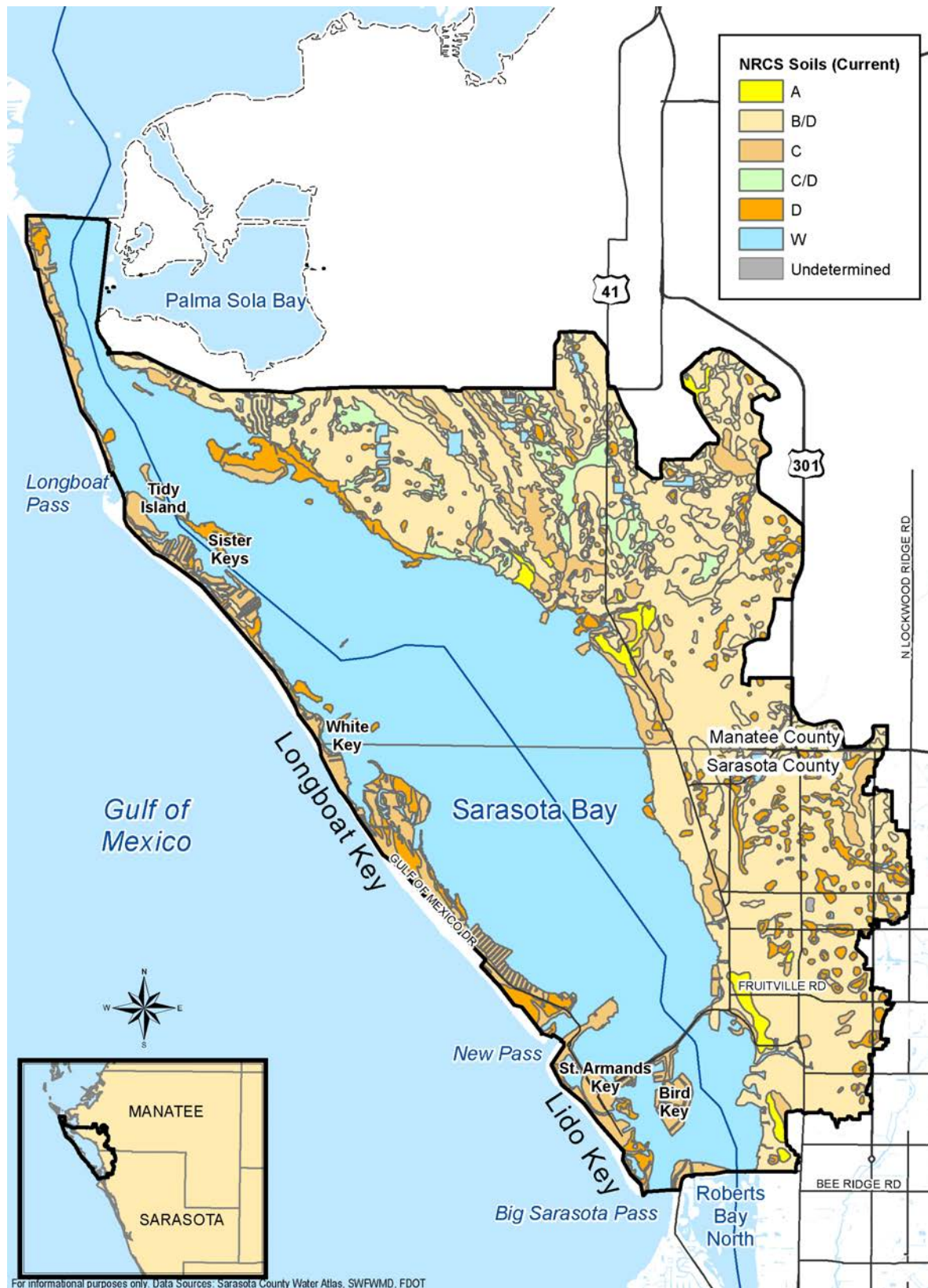


Figure 3-28 Sarasota Bay Watershed Soil Hydrologic Groups



Table 3-4 Sarasota Bay Watershed Current Soils (NRCS)

HSG	Basin								Sarasota Bay Watershed	
	Hudson Bayou Basin		Whitaker Bayou Basin		Sarasota Bay Coastal Basin		Manatee County Basin			
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
A	84	3%	6	0%	138	1%	291	1%	519	1%
B	0	0%	0	0%	0	0%	5	0%	5	0%
B/D	2,055	85%	3,776	81%	1,115	8%	11,382	40%	18,328	37%
C	66	3%	153	3%	1,713	12%	2,509	9%	4,441	9%
C/D	0	0%	0	0%	0	0%	949	3%	949	2%
D	184	8%	654	14%	628	4%	1,226	4%	2,692	5%
W	18	1%	61	1%	10,742	75%	12,139	43%	22,960	46%
UNDETERMINED	0	0%	16	0%	2	0%	0	0%	18	0%



4.0 ESTUARY

This section summarizes the physical extent and general features of Sarasota Bay. Detailed descriptions of water quality, pollutant sources, and critical habitats and biological communities are provided in Appendices C (Water Quality) and D (Natural Systems).

4.1 PHYSICAL AND POLITICAL BOUNDARIES

The estuary boundaries are set by physical and natural features that in turn determine to a large extent the behavior of water and biota in the estuary. A thorough understanding of these features is germane to the effective management of the estuarine resources.

Sarasota Bay proper is a lagoonal estuary on Florida's southwest coast and extends from just south of Palma Sola Bay at the Cortez bridge south to the northern boundary of Roberts Bay North at the Siesta Drive bridge, just south of Big Sarasota Pass ([Figure 4-1](#)), a distance of about 14.5 miles. The surface area of the bay is 22,703 acres.

The bay is approximately evenly divided between Sarasota County and Manatee County to the north. The eastern (mainland) shore of the estuary is within Sarasota and Manatee counties and the City of Sarasota. The western estuary boundary includes barrier islands that are within the jurisdiction of the City of Longboat Key (Longboat Key), Sarasota County (St. Armands Key and Lido Key), and, at the extreme northwest, Manatee County (Anna Maria Island).

The Sarasota Bay estuarine system, including Sarasota Bay and Roberts Bay North, was designated by FDEP as an OFW in 1986 ([Chapter 62-302.700, FAC](#)). OFWs are designated for "special protection due to their natural attributes" ([Section 403.061, FS](#)). The OFW designation was based on a finding that the waters are of exceptional recreational or ecological significance. The intent of an OFW designation is to maintain ambient water quality, even if these designations are more protective than those required under the waterbody's surface water classification.

Although much of the estuary's watershed has been developed, the estuary itself has been recognized for its abundant valuable natural resources. SWFWMD placed Sarasota Bay on its list of priority waterbodies for the SWIM program in 1987. USEPA designated Sarasota Bay as an Estuary of National Significance and authorized the Sarasota Bay National Estuary Program (SBEP) in 1989 (USEPA, 2005).

Sarasota Bay west of the ICW is designated as Class II (suitable for shellfish propagation or harvesting), and the bay east of the ICW is Class III Marine (suitable for recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife).

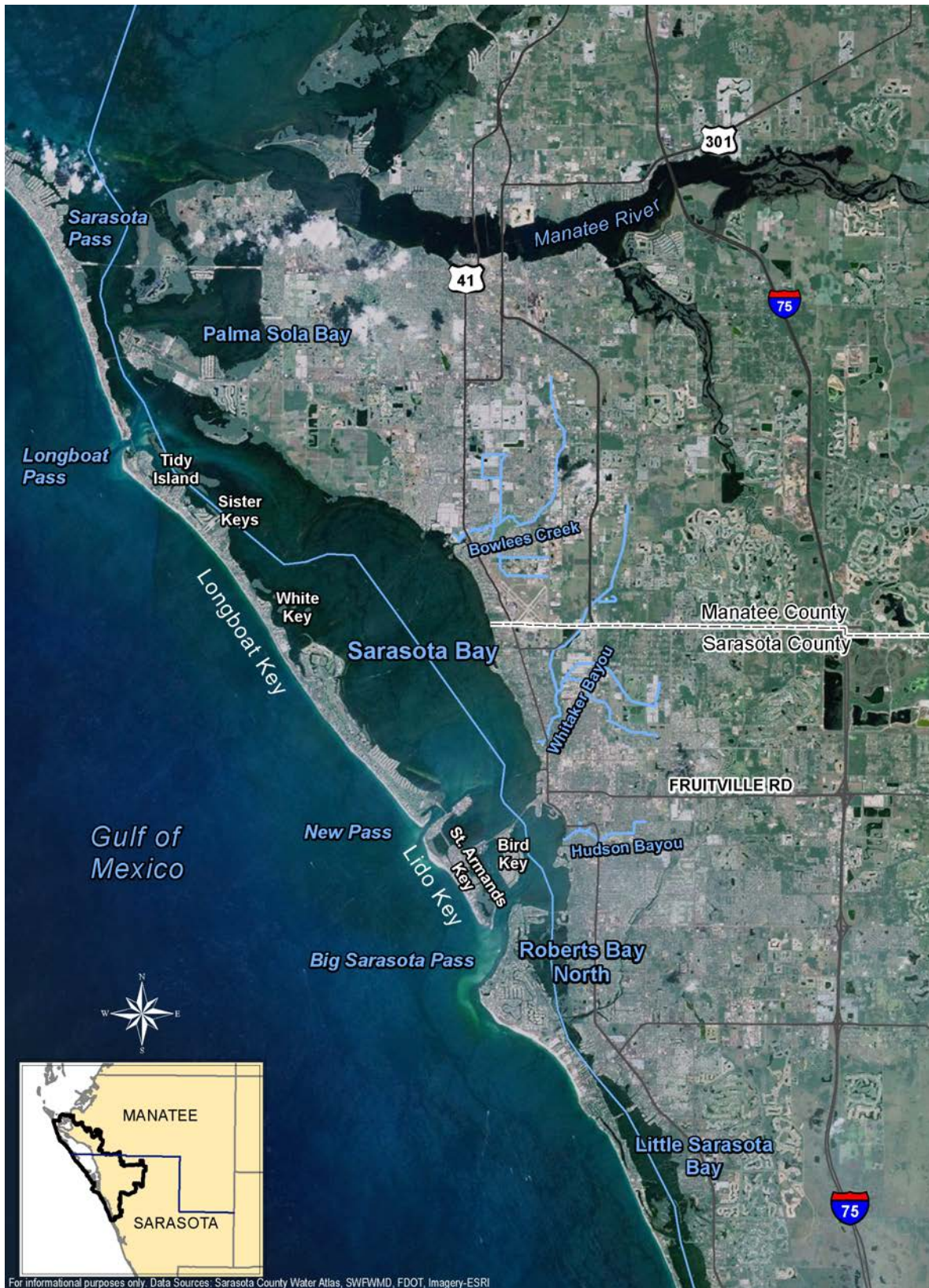


Figure 4-1 Sarasota Bay Estuary Location and Boundaries



4.2 BATHYMETRY

Bathymetric data for the estuary were obtained from the National Geophysical Data Center (NGDC). These data are used by the National Ocean Service to produce nautical charts. The bathymetry data used by NGDC were obtained from numerous sources including U.S. National Ocean Service Hydrographic Center, U.S. Geological Survey (USGS) 3 arc-second Digital Elevation Models (DEMs), U.S. Army Corps of Engineers, and other institutions (Jones Edmunds, 2010).

Sarasota Bay bathymetric information is contained on the National Ocean Services chart #11425 dated September 2007 and is presented in [Figure 4-2](#). Sarasota Bay has an average depth of 6.5 feet with a maximum depth of >20 feet, based on a vertical datum referenced to mean lower low water (MLLW). The horizontal datum is the North American Datum of 1983 (NAD 83).

In the northern extreme of the estuary, water depths are shallow, mainly 5 feet or less with the exception of the ICW that bisects the bay longitudinally. The design controlling depth of the ICW through Sarasota Bay is 9 feet, although shoaling and scouring can greatly alter local conditions. Water depth in the center of the bay exceeds 10 feet in places with gradual contours to the shoreline.

Before the ICW was dredged, the generally shallow depths of Sarasota Bay limited excursions of higher saline Gulf of Mexico water into the bay and likely reduced dilution and flushing of the pollutant loads present at that time due to tidal exchange. Deepening the ICW channel allowed better tidal exchange in the bay and increased transport and processing of nutrients and other pollutants. However, at the time of ICW dredging, pollutant loadings were much lower than they are currently, and the extent of water quality problems during that period is not known. Conversely, the shallower depths allow more rapid freshwater-induced flushing when freshwater inputs were high, so that pollutant loads associated with larger loading events may have more rapidly moved out of the system.

4.3 CIRCULATION AND COASTAL PASSES

Circulation in Sarasota Bay is driven primarily by tidal exchange and secondarily by freshwater inflow. The passes connecting Sarasota Bay to the Gulf of Mexico provide avenues for tidal exchange, with the resulting circulation within the estuarine system dependent upon the locations and sizes of these passes. Circulation is a major determinant of water quality, including salinity, nutrients, and algal biomass in the bay. Circulation also affects sediment movement and can cause shoaling or scour in inlets and passes.

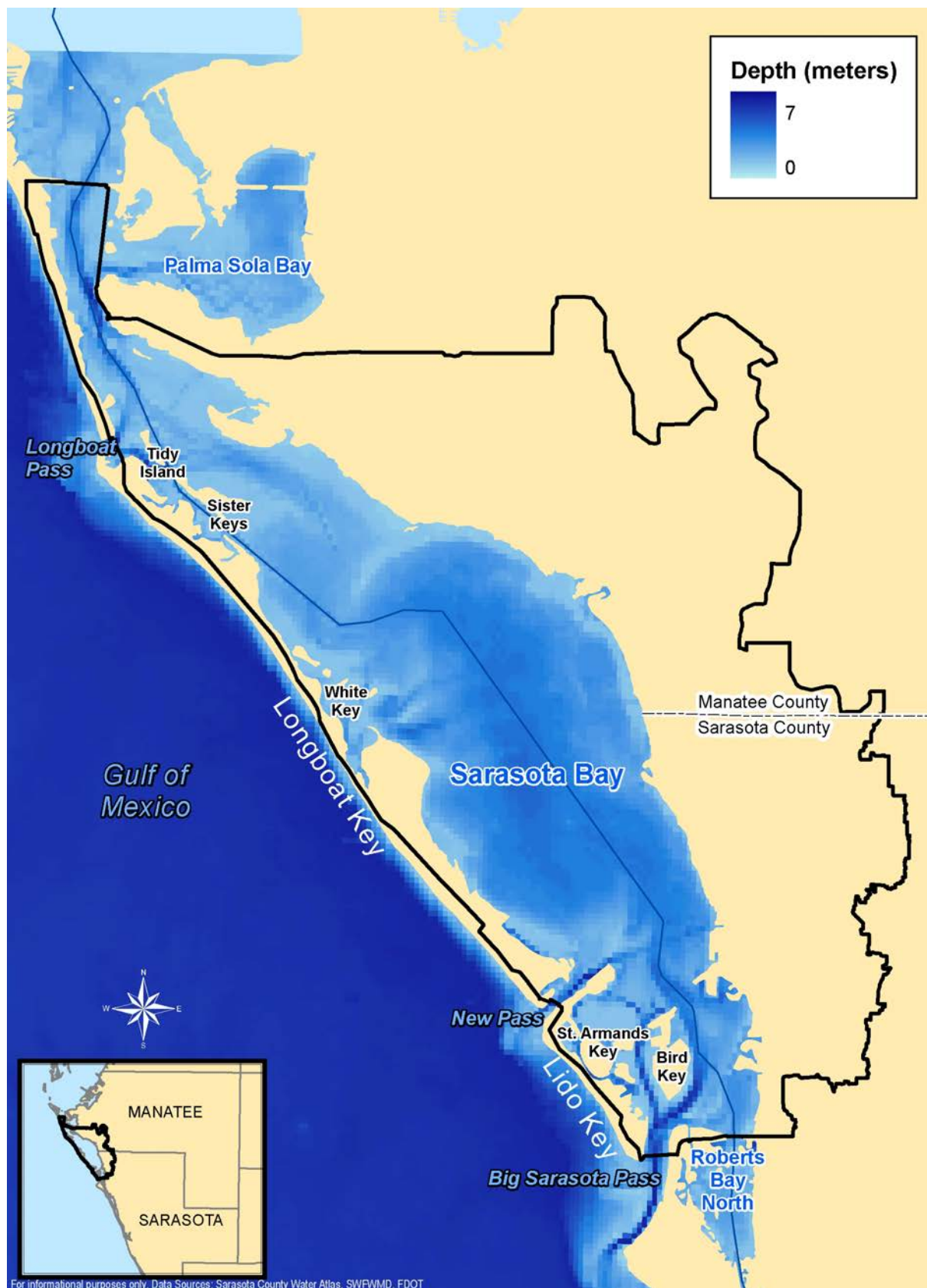


Figure 4-2 Bathymetry of Sarasota Bay and Roberts Bay North (NGDC, 2010)



Sarasota Bay receives runoff from the Hudson Bayou, Whitaker Creek, Bowlees Creek, and coastal drainage areas. The freshwater inflows result in a net outflow from the estuary, generally on a tide-driven basis. Circulation in Sarasota Bay is governed in part by flows north to Anna Maria Sound and south to Roberts Bay North. These narrow flow paths are relatively shallow except for the deeper ICW channel. The ICW enhances circulation and flushing and reduces retention time of water in the bay, reducing the accumulation of pollutants.

Tidal communication between the bay and the Gulf of Mexico is via Anna Maria Pass north between Anna Maria Island and Longboat Key, New Pass between Longboat Key and Lido Key, and Big Sarasota Pass at the south end of Lido Key north of Siesta Key ([Figure 4-1](#)). Of the three passes, Big Sarasota Pass is the largest, with a reported maximum depth of 27 feet. Anna Maria Pass also has a maximum depth of 27 feet charted but is not as wide. New Pass has a maximum reported depth of 13 feet and is reportedly the most prone to severe shoaling of the three (Davis et al., 2007).

The strongest currents in the system are found in the passes during incoming and outgoing tides, with the areas between the passes generally experiencing much weaker currents (Sheng, 1992). Modeling of tidal circulation in the Sarasota Bay system showed that the areas between the passes, where the tidal signals entering from adjacent passes meet, are areas of very small current velocities (Sheng and Peene, 1991). Consequently, these areas have relatively lower flushing rates.

A hydrodynamic model developed by ATM and ECE (2004) was used to investigate fluxes into and out of Roberts Bay North for existing conditions (Janicki Environmental, 2010). These fluxes were across the boundary between Roberts Bay North and Sarasota Bay to the north and across the boundary between Roberts Bay North and Little Sarasota Bay to the south. Over a 2-year simulation period, water mass transfers between Roberts Bay North and Sarasota Bay to the north were about twice as large as those between Roberts Bay North and Little Sarasota Bay to the south. This is to be expected given that Big Sarasota Pass is adjacent to the northern end of Roberts Bay North, so that the influence of the tidal signal is stronger across the northern boundary of Roberts Bay North, resulting in more water movement across this boundary.

Modeling was also used to estimate residence times in Sarasota Bay segments (Janicki Environmental, Inc., 2010). Segment-specific residence times ranged from 28.8 days for Sarasota Bay to 2.8 days for Roberts Bay North and represent the median hydraulic residence time within each segment given the observed conditions of 1994–2007. The residence times, which were based on a monthly scale, varied little over the 1994–2007 period with a range of 2–3 days for Sarasota Bay and were virtually unchanged for Roberts Bay North. More variability would be observed using a different time scale that would identify the signature of individual tidal cycles.



Maintenance of the passes enhances circulation in the bay and provides ecological benefits. However other cultural activity has reduced circulation as well as diminished the extent of estuarine habitats. Two examples are Lido Key, which was formed from several small mangrove islands in the late 1920s, and Bird Key, which was constructed of fill material taken from shallow grass beds during the early 1960s. These two artificial uplands near Big Pass have both reduced the benefits of tidal interactions with the Gulf of Mexico and have replaced natural habitats with urban development.

4.4 SEDIMENT CHARACTERISTICS

Sediments in the bay were characterized by Knowles and Davi (1983) and are reported to consist of (1) fine to very fine quartz sand contributed by littoral drift and reworking of older deposits, (2) fine to coarse quartz and phosphatic sand contributed by Tertiary carbonates and Pleistocene terrace deposits, (3) biogenic carbonate debris that is produced within the bay and/or derived from the nearby Gulf of Mexico, and (4) clay minerals derived from weathering of nearby carbonates and shales. These findings were corroborated by Cutler and Leverone in 1993. Bedrock beneath the bay ranges from 0 to 25 feet below present sea level and is largely responsible for the present aerial configuration of Sarasota Bay (Knowles and Davi, 1983).

Sediments are an important component of the estuarine ecosystem. Sediment characteristics can affect habitat type by providing stable substrate for vegetation and benthic organisms. Local flora and fauna can in turn change sediment characteristics, for example by the accumulation of organic detritus around mangrove roots and the cycling of material caused by burrowing benthos. Sediments also influence the fate of chemicals released into the water column, e.g., clay particles binding metals, phosphorus, and organic compounds.

Physical transport of sediment also influences circulation and flushing, which can affect water quality and navigation. Dredging activities in the bay, including dredge and fill projects and channel excavation and maintenance, have resulted in deep holes that act as sediment traps, especially for fine-grained particles. Channel dredging has also created spoil islands, some of which have become vegetated with mangroves. These created habitats include Sister and Jewfish Keys south of Anna Maria Pass along the ICW.



5.0 PUBLIC LANDS

The majority of the Sarasota Bay Watershed has been altered, leaving only isolated natural and conservation areas, most of which are under public ownership ([Figure 5-1](#) and [Table 5-1](#)). Fortunately, since 1999 the County's Environmentally Sensitive Lands Protection Program (ESLPP) has been protecting the remaining natural lands through acquisition and less-than-fee simple methods by willing sellers. Designated natural and conservation areas make up only 7% of the entire watershed area and include Priority Sites, Protected Lands, Public Lands, and Developed Properties Preserves ([Figure 5-1](#)).

Priority sites are unprotected lands identified by ESLPP as priorities for future protection. Priority sites within the County are ranked on environmental criteria, including connectivity, water quality, habitat rarity, land quality, and manageability. The County's ESLPP continually works to acquire and protect natural lands.

Protected lands are those lands protected through the ESLPP program, which is funded by a 0.25-mill ad valorem tax that passed by referendum in March 1999 and was extended through 2029 by a second referendum in November 2005 (includes fee simple acquisitions, conservation easements, and lands protected through partnerships between ESLPP and other agencies/authorities).

Public lands are the major public (State, County, City) natural areas in Sarasota County as defined by Sarasota County Resource Management. Some portion of the area has been identified as having conservation, preservation, or mitigation uses. The Florida Natural Areas Inventory (FNAI) has also identified public lands in the watershed as having natural resource value. These lands are therefore being managed by the State, Local, or Federal government for conservation purposes.

Developed properties preserves are preservation, conservation, and mitigation areas in private developments in Sarasota County as depicted in Land Development Regulation site development plans or Sarasota County plat books.

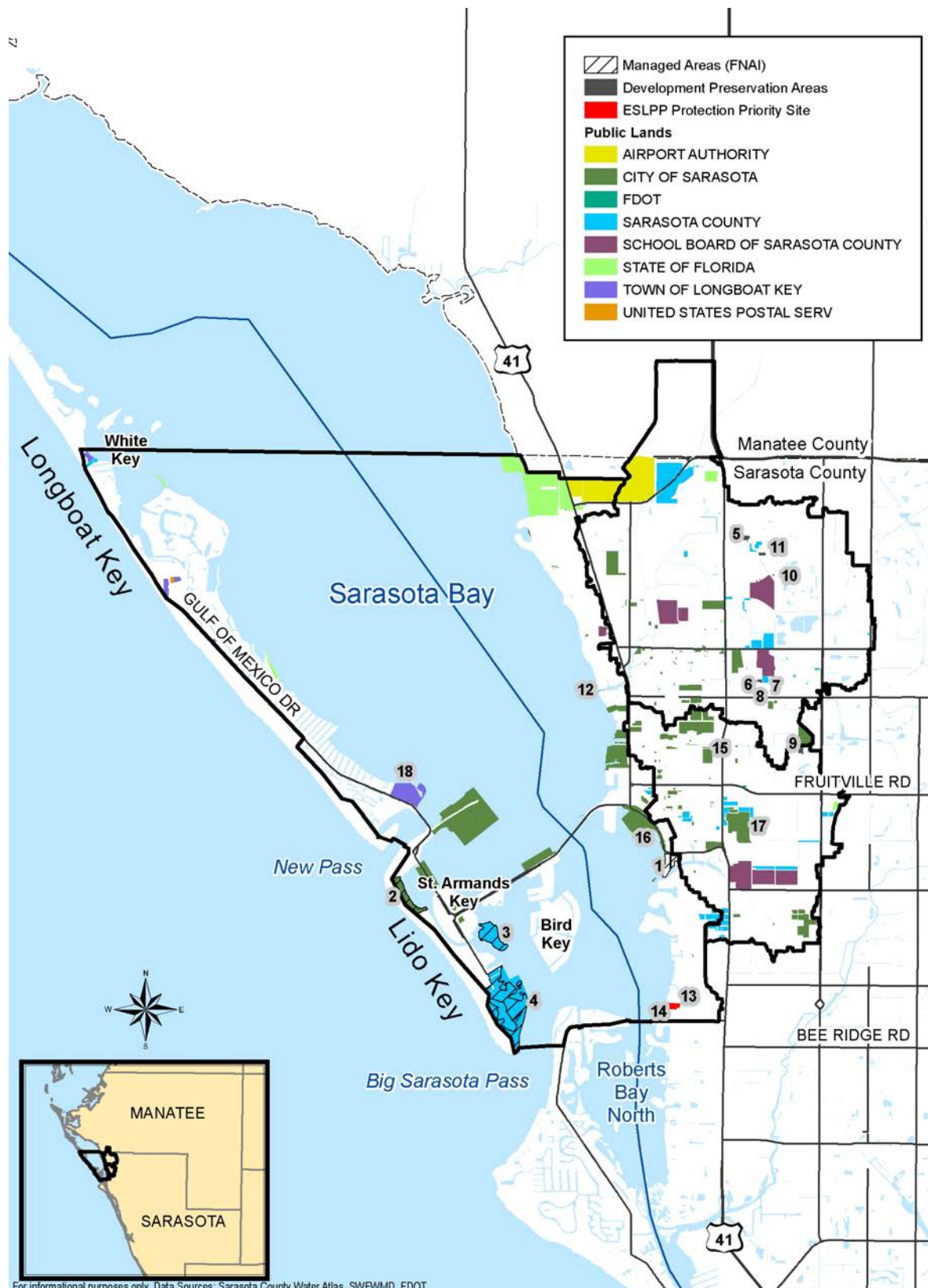


Figure 5-1 Sarasota Bay Watershed Public Lands



Table 5-1 Sarasota Bay Watershed Public Lands

Map ID	Name	Managing Agency	Type
1	Marie Selby Botanical Gardens	Marie Selby Botanical Gardens	FNAI
2	North Lido Public Beach	City of Sarasota	FNAI
3	Otter Key	Sarasota County	FNAI
4	South Lido County Park	Sarasota County	FNAI
5	Anchor Industrial Park of Sarasota Wetland	Community	Preservation Area
6	Harvest Acres Forested Wetland A	Community	Preservation Area
7	Harvest Acres Forested Wetland B	Community	Preservation Area
8	Harvest Acres Uplands	Community	Conservation Easement, Preservation Area
9	Lord's 1st Addition Wetland	Community	Preservation Area
10	Spring Oaks Wetland	Community	Preservation Area
11	Spring Oaks Wetland	Community	Preservation Area
12	Whitaker's Landing Wetland	Community	Conservation Easement
13	Private	ESLPP	Priority Site
14	Private	ESLPP	Priority Site
15	Gillespie Park	City of Sarasota	Park
16	Island Park	City of Sarasota	Park
17	Payne Park	City of Sarasota	Park
18	Quick Point Preserve	Town of Longboat Key	Park



Some of the areas important to sustaining natural resources include South Lido Park, Otter Key, North Lido Beach Park, and Quick Point Nature Preserve.

South Lido Park ([Figure 5-2](#)) is 159 acres of mangrove forests, pine flatwoods, and coastal hammocks at the southern tip of Lido Key. The park is bordered by the Gulf of Mexico, Big Pass, Sarasota Bay, and Brushy Bayou. This County-owned park boasts natural beaches, birding opportunities, and a paddling trail through a rich and diverse ecosystem. The substantial seagrasses in this lagoonal area provide food and protection for channeled whelk, hermit crabs, and mullet among other marine animals. The area is rich in coastal mangroves and mangrove islands, providing habitat for juvenile fish and large nesting water birds such as brown pelicans, great blue herons, and great egrets. This park is well-known for scenic landscapes and wildlife viewing.



Figure 5-2 South Lido Park
(photo credit: Simona Duque, Sarasota County Water Atlas)

Otter Key, a 30-acre mangrove island east of Lido Key, is another County park. This island also accommodates a number of waterfowl and juvenile fish and is frequented by kayakers and wildlife enthusiasts ([Figure 5-3](#)).



Figure 5-3 Kayak and Canoe trails in the Mangrove Tunnels near South Lido Beach and Otter Key
(photo credit: Bruce Maloney, Sarasota County Water Atlas)



North Lido Beach Park was purchased in 1977 by the City of Sarasota to be preserved as a natural wildlife habitat and is one of the finest examples of a natural coastal dune system in public ownership. The park's 77 acres of natural beach is host to many local and migratory shore birds. A great horned owl as well as an occasional bald eagle has been spotted in the park. The park is also an important sea turtle nesting site. Bordering the bayside of North Lido Beach Park is Pansy Bayou, which is frequented by manatees. North Lido Beach Park is within walking distance from St. Armands Circle and offers visitors a white sandy beach, fishing, swimming, and a nature trail ([Figure 5-4](#)).



Figure 5-4 North Lido Beach Park
(photo credit: Deborah Zeilman, Sarasota County Water Atlas)

Quick Point Nature Preserve is 34 acres of grassflats, mangrove forest, salt marsh, natural and man-made lagoons, and upland coastal hammock on the southern tip of Longboat Key. This preserve has approximately 3,000 feet of shoreline on Sarasota Bay and New Pass ([Figure 5-5](#)). Home to whelks, conchs, juvenile crabs, and many kinds of small fish, including mullet and black drum, the lagoon also attracts wading birds such as the snowy egret, white ibis, and great blue heron. This preserve, owned



Figure 5-5 Quick Point Nature Preserve Natural Mangrove Lagoon
(source: <http://longboatkey.org>)



and maintained by the Town of Longboat Key, offers nature trails, boardwalks, a canoe or kayak launch, and fishing docks, as well as educational signage (Figure 5-6 and Figure 5-7).

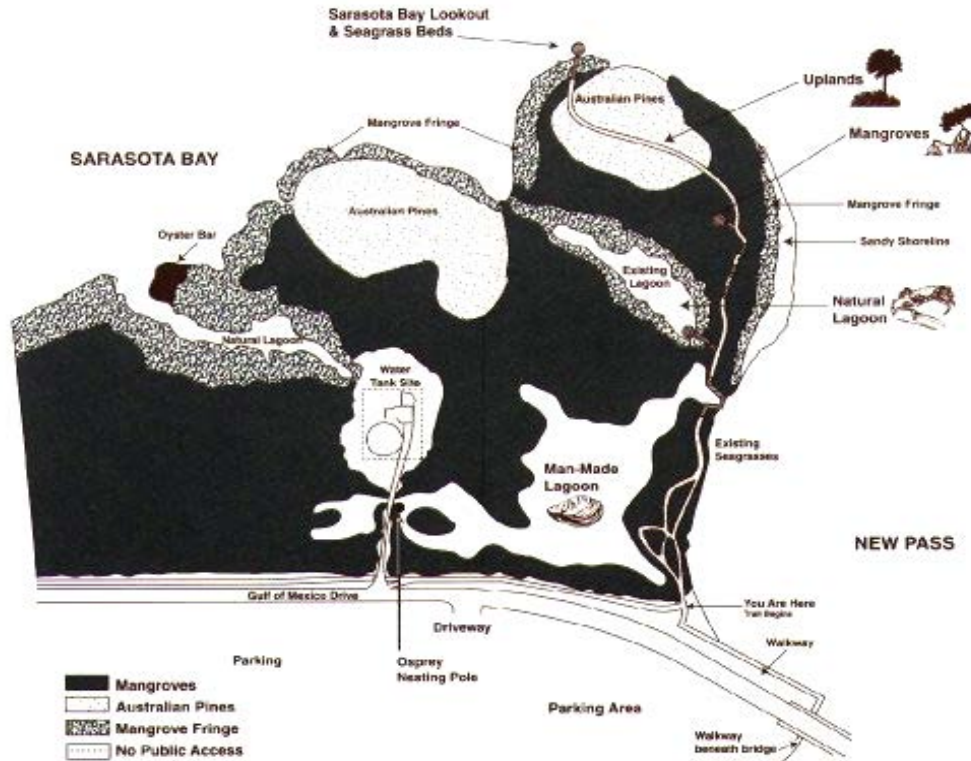


Figure 5-6 Quick Point Nature Preserve Habitats
(source: <http://longboatkey.org>)



Figure 5-7 Entrance to Quick Point Nature Preserve
(photo credit: <http://discovernaturalsarasota.org>)



6.0 THREATENED AND ENDANGERED SPECIES

Preservation lands preserve habitat for many threatened and endangered native species, including Florida scrub jays, eagles, gopher tortoises, manatees, and sea turtles.



Figure 6-1 Florida Scrub Jay

The Florida scrub jay was added to the State threatened species list in 1975 and the Federal threatened species list in 1987 ([Figure 6-1](#)). Named for its habitat, the scrub jay prefers the sandy, arid Florida scrub. Unfortunately, Florida scrub is also attractive for its high development potential, which threatens the Florida scrub jay's habitat and existence. Protection of the Florida scrub jay and its habitat is enforced by U.S. Fish and Wildlife Service (USFWS). Development proposals are reviewed by USFWS to determine how impacts may be avoided, minimized, or mitigated. USFWS must release a property before the County can issue any development permits for a parcel. Coordination with the Florida Fish and Wildlife Conservation Commission is also required.

Although removed from the Federal list of Threatened and Endangered Species in August 2007, the bald eagle is still protected by Federal (Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act) and State law (Florida Statute 372.0725) ([Figure 6-2](#)). Eagles are very sensitive to human activity and require nesting areas free from human activity. There are approximately 1,133 bald eagles in Florida and 41 reported active nests in Sarasota County (scgov.net). If a nest has been sighted or reported on or near a property, Sarasota County requires proof of coordination with the U.S. Fish and Wildlife Service (USFWS) before a building permit can be issued.



Figure 6-2 Bald Eagle



Figure 6-3 Gopher Tortoise
(source: fws.gov)

The gopher tortoise ([Figure 6-3](#)) is another endangered species that lives in Sarasota County. Like the scrub jay, the tortoise prefers dry/xeric habitats, such as scrubs, coastal dunes, and pine flatwoods. Habitat destruction from development has reduced the tortoise's habitat area and diminished the overall gopher tortoise population throughout the state and Sarasota County. The ESLPP lands provide a much-needed haven for many species, including this reptile. In turn, the tortoise's burrow is used by several other threatened species for shelter, such as the indigo snake, gopher frog, and the Florida mouse.



Figure 6-4 Loggerhead Turtle
(source: fws.gov)

Sarasota County and the City of Sarasota protected lands also provide a safe nesting habitat for sea turtles. Sarasota County has the highest density of sea turtle nesting on the Gulf Coast of Florida and has supported nesting of the Kemp's ridley, loggerhead ([Figure 6-4](#)), leatherback turtle, and green sea turtles. The ridley and the leatherback are two of the most endangered species of sea turtles. The Sarasota County Comprehensive Plan requires that special measures be taken to protect sea turtles and their habitats (scgov.net).

Sarasota County is one of 13 counties designated as a priority protection site for the West Indian Manatee ([Figure 6-5](#)), which is protected by State and Federal law. Sarasota County adopted a Manatee Protection Plan in September 2003 (scgov.net). The Sarasota County Government Online website (scgov.net) states that the plan includes:

- ❖ An inventory of boat facilities.
- ❖ An assessment of boating and activity patterns.
- ❖ Manatee sighting and mortality information.
- ❖ A boat facility siting plan—to determine the best areas for new marinas, boat ramps, etc.
- ❖ Manatee protection measures, such as boating speed regulations in areas with high boat and manatee usage.
- ❖ Information on aquatic preserves, OFWs, ports, manatee refuges, etc. within the County.
- ❖ An education and awareness program for the public and boaters, divers, and school children.
- ❖ A water quality and habitat protection program (including land acquisition and aquatic plant control plans for manatee areas).



Figure 6-5 West Indian Manatee
(source: fws.gov)

More information on threatened and endangered species and critical habitat can be found in Appendix D (Natural Systems) of this plan.



7.0 RECREATIONAL FACILITIES

Sarasota County, the City of Sarasota, and the Town of Longboat Key operate 56 public recreational facilities totaling about 710 acres within the watershed ([Table 7-1](#)). These sites include sports facilities, natural areas, neighborhood parks, and beach and boat access parks. The parks range in size and land use from urban sites of under an acre to several large natural area parks. The parks are scattered throughout the watershed, as shown in [Figure 7-1](#).

The recreational facilities provide several public services, including active recreation (softball, golf, boating, etc.) and passive recreation (picnicking, bird watching, etc.). Several of the recreational facilities also protect natural resources. South Lido Park, for example, a 159-acre conservation area wedged between Sarasota Bay and the highly urbanized gulf coast of Lido Key, offers refuge to wildlife.

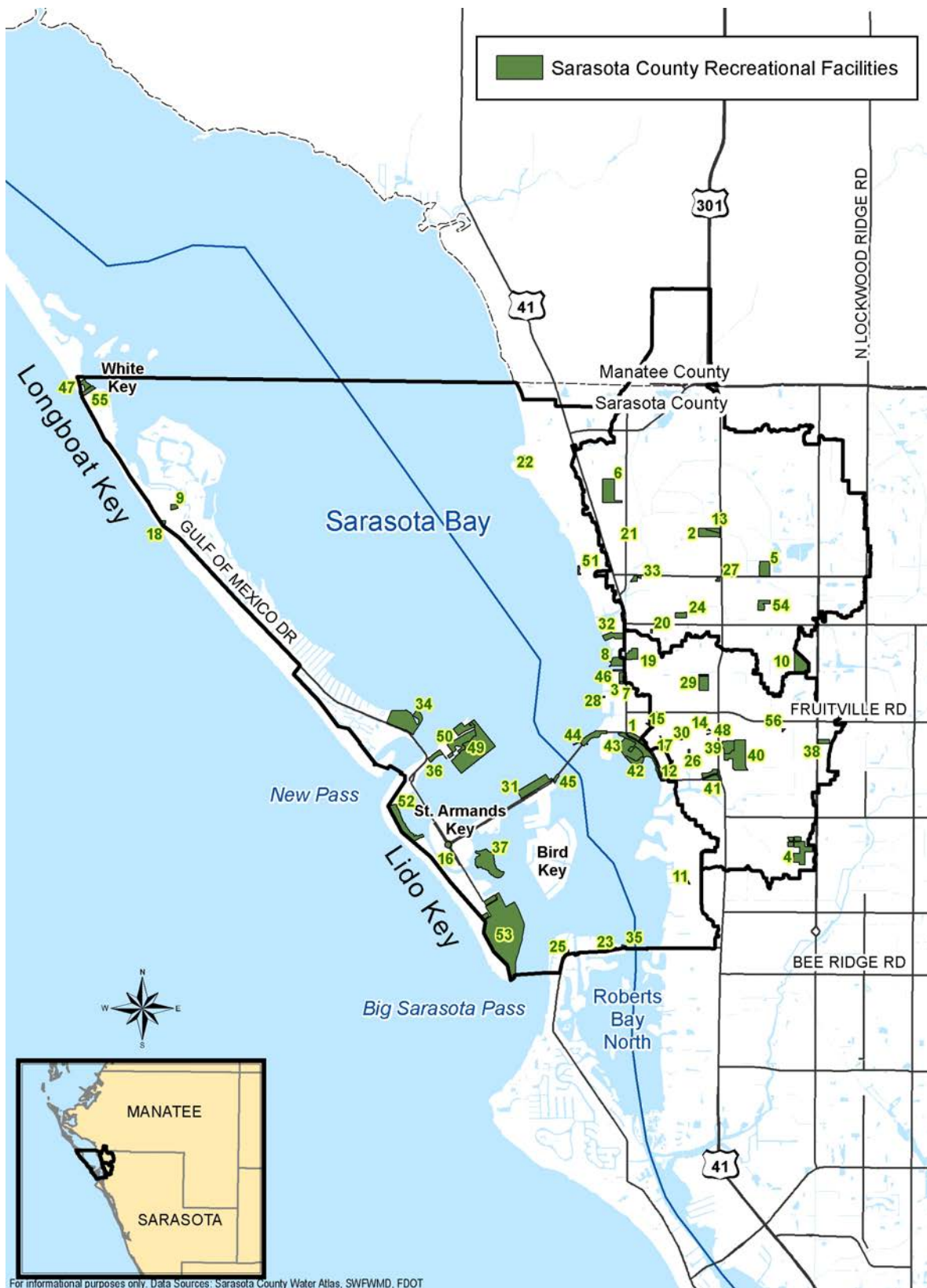


Figure 7-1 Sarasota Bay Watershed Recreational Facilities



Table 7-1 Sarasota Bay Watershed Area Recreational Facilities

Map ID	Name	Park Class	Acres	Owner
1	Bayfront Park East 41	Community Park	7.8	City of Sarasota
2	Robert L Taylor Community Complex	Community Park	10.2	City of Sarasota
3	Bayfront Community Center	Community Park	0.2	City of Sarasota
4	Arlington Park and Aquatic Complex	Community Park	22.4	City of Sarasota
5	Newtown Estates Park	Community Park	10.5	Sarasota County
6	North Water Tower Park	Community Park	21.4	City of Sarasota
7	Municipal Auditorium at Centennial Park	Community Park	0.5	City of Sarasota
8	Centennial Park Sarasota	Community Park	9.5	City of Sarasota
9	Longboat Key Tennis Center	Athletic Complex	2.4	Town of Longboat Key
10	Ed Smith Sports Complex and Parking	Athletic Complex	50.8	City of Sarasota
11	McClellan Parkway Park	Neighborhood Park	0.2	City of Sarasota
12	Little Five Points Park	Neighborhood Park	0.1	City of Sarasota
13	Cohen Park	Neighborhood Park	3.2	City of Sarasota
14	Links Plaza Park	Neighborhood Park	0.2	City of Sarasota
15	Selby Five Points Park	Neighborhood Park	0.5	City of Sarasota
16	St Armands Circle Park	Neighborhood Park	2.2	City of Sarasota
17	Pineapple Park	Neighborhood Park	0.2	City of Sarasota
18	Bicentennial Park	Neighborhood Park	1.0	Town of Longboat Key
19	Pioneer Park	Neighborhood Park	7.8	City of Sarasota
20	Mary Dean Park	Neighborhood Park	0.5	City of Sarasota
21	Firehouse Park	Neighborhood Park	1.7	City of Sarasota
22	Sapphire Shores Park	Neighborhood Park	0.7	City of Sarasota
23	Norasota Way Park	Neighborhood Park	0.3	City of Sarasota
24	Orange Avenue Park	Neighborhood Park	4.3	City of Sarasota
25	Galvin Park	Neighborhood Park	0.2	City of Sarasota



Table 7-1 Sarasota Bay Watershed Area Recreational Facilities

Map ID	Name	Park Class	Acres	Owner
26	Laurel Park Sarasota	Neighborhood Park	0.5	City of Sarasota
27	Fred Glossie Atkins Park	Neighborhood Park	0.9	City of Sarasota
28	Waterfront Park at Centennial Park	Neighborhood Park	0.4	City of Sarasota
29	Gillespie Park	Neighborhood Park	10.6	City of Sarasota
30	Charles Ringling Park	Neighborhood Park	0.2	City of Sarasota
31	Bird Key Park	Neighborhood Park	19.5	City of Sarasota
32	Whitaker Gateway Park	Neighborhood Park	8.4	City of Sarasota
33	Dr Martin Luther King Jr Park	Neighborhood Park	2.6	City of Sarasota
34	Quick Point Nature Preserve	Preserve	37.4	Town of Longboat Key
35	Bay Island Park North	Reserve	0.6	City of Sarasota
36	Bay Walk Park	Reserve	4.6	City of Sarasota
37	Otter Key	Bay Islands	29.7	Sarasota County
38	Girls Inc Property	Community Park	3.3	Sarasota County
39	Payne Park	Community Park	9.2	City of Sarasota
40	A B Smith Park	Community Park	30.9	City of Sarasota
41	Lukewood Park	Community Park	8.0	City of Sarasota
42	Bayfront Park and Marina	Community Park	21.4	City of Sarasota
43	Bayfront Park and Marina Submerged Lands	Community Park	21.1	City of Sarasota
44	Harts Landing	Community Park	10.0	City of Sarasota
45	John Ringling Causeway Park	Neighborhood Park	1.6	City of Sarasota
46	Lawn Bowling Civic Center	Community Park	2.9	City of Sarasota
47	Bayfront Park Recreation Center	Athletic Complex	4.2	Town of Longboat Key
48	Roberts Memorial Park	Neighborhood Park	0.1	City of Sarasota
49	Ken Thompson Park Submerged Lands	Community Park	63.3	City of Sarasota
50	Ken Thompson Park	Community Park	29.6	City of Sarasota
51	Indian Beach Drive Park	Neighborhood Park	1.0	City of Sarasota



Table 7-1 Sarasota Bay Watershed Area Recreational Facilities

Map ID	Name	Park Class	Acres	Owner
52	North Lido Beach	Beach Access Park	67.6	City of Sarasota
53	South Lido Park	Beach Access Park	151.9	Sarasota County
54	Lime Lake Park	Neighborhood Park	5.7	Sarasota County
55	Longboat Key Site	Water Access Park	3.6	Sarasota County
56	Ringling Blvd Site	Neighborhood Park	0.4	Sarasota County



8.0 PUBLIC EDUCATION

Sarasota County, the City of Sarasota, and other organizations promote environmental stewardship. They help individuals, community-based organizations, businesses, schools, and others undertake watershed restoration initiatives in Sarasota County through public outreach and education. Education regarding topics including natural resources, forestry, watershed management, recycling, and overall county government structure is provided regularly. Keep Sarasota County Beautiful manages several outreach programs including the yearly Coastal Clean-up, Adopt-a-Road, Adopt-a-Park, and Adopt-a-Shore. The County's Neighborhood Services Department offers classes and workshops on how to improve and maintain communities and provides grants to implement what residents have learned to enhance their neighborhoods' character, value, safety, health, and infrastructure.

The County's Neighborhood Environmental Stewardship Team (NEST) is a volunteer organization partnering with residents to increase awareness of the importance of native habitats and watersheds in the community. NEST's primary purpose is to provide constructive and meaningful activities for people to improve the environmental quality of their watershed and neighborhoods while expanding the knowledge base and advocacy for watershed improvements.

The NEST program encourages people to interact with nature through enjoyable and hands-on activities. The NEST idea was initiated during the development of the Lemon Bay Ecosystem Restoration Project in 2001 as an opportunity for residents (neighbors, civic groups, student organizations) to actively work with land managers and restoration ecologists in restoring the native habitats of the preserve. During this initial project, citizens from the surrounding neighborhoods participated in water quality monitoring, fish sampling, a frog listening network, trash and invasive plant removal, native plantings, and a scrub-jay watch program.

In addition to Sarasota County, the City of Sarasota and organizations such as SWFWMD, SBEP, FDEP, Mote Marine Laboratory, University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Extension, and many small non-profit organizations play a key role in educational outreach in the Sarasota Bay watershed area. [Table 8-1](#) summarizes the various organizations and their respective educational outreach programs.

The following describes some of the partner public education programs:

SWFWMD offers a multitude of training, incentives, grants, and educational materials. The SWFWMD educational website, www.swfwmd.state.fl.us/education/, offers free materials and expert speakers, current funding opportunities, and web activities that teach readers about watersheds, conservation, and water quality.



Table 8-1 Public Outreach Programs

Entity	Outreach Programs
Sarasota County	NEST (Neighborhood Environmental Stewardship Team) voluntary association of people - neighbors, civic groups, student organizations, and others who want to improve environmental conditions in their watershed.
	Recycling (publication; community, and school education)
	Discover Natural Sarasota County (publication)
	Keep Sarasota County Beautiful (Adopt-a-Road, -Park, -Pond, -Shore, and -Spot; portable pocket ashtrays, Bag-it-in-Your-Car-Day)
	Public Service Announcements and County Talk (Comcast TV 19 / Verizon 32)
	Improves communications between citizens and government; fosters increased citizen involvement
	Neighborhood, Urban, and Canopy Road Tree Programs (design, selection and planting services)
	Grant Program (helps residents enhance their neighborhoods' character, value, safety, health and infrastructure)
	Neighborhood University Program (classes and workshops designed to inform residents of Sarasota County on how to improve and maintain their communities and neighborhoods)
Florida Department of Environmental Protection	Florida Yards (FloridaYards.org; a project of the Florida Springs Initiative)
	Green Lodging Facilities Program (recognizes and rewards environmentally conscientious lodging facilities)
	Clean Marinas Program (Clean Marina Designation status is awarded to marinas and boatyards that demonstrate continued commitment and protection to the water and marine life.)
Sarasota Bay Estuary Program	Protection, Involvement, Restoration and Education (PIER) – (provides funding and technical assistance to environmental education and research programs.)
	Bay Buddies (established to get everyday people involved in making a difference in their community)
	Funding for Bay-Friendly Projects (Bay Education, Bay Restoration, and Bay-Friendly Landscapes promote environmental education, awareness and stewardship)
	Publications (State of the Bay, A Chronicle of Florida Gulf Coast, Bay Reflections, etc.)



Table 8-1 Public Outreach Programs

Entity	Outreach Programs
Southwest Florida Water Management District	Florida Friendly Landscapes (education program that promotes the use of Florida-friendly landscaping to homeowners, builders, developers and landscape and irrigation professionals; partner to University of Florida's Florida Yards & Neighborhoods Program)
	Training (interdisciplinary water education programs including Project WET; Healthy Water, Healthy People; Great Water Odyssey; etc.)
	Funding (Mini-Grants, Community Grants)
	Web Activities (Learn about watersheds, Splash! Activities, Monitoring)
	Educational materials (free publications and materials for adults and children including Water Matters, Water Matters Hispanic outreach, Florida Waters, Watershed Excursion, etc.)
	FARMS Program (Facilitating Agricultural Resource Management Systems), an agricultural best management practice cost-share reimbursement program involving both water quantity and water quality aspects; developed with the Florida Department of Agriculture and Consumer Services)
	Water Conservation Hotel and Motel Program (Water C.H.A.M.P.) (helps hotels and motels save water and money while practicing more efficient housekeeping and landscaping)
Mote Marine Laboratory	Center for School & Public Programs (on-site learning experiences for schools, families and other professional and social organizations)
	Center for Volunteer & Intern Resources (direct training and active educational experiences)
	Center for Distance Learning (interactive videoconferencing to engage students in interactive live programs)
	Mote TV (educational videos)
City of Sarasota Environmental Management Task Force (EMTF)	Your Green City (yourgreencity.sarasotagov.com) serves as the outreach and public information arm of the City of Sarasota Environmental Services Division. The website is extensive and offers tips on recycling, landscaping, water conservation, jobs, upcoming events, and more.



Table 8-1 Public Outreach Programs

Entity	Outreach Programs
University of Florida IFAS Extension	Florida Yards & Neighborhoods partners with national, state, and local agencies to teach Florida-friendly landscaping
	BMP Training meets the requirements of the Sarasota County Fertilizer Ordinance for landscape company employees who apply fertilizers.
	Master Gardener Program trains volunteer educators to provide information to Floridians about gardening, environmental horticulture, and pest management.
	Rain Barrel Workshops are classes on the construction and use of rain barrels and their environmental benefits. Sarasota County currently sells rain barrels for \$37 each after the class.
	The Florida House will re-open in Fall 2010. Florida House is a demonstration facility, which offers education classes and tours.
Other Non-profit Organizations	1000 Friends of Florida, Science and Environment Council of Sarasota County, Florida House Institute



SBEP's Protection, Involvement, Education, and Restoration (PIER) program provides local teachers with a free curriculum about coastal habitats, invasive species, watersheds, and fire ecology as well as free field trips to parks around Sarasota Bay. SBEP also provides many educational publications and grants.

The UF/IFAS Extension program is a partnership between the University of Florida, State, Federal, and county governments to provide scientific knowledge and expertise to the public (UF/IFAS). The UF/IFAS County Extension in Sarasota offers a multitude of free educational courses to community related to natural resource sustainability, such as Florida Yards & Neighborhoods, the Master Gardener Program, and Rain Barrel Workshops.

The UF/IFAS Extension Program has unique demonstration facility in Sarasota County. The Florida House Learning Center is a model home and landscape that demonstrate green building and sustainable living. It was originally conceived as an educational outreach for water conservation after a severe regional drought in the late 1980s and was organized by UF/IFAS and interested citizens. The Florida House features water and energy-conserving designs and devices; Energy Star® appliances; renewable resources such as cork flooring, recycled plastic carpet, and a "Model Florida Yard." The Florida House is believed to be one of the first such educational demonstration facilities in the country (Figure 8-1) (Florida House Learning Center History, 2007—<http://sarasota.extension.ufl.edu/FHLC/FLHouseHistory.shtml>).



Figure 8-1 Florida House
(<http://sarasota.extension.ufl.edu/FHLC/FLHouseHistory.shtml>)



9.0 CONCLUSION

The Sarasota Bay watershed provides resources for the economy, recreation, and wildlife. Clean water resources, healthy streams, and safety from flooding are important for residents, businesses, and the local economy. Although the entire bay currently meets State water quality standards, some of the watershed's stream segments have listed impairments. Managing water and other natural resources is necessary to sustain the economy and environmental health of your community. Fortunately, advances in stormwater system technology and building techniques, combined with today's more stringent building codes, can better help balance the needs of the environment with those of the community.

This plan presents a scientific and community-based approach for formulating, evaluating, prioritizing, and implementing watershed management actions. These actions will be holistic in recognition of the relationships and interdependencies of watershed functions as well as the related goals of state, regional, and federal partners.

The Sarasota Bay Watershed Water Quality Management Plan balances the goals of restoring natural systems, enhancing water quality, ensuring the sustainability of the water supply, and protecting against floods while expanding recreational and educational opportunities. This plan summarizes past, present, and future watershed conditions and goals. The plan also contains recommendations for activities to help us reach these goals and progress toward sustaining and enhancing the health of our watershed.

Watershed management requires a holistic approach to protecting water resources, one that integrates all of the physical and biological components of the landscape.