SOUTHERN COASTAL WATERSHED

COMPREHENSIVE WATERSHED MANAGEMENT PLAN

Prepared by:
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CHAPTER I

EXECUTIVE SUMMARY

The Southwest Florida Water Management District (District) recently developed the Comprehensive Watershed Management (CWM) Program for water resource assessment and planning on a watershed-wide basis. The CWM Program was designed to allow for careful evaluation of the status of water resources on a regional basis, with special attention paid to the District's primary Areas of Responsibility (AOR's): 1) water supply, 2) flood protection, 3) water quality, and 4) natural systems. This document represents the first draft of the CWM Program effort focusing on the Southern Coastal Watershed.

The Southern Coastal Watershed contains the watersheds of Sarasota Bay, Dona and Roberts Bays, Lemon Bay, and Gasparilla Sound. These watersheds are south and west of the watersheds of the Manatee and Myakka Rivers, and north and west of the watershed of the coastal basin of the Charlotte Harbor estuary. The Southern Coastal watershed is highly developed, particularly in the northern portions in Manatee and Sarasota County. Fortunately, many resource assessments have been completed in the Southern Coastal Watershed, and much information already exists to aid in the evaluation of potential issues associated with the above-mentioned AOR's.

After reviewing available information gathered from completed and ongoing efforts, the following issues have emerged as priorities.

For Water Supply, there is a need to: 1) seek inclusion of water resource/land use planning as a consistency requirement for Local Government Comprehensive Plans, 2) improve compliance with water shortage restrictions and year-round conservation measures, 3) develop alternative water sources, 4) adopt minimum aquifer levels for the Intermediate Aquifer, 5) improve coordination between land and water planners, and 5) promote conservation and reuse.

For Flood Protection, there is a need to: 1) enhance flood protection data collection and management efforts, 2) acquire additional floodplain information, 3) effectively manage and/or regulate for increased runoff associated with urbanization of the watershed, 4) coordinate water resource planning and land use planning, 5) determine ownership, operation and maintenance responsibilities for flood management systems, 6) seek consistent sources of funding for flood management systems, and, 7) educate the public on the role that floodplains play in flood protection and the probability of flood events in low-lying areas.

For Water Quality, there is a need to: 1) continue ongoing monitoring and data management activities in Sarasota and Manatee Counties, 2) expand ongoing monitoring and data management activities into Charlotte County, 3) determine the potential ecological

consequences of increased nutrient loads into Lemon Bay, 4) develop a detailed hydrologic model to better understand the ecological impacts associated with flood control practices in the Cow Pen Slough sub-basin, 5) continue ongoing efforts to reduce wastewater-related point and non-point source pollutant loads throughout the watershed, and 6) continue ongoing efforts to reduce stormwater-related non-point source loads throughout the watershed.

For Natural Systems, there is a need to: 1) continue ongoing efforts focused on enhancing, restoring and creating wetlands in the watershed, and 2) protect existing natural systems within the watershed through purchase and the use of conservation easements.

Background information that led to the prioritization of these needs is found in chapters relating to the District's AOR's - water supply, flood protection, water quality, and natural systems. The desire of the individuals who helped to develop the Southern Coastal Watershed Management Plan is that this document would be modified and updated regularly, as required. It is hoped that most of the projects outlined within this text will be funded and completed through the combined efforts of the appropriate federal, state, regional and local governments.

Many thanks are due to the members of the Southern Coastal CWM Team for their long hours spent on this project.

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CHAPTER II

INTRODUCTION

COMPREHENSIVE WATERSHED MANAGEMENT

The District's Comprehensive Watershed Management (CWM) Program is a watershed approach to water management. This approach is the most effective way to integrate a variety of resource activities. This program is the District's response to the recent federal and state ecosystem management focus. From a hydrologic standpoint, watersheds are a logical unit within which to apply the ecosystem concept. In fact, the District Governing Board made CWM an FY-94 Strategic Initiative that directed staff and funding resources to this project. Additionally, a majority of the District Basin Boards have also made watershed assessments a priority for future cooperative funding proposals and projects.

A staff workgroup was convened to develop and implement the CWM Program. The workgroup consists of members from several District departments including resource-based and management support representatives. This group developed three primary goals for the CWM Program:

1. To identify and prioritize existing and potential water resource issues within the District relating to Water Quality, Flooding, Water Supply, and Natural Systems.

2. To develop strategies for remedial or protective action(s) to address the water resource issues identified in Goal #1.

3. To implement the strategies in Goal #2 and monitor their effectiveness.

The District is applying this CWM Program approach to 13 watersheds to protect and/or restore their water resource assets. These 13 watersheds are an aggregate of the 16 that comprise the 16-county region as recognized by the Resource Regulation Department.

The CWM Program, similar to the development of Surface Water Improvement and Management (SWIM) Plans and Comprehensive Conservation and Management Plans through the federally-initiated National Estuary Program (NEP), will also produce several additional benefits. First, by focusing on more defined areas within the District, problems and solutions can be addressed within the constraints of limited funds. Secondly, the interconnective aspects of the watershed approach are more compatible with basic ecological principles. Evaluating the relationships between activities and natural systems will provide more effective surface water assessments and management plans. The links between terrestrial activities and habitats and their interactions with surface waterbodies can thus be accounted for. Thirdly, by clearly defining long-term goals the CWM Program plans will promote greater consistency in management planning and implementation and thus lead to more equitable management decisions.

The CWM Program approach to watersheds is very similar in concept to the Ecosystems Management philosophy now being employed by the Florida Department of Environmental Protection. The southern parts of the Southern Coastal Watershed around the Cape Haze peninsula lie within the Charlotte Harbor Ecosystem Management Area (EMA) and the Charlotte Harbor NEP study area and CWM Program efforts within the coastal basins will complement and reinforce the programs within the general Charlotte Harbor watershed, which also include the Myakka River, the Peace River and coastal basin areas. The northern portions of the watershed surround Sarasota Bay, which is also a NEP waterbody and a SWIM program waterbody. The Southern Coastal CWM Program team will help coordinate and complement efforts by various local governments, state and federal agencies, and non-governmental organizations throughout the watershed.

DISTRICT DIRECTIVES

Mission Statement

The CWM Program, as with all District activities, must be consistent with the District's mission. The Governing Board of the Southwest Florida Water Management District has adopted a formal Mission Statement, as follows:

The mission of the Southwest Florida Water Management District (the District) is to manage the water and water-related resources for the people through regulatory and other programs. Central to the mission is maintaining the balance between the water needs of current and future users while protecting and maintaining the natural systems which provide the District with its existing and future water supply.

The Governing Board of the Southwest Florida Water Management District assumes its responsibilities as authorized in Chapter 373 and other chapters of the Florida Statutes by directing a wide-range of programs, initiatives, and actions. These programs include, but are not limited to, flood control, regulatory programs, water conservation, education, and supportive data collection and analysis efforts.

Primary Areas of Responsibility and Goal Statements

The District's mission has been subdivided into four primary Areas of Responsibility (AORs). Goals have been developed to establish the long-term direction of programs and activities that address water resource issues. The four areas of responsibility and their respective goals are as follows:

WATER QUALITY: To protect water quality by preventing further degradation of the water resource and enhancing water quality where appropriate.

FLOOD PROTECTION: To minimize the potential for damage from floods by protecting and restoring the natural water storage and conveyance functions of flood prone areas. The District shall give

preference wherever possible to nonstructural surface water management methods.

NATURAL SYSTEMS: To protect, preserve and restore natural Florida ecosystems and to establish minimum water levels and flows necessary to maintain these natural systems.

WATER SUPPLY: To ensure an adequate supply of the water resource for all reasonable and beneficial uses, now and in the future, while protecting and maintaining the water and related resources of the District.

These regional water management goals build a bridge between the divergent functions of the District, local, other regional, state and federal agencies. This bridge creates common ground for consistent, coordinated action in the best interest of Florida citizens. The predominant theme of this Watershed Management Plan is the effective integration of land and water planning to achieve sound resource management and protection.

The AORs have been agreed upon by all five water management districts and the Florida Department of Environmental Protection as representative of our collective water management agenda. This coordinated decision was a development step of the comprehensive, 20-year District Water Management Plans (DWMP). The District's DWMP (1995a, b) identified the issues that led to the creation of the Comprehensive Watershed Management Initiative. It is that initiative that has resulted in the development of watershed management plans.

Additionally, the DWMP has adopted specific goals regarding the Southern Coastal Watershed:

WATER QUALITY: Historically, the major point source of pollution in the basin was the City of Sarasota wastewater treatment plant which discharges into Whitaker Bayou. The plant has been upgraded, with substantial reductions in discharged pollutant loads. The City continues to explore options to further improve its reuse programs, to further reduce pollutant loads. Agricultural and urban stormwater runoff is also a problem in this basin. The watershed contains numerous drainage ditches and residential canals which discharge to estuaries and the Gulf. Many of these manmade waterways do not have adequate circulation, allowing the build up of contaminants from stormwater runoff. Tributaries and direct runoff also supply the bay systems with heavy nutrient loading. High densities of septic systems constructed in areas of poor drainage and inappropriate soils pose a threat to surface water quality as well.

GOAL: Protect water quality in near shore coastal areas by working with federal and State agencies, local governments, and the public and by enforcing existing District regulations to prevent further degradation.

FLOOD PROTECTION: Tidal flooding and inland flooding are both problems in this watershed. Flood damage occurs where there is development in coastal and interior flood-prone areas. Since some of the most extensive flood damage can occur as a result of tidal surges associated with tropical storms, coastal development should be planned with this in mind. Local governments authorize land uses, and must be the first line of defense in flood prevention. Where development has already occurred in low lying coastal and inland areas, there must be an effort to reduce the potential for damage.

GOAL: Minimize potential for damage from floods by protecting and restoring the natural water storage and conveyance functions of flood prone areas.

NATURAL SYSTEMS: This watershed contains valuable upland and wetland areas which provide habitats for numerous listed species and provide recharge, runoff attenuation and water quality treatment benefits. Both Sarasota Bay and Charlotte Harbor have been designated as Estuaries of National Significance under the National Estuary Program (NEP). In addition, two Outstanding Florida Waters (OFW) water bodies (Sarasota Bay Estuarine System, and Lemon Bay Estuarine System are present. All, however, are threatened by increased boat traffic, shoreline hardening and the trimming of mangroves and other intertidal habitats and their replacement by lawns, landscaping and drainage canals.

GOAL: Protect, preserve and restore important upland and wetland systems.

WATER SUPPLY: Surface water from this watershed will not be a source of future potable supply due to the small size of streams. This area is in the Southern Water Use Caution Area (SWUCA) indicating a strain on existing ground water supply sources. Emphasis in this watershed will be on conservation and alternative supply sources.

GOAL: Maximize use of alternative supplies, including conservation, and protect surface water features from adverse impacts associated with water supply development and withdrawal.

The four resource-based primary areas of responsibility cover all aspects of water management and are strongly linked. For example, it is difficult and undesirable to separate the role of natural systems in assuring adequate water supplies for humans, or to sever the effects of flood protection actions on water quality downstream. As a result, some duplication is inevitable in dealing with complex water management programs that span more than a single area of responsibility. This plan will address all four areas of responsibility in a comprehensive and integrated manner for the Southern Coastal Watershed.

METHODS AND APPROACH

The general approach taken to develop the CWM Plan for the Southern Coastal Watershed was to evaluate existing data and analyses, examine existing and potential future activities

within the watershed, to develop a list of identified issues which need to be addressed, and to develop a two-part program, one part to implement District efforts and activities and one part toward guiding local government and private sector activities and land use practices within the watershed.

After initial data and literature search efforts within the District, state agencies, local governments were pulled in to provide their input and guidance to the development of the plan.

Further discussion under this section will outline more specifically the various efforts, processes, meetings, workshops, etc. that will help develop the adopted plan for the watershed. The plan will include a process for periodic revision and update and will eventually have a "five-year plan" component outlining projects, data collection, rule revisions, etc. which will be undertaken within specific time frames and for which adequate budgets are identified. The five-year plan will eventually be coordinated with the Manasota and Peace River Basin Boards' Five-Year Plans for the purposes of Basin Board Initiatives and the cooperative funding of appropriate projects.

LITERATURE CITED

SWFWMD (Southwest Florida Water Management District). 1995a. District water management plan, volume 1. Brooksville, Florida.

SWFWMD (Southwest Florida Water Management District). 1995b. District water management plan, volume 2. Brooksville, Florida.

CHAPTER III

WATERSHED DESCRIPTION

Section 3.1 Location

The Southern Coastal Watershed (Watershed) extends along the southwestern shore of Florida from the mouth of Tampa Bay to the mouth of Charlotte Harbor (Map 1 in Appendix). It is bounded to the north by the Tampa Bay/Anclote Drainage and the Manatee River Watershed, and to the east by the Myakka River watershed. More than 60 miles of barrier islands and the estuaries they protect are included in the Watershed. Most of the Watershed falls within the Manasota Basin of the Southwest Florida Water Management District, although the southernmost section lies within the Peace River Basin. The Watershed includes portions of Manatee, Sarasota and Charlotte Counties. Major urban centers include portions of Bradenton, as well as all of Sarasota and Venice.

Section 3.2 Climate

The climate of the Southern Coastal Watershed is humid subtropical, characterized by warm, wet summers and mild, dry winters. The annual average temperature at two closely spaced weather stations near Bradenton, at the northern end of the Watershed, is 72°F (period of record 1954-1993, NOAA 1993). At a Fort Myers station, about 25 miles south of the Watershed, the annual average temperature is 74° F (period of record 1961-1990, Southeast Regional Climate Center 1998). Monthly average temperatures range from the low to mid-eighties in July and August to the low sixties in January.

Annual rainfall averages about 56 inches per year at Bradenton and 53 inches per year at Fort Myers. Monthly rainfall is highest from June through September, when over half the annual rainfall occurs. Convective thunderstorms typically account for the bulk of precipitation during summer and early fall, often producing extremely intense localized rainfall events.

The evapotranspiration rate for the region including the Southern Coastal Watershed has been estimated at 39 inches per year (Dohrenwend 1977). Nearly 60% of the evapotranspiration occurs during the six-month period from May through October.

Section 3.3 Physiography and Soils

The Southern Coastal Watershed lies within the Gulf Coastal Lowlands and DeSoto Plain subdivisions of the central or mid-peninsular physiographic zone of Florida (White 1970). Most of the Watershed is within the Gulf Coastal Lowlands, which are nearly level plains extending the length of Florida's Gulf coast. A small segment of the Watershed drained by the upper reach of Cow Pen Slough lies within the DeSoto Plain, a broad, gently sloping plain extending from central Manatee County into the northwest corner of Glades County.

Elevations in the Southern Coastal Watershed are generally between 5 and 35 feet above the National Geodetic Vertical Datum.

The soils of the Southern Coastal Watershed may be classified into four groups: very poorly drained; poorly drained; somewhat poorly drained to moderately well drained; and poorly to moderately well drained (United States Department of Agriculture Soil Conservation Service 1983, 1984, 1991). Very poorly drained soils, including the Estero, Wulfert and Kesson groups are common in the tidal mangrove swamps. Poorly drained soils, including the Eau Gallie, Floridana, Wabasso, and Bradenton series are the dominant soils in the northern portion of the Watershed. To the south, in Sarasota and Charlotte Counties, the dominant soils are the Eau Gallie, Myakka, Holopaw, Pineda, and Imokalee series. Myakka, Waveland and Cassia soils, which are somewhat poorly drained to moderately well drained, occur in the northeastern section of the Watershed on the DeSoto Plain. The barrier islands along the western edge of the Watershed consist of poorly drained to well drained sandy soils of the Canaveral, Beaches, Kesson, Wulfurt, and Myakka groups.

Section 3.4 Hydrogeology

The Southern Coastal Watershed is underlain by numerous layers of sedimentary deposits which store, confine or provide conveyance for ground water. The principal hydrogeologic units of the Watershed include the surficial, intermediate and Floridan aquifer systems.

The surficial aquifer system in the Southern Coastal Watershed consists of unconsolidated sands, marl and shell originating from the Holocene and Pleistocene ages. These deposits are generally less than 50 ft thick throughout the Watershed (Barr 1996). Poor transmissivity and the shallow nature of the surficial aquifer in the area limit use of this system as a water supply.

The intermediate aquifer system includes permeable and impermeable sedimentary deposits lying between the surficial and Floridan aquifer systems (Southeastern Geological Society 1986). These deposits consist of undifferentiated sediments from the Pleistocene and Pliocene ages, and the Hawthorn Group of the Miocene age. Thickness of the intermediate aquifer systems varies from about 300-650 ft in the Southern Coastal Watershed (Barr 1996). The intermediate aquifer is the primary source of ground water for irrigation and domestic supply in the Watershed.

The Floridan aquifer system consists of limestones and dolomites that formed prior to the Miocene age (Miller 1986). In the region of the Southern Coastal Watershed, the aquifer consists of two hydrologic units, the Upper and Lower Floridan aquifers, which are separated by a middle confining unit. The Upper Floridan aquifer is the most productive aquifer of the region, although the high mineral content of ground water from the aquifer limits use of this resource in much of the Southern Coastal Watershed. The top of the Upper Floridan aquifer ranges from about 300-700 feet below the surface in the Watershed and thickness of the aquifer varies from about 1300-1800 feet (SWFWMD 1988c, after Wolansky and Garbade 1981). The Lower Floridan aquifer contains highly mineralized

water.

The potential for contamination of groundwater in aquifers of the Southern Coastal Watershed has been evaluated using physical information on the hydrogeologic setting of the region and chemical/isotopic information on water in the aquifers. Both approaches indicate that the potential for contamination of the Upper Floridan aquifer is very low (SWFWMD 1988a, b, c, Swancar and Hutchinson 1992). The thickness of the intermediate aquifer system in the region, and its relatively low permeability, function as a barrier to downward movement of contaminants. Analyses based on the hydrogeologic setting indicate that the susceptibility of the intermediate aquifer system to contamination from surface sources is also very low (SWFWMD 1988a, b, c). However, the potential for contamination of the intermediate aquifer with ground water from the Upper Floridan aquifer exists as a result of the high potentiometric surface of the Upper Floridan aquifer and from improperly cased wells (Metz and Brendle 1996). Lateral intrusion of salt water into the intermediate aquifer system is also a problem in the Watershed. The surficial aquifer of the region is highly susceptible to ground-water contamination, due to the lack of confinement and non-artesian properties of the aquifer (Map 2 in Appendix).

Section 3.5 Surface Water Hydrology

The Southern Coastal Watershed includes numerous estuaries, wetlands, and small coastal streams that are tidally influenced over much of their length, and also a few longer stream/canal systems with predominantly freshwater habitats. Based on information collected by the United States Geological Survey's Hydrologic Division, the Watershed can be divided into 23 sub-basins (Map 1 in Appendix).

At the northern end of the Watershed, a small area drains into Palma Sola Bay (sub-basin 2) and several sub-basins drain to the Sarasota Bay estuary. Freshwater runoff enters Sarasota Bay from the Bowlees Creek system (sub-basin 3), Whitaker Bayou (sub-basin 5), Hudson Bayou (sub-basin 7), other mainland coastal areas and the barrier islands of Longboat Key, Lido Key and Anna Maria Island (sub-basin 1). Portions of Anna Maria Island also drain to Anna Maria Sound.

To the south, Phillippi Creek (sub-basin 6), a highly channelized drainage system, empties into Roberts Bay and Little Sarasota Bay. Catfish Creek (sub-basin 10) also drains into Little Sarasota Bay. Downshore, South Creek (sub-basin 9) empties into a region known as Dryman Bay. Runoff from other coastal regions of the mainland, Siesta Key, and Casey Key (sub-basin 8) also contributes to the freshwater flow entering Little Sarasota Bay.

The estuaries of Anna Maria Sound, Palma Sola Bay, Sarasota Bay, Roberts Bay and Little Sarasota Bay have been included in State and Federal habitat conservation and restoration programs. The United States Environmental Protection Agency designated these waters, which total about 52 square miles in area collectively, as an Estuary of National Significance in 1988, and established the Sarasota Bay National Estuary Program. The Sarasota Bay National Estuary Program (1995) subsequently developed a conservation and management plan for restoring and maintaining the ecological integrity of the bay. The estuaries have

also been designated as Outstanding Florida Waters by the Florida Department of Environmental Regulation (now the Florida Department of Environmental Protection). In 1995, the Southwest Florida Water Management District included Sarasota Bay on its list of priority water bodies for protection or restoration in accordance with the Surface Water Improvement and Management (SWIM) Act passed by the Florida Legislature. The SWFWMD (1997) has developed a management plan which identifies actions in the Sarasota Bay National Estuary Program comprehensive plan which may be funded with monies from the SWIM Trust Fund.

Dona Bay and Roberts Bay (the second "Roberts Bay" in the Watershed), which become contiguous at their western ends, are small estuaries near the City of Venice. Dona Bay receives some discharge from coastal regions included in sub-basin 8, but most flow into the estuary is from Shakett Creek/Cow Pen Slough (sub-basin 4), a network of canals and natural stream segments which drain an area of approximately 90 square miles. Increased seasonal freshwater flow and sediment loads transported by this highly-modified drainage system have contributed to the degradation of water quality and habitat in Dona Bay (Mote Marine Laboratory 1975). Roberts Bay is the terminus for Curry Creek (sub-basin 11). Hatchett Creek (sub-basin 12) is a highly channelized system that drains into the Intercoastal Waterway near the southern end of Roberts Bay.

Lemon Bay extends from the vicinity of South Venice to the Gasparilla Island Causeway. This estuary is within the boundaries of the Charlotte Harbor NEP, and has been designated as an aquatic preserve by the Florida Legislature and an Outstanding Florida Water by the Department of Natural Resources. These designations should promote the preservation of the exceptional biological, aesthetic and scientific qualities of the bay (see Florida Department of Natural Resources 1991 for a review of the natural and cultural history of Lemon Bay). Alligator Creek (sub-basin 13) flows through the city of South Venice into the bay. Forked Creek (sub-basin 14) drains a sizable area south of the city. Rock and Oyster Buck Creeks (sub-basins 16 and 18) flow into the bay through less populated regions of the Watershed. Runoff from coastal regions of the mainland, and the barrier islands of Manasota Key, Don Pedro Island and Little Gasparilla Island (sub-basin 8) also enters Lemon Bay.

Gasparilla Sound receives runoff through Buck Creek (sub-basin 19), Coral Creek (sub-basin 20), Catfish Creek Bayou (sub-basin 21), Boggess Hole outflow (sub-basin 23), Whidden Creek (sub-basin 22), and other mainland coastal areas (sub-basin 8). Portions of Gasparilla Sound, Charlotte Harbor and much of the land along the eastern shore of Charlotte Harbor below the mouth of the Myakka River is included in sub-basin 17.

In Chapters VI and VII of this Comprehensive Watershed Management Plan, sub-basins of the Southern Coastal Watershed are grouped into larger basin units (Map 3 in Appendix). The reader is referred to Chapter VI - Water Quality, for further details.

Section 3.6 Population Growth and Economy

The population of Florida has increased greatly during recent years and Florida's coastal

communities have experienced a large portion of the growth. The vast majority of the residents of Manatee, Sarasota and Charlotte Counties, and most of the seasonal visitors to the area live within a relatively narrow corridor extending roughly ten miles inland from the Gulf. Most of the future growth in the region is expected to occur in this corridor as there is ample land available for development and local governments are encouraging concentrated development where adequate infrastructure exists or is expected to be developed. This means that the entire Southern Coastal Watershed, except public lands, conservation areas and possibly some of the easternmost sections of the Watershed will eventually become urbanized.

The region experienced tremendous growth during the decade between the 1980 and the 1990 Census of Population and Housing (Table III-1). Manatee County's population grew nearly 43%, Sarasota County grew nearly 37%, and Charlotte County grew by 90%. Nearly all of the recent population growth in the region can be attributed to net immigration. This is not surprising given that 30% of the population is over the age of 65 (Bureau of Economic and Business Research 1994). The population of the region is expected to grow considerably during the next thirty years, although at a rate less than that which occurred in the 1980's. By 2010, the number of people living in Manatee, Sarasota and Charlotte counties is expected to be 65% greater than in 1990.

Table III-1. Permanent resident population estimates and projections for Manatee, Sarasota and Charlotte Counties, and major urban areas of the Southern Coastal Watershed for the period 1980-2020 (N/A indicates data are not available).

County or Urban Area	1980	1990	1995	2000	2010	2020
Manatee County [1]	148,400	211,707	223,508	258,418	302,674	344,000
Sarasota County [2]	202,300	277,776	301,528	326,800	375,100	423,200
Charlotte County [3]	58,460	110,975	127,646	147,400	185,800	225,500
City of Bradenton [4]	30,288	43,769	44,200	46,900	52,100	N/A
City of Sarasota [5]	48,868	50,897	51,143	51,967	53,526	N/A
City of Venice [6]	12,153	17,052	18,450	21,246	22,556	22,556
Barrier Island Towns [7]	11,998	14,148	16,037	17,021	N/A	18,455[8]

Sources:
1. Manatee County Board of Commissioners (1996); seasonal population multiplier is about 16%.
2. Sarasota County Board of Commissioners (1997); functional population increase estimated at 26%.
3. Charlotte County Board of Commissioners (1997); seasonal population increase estimated at 30%.
4. Bradenton, City of, City Council (1996) and Bureau of Economic and Business Research (1997); seasonal population increase estimated at 13%.
5. Sarasota, City of, City Commission (1998) and Bureau of Economic and Business Research (1997); seasonal population increase of 20% , daily functional population increase of 46%.
6. Venice, City of, City Council (1996); functional population increase of 37%.
7. Anna Maria ( ), Holmes Beach, City of, City Commission (1997), Bradenton Beach, ( ), Longboat Key, Town of, Town Council (1997), and Bureau of Economic and Business Research (1997); seasonal population increase on entire barrier islands estimated at more than 90%.
8. Estimated build out population of barrier island communities assuming current densities and no annexations.

Employment in Manatee, Sarasota and Charlotte Counties (Table III-2) is dominated by the service and retail industry sectors, which account for about 60% of the total number of jobs in the region. This is typical of counties with resort communities and large populations of retirees, seasonal visitors, tourists and other immigrants. The public sector constitutes the next largest employment category, accounting for 12% of the regional job base. Manufacturing is also a significant employment category of the region. In Manatee County, this sector accounts for 14% of the total number of jobs, well above the state average of 8 percent.

Table III-2. Employment (numbers of jobs and percentages of totals) by major category for Manatee, Sarasota and Charlotte Counties in 1995.

Employment Category	Manatee	%	Sarasota	%	Charlotte	%	Total	%
Agriculture	5,445	6.5	1,461	1.2	582	1.9	7,488	3.2
Construction	3,326	4.0	6,616	5.6	2,042	6.7	11,984	5.1
Manufacturing	11,568	13.8	8,246	6.9	892	2.9	20,706	8.9
Transportation & Public	1,502	1.8	3,572	3.0	997	3.3	6,071	2.6
Wholesale Trade	2,272	2.7	3,999	3.4	537	1.8	6,808	2.9
Retail Trade	17,266	20.6	29,722	25.0	8,840	28.9	55,828	23.9
Finance, Insurance & Real	2,872	3.4	7,666	6.4	1,486	4.9	12,024	5.1
Services	29,289	34.9	43,460	36.5	10,506	34.3	83,255	35.6
Government	10,082	12.0	13,864	11.6	4,639	15.2	28,585	12.2
Other	331	0.4	531	0.45	83	0.3	945	0.4
Total	**83,953**		**119,137**		**30,604**		**233,69**	

Source: Bureau of Economic and Business Research (1997).

Section 3.7 Land Use and Transportation

Using categories derived from Florida Department of Transportation (1985) land use/cover in the Southern Coastal watershed is an amalgam of urban, agricultural and wetland or open water habitats (Map 4 in Appendix, Table III-3). Based on aerial photographs from 1995, urbanized areas account for over one-third of the total area of the Watershed (including open water areas). Coastal areas, including the barrier islands are almost entirely urbanized. Eastern portions of the watershed contain substantial areas of agricultural lands, which account for 10% of the total acreage of the Watershed. Agriculture in the Watershed is dominated by range and pastureland and row-crop farming. Upland forests are patchily distributed in the watershed, although a sizable intact forested area remains inland from

Lower Sarasota Bay. Significant wetland acreage remains in the southern region of the watershed, along the shores of Gasparilla Sound and Charlotte Harbor.

Table III-3.Land use/cover (acreage and percentage of total acreage) for the Southern Coastal Watershed and receiving water bodies in 1995.

Land Use / Land Cover	Acreage	% of Total Acreage
Urban and Built-Up	108,945	35
Transportation, Communication and Utilities	5,829	2
Agriculture	31,014	10
Rangeland	15,643	5
Barren Land	330	<1
Upland Forest	32,603	11
Wetlands	41,578	14
Mining	498	<1
Water	71,804	23
Total	**308,244**	**100**

Much of the Watershed is within the 100-year flood zone designated by the Federal Emergency Management Administration (Map 5 in Appendix). Additional acreage in areas of the Watershed away from the coast and stream channels is also prone to flooding. Much of the urban development in the Watershed has occurred in these flood prone areas. Improper development of these areas has, and may result in significant threats to life, property, and the quality of aquatic and shoreline habitats.

The communities of the Southern Coastal Watershed are served by a highly-developed transportation infrastructure. Two major roads, U.S. 41 and Interstate 75 roughly parallel the coast, providing north-south transit in the upper two-thirds of the watershed, and east-west transit around Charlotte Harbor to Punta Gorda in the lower third. Other major roads include State Road 64, which connects the City of Bradenton to Zolfo Springs in central Hardee County, and State Roads 70 and 72, which begin in Bradenton and Sarasota, respectively, and converge on the City of Arcadia in DeSoto County. A major rail line enters the Watershed at Bradenton and runs south past the City of Venice. Another connects Gasparilla Island with the City of Arcadia. In addition to these highway and rail systems, the region is served by the Sarasota-Bradenton International Airport which overlaps the Sarasota-Manatee County line at U.S. 41.

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CHAPTER IV

WATER SUPPLY

4.1 Overview of Watershed

The Southern Coastal Watershed is located within the Southern West-Central Florida Ground-Water Basin (SWCFGWB or the Basin), one of three distinct ground water basins within west-central Florida. No significant ground water flow crosses the basin boundaries; therefore, nearly all ground water is derived from recharge by rainfall within the Basin. Upper Floridan aquifer flow in the SWCFGWB is derived primarily from rainfall recharge that occurs in the Lake Wales Ridge area, and also in the Green Swamp, which are located along the northern and eastern edges of the Basin, respectively. Down gradient of these areas, ground water flows west and southwest toward and into the Gulf of Mexico, except in southern Hillsborough and western Manatee Counties, where flows are limited due to ground water pumpage.

Within the SWCFGWB, the ground water system is divided into three main aquifers: the surficial, intermediate and Upper Floridan. Each aquifer is separated by a confining layer of variable thickness and areal extent. The uppermost aquifer, the surficial, is largely undeveloped due to its limited thickness and low permeability, except near the coast and in Charlotte County where ground water from deeper aquifers is too mineralized for potable use. Underlying the surficial aquifer is the intermediate or secondary artesian aquifer system. The intermediate aquifer system is a moderately productive, highly developed source of water which is used for domestic and public supplies south of Polk County. The lowermost and most productive aquifer is the Upper Floridan aquifer system. The Upper Floridan is a major source of water for agriculture, industry and public supply, except in Charlotte County and the coastal area of Sarasota County.

Surface waters within the Southern Coastal Watershed include numerous fresh and salt water wetlands and several coastal streams and sloughs. The creeks and sloughs found in the Southern Coastal Watershed primarily serve as drainage features for the coastal region, however, and do not currently represent significant water supplies for industrial, agricultural or domestic use, with the possible exception of Cow Pen Slough (see Chapters VI and VII).

Water Use

Public supply represents the most significant water use within the watershed. Each community within the watershed meets its potable water demands through either ground or surface water resources. Nine public supply wellfields/withdrawal sites with average permitted quantities greater than one million gallons per day are located within the Southern Coastal watershed. Fourteen public supply water facilities with withdrawal quantities greater

than 100,000 gallons per day (gpd) are also located throughout the watershed.

Agriculture has historically been a significant activity within the Southern Coastal watershed and continues to play a significant role in water supply demands. As development pressures continue to consume increasingly valuable coastal agricultural lands, water demands from agricultural activities within the watershed are likely to decrease. Continued urbanization of the Southern Coastal watershed may, however, lead to expanded agricultural and/or ranching operations further inland, thereby increasing water demands within those watersheds.

Recreational water use represents another significant water use demand category within the Southern Coastal watershed. The majority of withdrawals within this category are used to meet golf course irrigation demands. In recent years, many golf courses have sought to offset all or a portion of their potable water use with reclaimed wastewater reuse. District rules require water use permit holders to use reclaimed wastewater reuse to offset potable water use, if available. Reuse of reclaimed wastewater has proven to be a significant water conservation measure in reducing ground and surface water withdrawals. However, Utilities must develop additional wet weather storage in order to make reuse available year round.

Significant surface water public supply sources play an important role in meeting potable water demands for populations within the Southern Coastal watershed. These sources include Lake Manatee and the Evers Reservoir, which are impoundments of the Manatee and Braden Rivers, respectively, in Manatee County. The Peace River/Manasota Regional Water Supply Authority's (PRMRWSA's) water treatment facility is located on the Peace River in DeSoto County. Lake Manatee serves as a potable water supply source for Manatee County Utilities, while the Evers Reservoir provides potable water resources to the City of Bradenton. While none of these facilities are located within the Southern Coastal watershed, they do supply significant quantities of potable water to communities within the watershed. Lake Manatee is permitted for average and maximum daily withdrawal quantities of 34.9 mgd and 50.2 mgd, respectively. The Evers Reservoir is permitted for average and maximum daily withdrawal quantities of 5.6 mgd and 8.2 mgd, respectively. The PRMRWSA facility is permitted to withdraw up to 17.6 mgd. Table IV-1 shows reported water withdrawals within the Southern Coastal watershed, by source and type.

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Table IV-1. Reported water withdrawals within the Southern Coastal Watershed (data from J. Quinn, SWFWMD, 1997).

Use Sector	Ground Water (mgd)	Surface Water (mgd)	Total Withdrawals
Agriculture	4.49	0.16	4.64
Commercial/Ind.	0.14	0.01	0.14
Mining/Dewatering	0.00	0.84	0.84
Public Supply	17.27	0.02	17.29
Recreation	3.76	3.39	7.14
Total	25.66	4.42	30.05

In addition to meeting demands for public supply, agricultural, recreational, commercial, industrial, and other activities, the water resources of the Southern Coastal watershed support a variety of wetland and upland ecosystems. Many water dependent ecosystems rely on the seasonal freshwater flows from the watershed's surface water features to maintain their health and viability. Increased demand on the watershed's once abundant water resources must now be closely managed to ensure that adequate supplies are available for human needs and the natural environment.

Membrane Technology

Ground water characteristics within the Southern Coastal watershed generally mirror those of the District; that is, mineralization increases with depth with movement to the south and toward the coast. Many ground water withdrawals within the Southern Coastal watershed are from brackish ground water sources. Brackish water is generally defined as water with a total dissolved solids concentration greater than 1,000 parts per million. The high mineral content of brackish water is not suitable for potable use with conventional treatment methods. Brackish water can, however, be made potable by various membrane technologies. While these methods have historically been expensive for water supply development, recent improvements in technology involving low pressure reverse osmosis and ultra-filtration membranes have reduced operating costs for newer systems.

One of the more significant problems facing this industry, however, is the disposal of waste brine. Reject water from membrane treatment plants is classified as industrial waste. The Florida Department of Environmental Protection (FDEP) regulates the treatment and disposal of industrial wastewater through Chapters 62-3, 62-4, 62-6 and 62-8, Florida Administrative Code (F.A.C.). Since most plants are located near the coast, discharge to tidal or brackish surface waters is one method of disposal. Location of disposal sites with adequate dilution, flushing and marine characteristics can, however, be problematic. Other methods of disposal include percolation ponds, spray irrigation or deep well injection. Table IV-2 lists water supply plants in the Southern Coastal watershed that are employing membrane treatment technology and have permitted treatment capacities greater than

100,000 gpd. Given the continued growth in Florida's coastal areas, unpredictable rainfall and increasing trends of salt water intrusion, the use of membrane technology for potable water supply development is anticipated to increase in the future. (SWFWMD, 1992).

Table IV-2. Water supply plants using membrane treatment technology in the Southern Coastal Watershed (>100,000 gpd treatment capacity; SWFWMD, 1992).

Name of Plant	City	Treatment Capacity (mgd)
City of Sarasota	Sarasota	4.5
City of Sarasota	Sarasota	12.0
Camelot Lakes	Sarasota	0.1
Sun N' Fun Resort, Inc.	Sarasota	0.127
Southbay Utilities	Sarasota	0.25
Spanish Lakes MHP	Nokomis	0.10
City of Venice	Venice	4.0
Venice Gardens Utility Corp.	Venice	1.0
The Plantation	Venice	0.5
Charlotte Harbor Water Assoc.	Harbour Heights	0.45
Englewood Water District	Englewood	3.0
Rotonda West Utilities	Rotonda West	0.5
Gasparilla Island	Englewood	0.2

Wastewater Reuse

The reuse of domestic wastewater, or wastewater reuse, can significantly reduce demands on ground and surface water withdrawals. Rules of the Florida Department of Environmental Protection (FDEP), Chapter 62-610, Florida Administrative Code (F.A.C.), govern wastewater reuse. Specific provisions of the rule regulate public access to reuse, including use of treated wastewater for residential, commercial and public landscape irrigation, golf course irrigation, and agricultural irrigation of edible crops. Also covered are slow- and rapid-rate land application systems for ground water recharge.

Section 403.064, Florida Statutes (F.S.), requires a wastewater reuse cost/benefit evaluation be conducted by all applicants seeking permits to construct and/or operate a wastewater treatment facility within a critical water supply problem area. The District has declared two critical water supply problem areas within the Southern Coastal watershed: the Eastern Tampa Bay and Southern Water Use Caution Areas. District rule, Chapter

40D-2, F.A.C., requires wastewater generators with Water Use Permits to provide a map indicating areas where reclaimed water facilities are located and their available quantities of reuse water. Further, Water Use Permit holders are required to investigate the feasibility of using reclaimed wastewater to offset potable water demands.

There are a number of wastewater treatment facilities that supply reclaimed wastewater to users within the Southern Coastal Watershed. A variety of projects have been, or are scheduled to be completed to expand wastewater reuse availability within the watershed. The District, through its Basin Cooperative Funding Program, has been involved in partially funding these projects in conjunction with local government cooperators. To date, the District has budgeted approximately $13,500,000 for wastewater reuse projects with Manatee, Sarasota and Charlotte Counties. These projects will result in a reduction in potable water use demands of approximately 30 million gallons per day (SWFWMD, 1996).

Population and Growth

Counties within the Southern Coastal Watershed continue to grow at a rapid pace. Areas of the watershed nearest the coast tend to be older developments, with some newer infill development and redevelopment. Recently, eastward growth has occurred toward the Interstate 75 corridor. This trend will likely continue for the foreseeable future. Obviously, as population increases, so will the water supply needs. Table IV-3 illustrates current and projected population for Manatee, Sarasota and Charlotte Counties (see citations listed for Table III-1).

Table IV-3. Estimated population and projections for Southern Coastal Watershed Counties

County	1995	2000	2010	2020
Manatee	223,508	258,418	302,674	344,100
Sarasota	301,528	326,800	375,100	423,200
Charlotte	127,646	147,400	185,800	225,500

4.2 Previous Studies

A number of studies and technical reports concerning water supply have been generated for portions of the Southern Coastal Watershed. The following is a brief summary of the selected studies.

Water Supply Studies and Reports

The District Water Management Plan (SWFWMD, 1995a) is a broad-based planning document that addresses activities related to water supply, flood protection, water quality, and natural systems (SWFWMD, 1995a). The plan identifies current programs, issues, and

strategies for regional water management. The water supply element of the DWMP comprises two sub-elements: (1) needs and sources and (2) source protection.

To address the first element, the District developed a Needs and Sources Plan. The initial Needs and Sources Plan was adopted in 1992 and was incorporated in the DWMP. The objective of the plan was to examine water demands and sources for the period 1990-2020 to provide a framework for water supply management (SWFWMD, 1992). The 1992 Needs and Sources Plan recognized that groundwater resources are stressed in the west-central and southern portions of the District (including all of the Southern Coastal Watershed). Reuse, conservation, desalination, surface water, and limited groundwater development were identified as potential sources to meet future needs in this area.

Continued viability of existing water supply sources is addressed through Water Resource Assessment Projects (WRAPs) and the delineation of Water Use Caution Areas (WUCAs). To date, four studies have been undertaken within the District including the Highlands Ridge, Eastern Tampa Bay, Northern Tampa Bay, and Southern WRAPs. Due to staff limitations, however, only the Eastern Tampa Bay and Northern Tampa Bay WRAPs have been completed. The WRAP reports contain hydrologic analyses and provide the technical basis for the establishment of safe yields in each area. Water Use Caution Areas have been declared by the District to prevent existing problems from becoming worse in areas where water resources are stressed (SWFWMD, 1992). The four designated Water Use Caution Areas correspond to the WRAP study areas. A more advanced discussion of these topics follows in the Ground Water Studies subsection. Other District programs which address long-term water supply source protection and viability are discussed in the DWMP, including District water use permitting, water shortage management, and land acquisition.

Water supply issues identified in the DWMP include: (1) water allocation strategies, (2) linkage of water use planning to local government comprehensive planning, (3) compliance and enforcement, (4) alternative supplies, (5) additional data collection, (6) watershed water budget approach to water management, and (7) water use fees. Options to address each issue have been evaluated and are outlined in the DWMP.

Surface Water Studies

The District's Needs and Sources study determined that the Peace River could be considered for additional water supply development to meet projected demands in Charlotte County, southern Sarasota County and the City of North Port, based on flow characteristics and available storage at the Peace River/Manasota Regional Water Supply Authority's (PRMRWSA's) Peace River Regional Water Treatment Facility in DeSoto County (SWFWMD, 1992). The PRMRWSA owns and operates the facilities and provides wholesale water to local governments in Charlotte and Sarasota counties.

While not located within the Southern Coastal Watershed, potable water is supplied from the Authority's facility to areas within the watershed through surface water withdrawals from the Peace River. The Authority's Peace River Water Treatment Facility consists of a river

intake, an off-stream storage reservoir, water treatment plant and an aquifer storage and recovery (ASR) system. The PRMRWSA is presently permitted to withdraw an average quantity of 32.4 million gallons per day (mgd) and a maximum quantity of 90.0 mgd from the Peace River, based on a phased approach to be reviewed by a peer-review committee required by the permit. The Authority's ASR system enables surface waters withdrawn during the wet season to be stored in the Upper Floridan aquifer. These stored waters are later withdrawn for use during the dry spring season when surface water withdrawals from the Peace River are limited by low flows.

The Manasota and Peace River Basin Boards' Peace River Option, a New Water Source Initiative (NWSI) project, has studied the feasibility of increasing withdrawals from the Peace River to offset potable ground water withdrawals for Charlotte and Sarasota counties. These studies, and ongoing monitoring programs, are focused on the impacts, if any, of these withdrawals on the River and Upper Charlotte Harbor. Proposed additional withdrawals must meet strict environmental standards and demonstrate no adverse effects on the River or Charlotte Harbor. Increased use of surface water sources could offset or reduce ground water withdrawals, which in turn would benefit the Floridan Aquifer throughout the region.

Ground Water Studies

Potentiometric levels of the Upper Floridan aquifer, the principal aquifer in the Southwest Florida Water Management District (SWFWMD), have been declining in the coastal areas of southern Hillsborough, Manatee and northern Sarasota Counties since the 1930's (SWFWMD, 1993, 1995). The rate of these declines greatly accelerated beginning in the early 1960s, and declines are now observed throughout the entire Southern West-Central Florida Ground-Water Basin (SWCFGWB). The SWCFGWB includes all of DeSoto, Hardee, Manatee, and Sarasota Counties, and portions of Charlotte, Highlands, Hillsborough, and Polk Counties. These declines are primarily caused by ground water withdrawals within the affected areas. Public supply wellfields and water use permit points are depicted earlier in Figure IV-1. Regional impacts caused by these lowered levels include water quality deterioration in coastal areas due to lateral salt water intrusion and local water quality deterioration due to upward movement of mineralized water from lower portions of the aquifer. Additional impacts include reduced well efficiency due to greater pumping depths, lowered lake levels, and reductions in spring and stream flows.

In response to these declines and associated impacts, the Governing Board of the SWFWMD directed staff to conduct detailed Water Resource Assessment Projects (WRAPs) to address the issue of safe yields in the areas of greatest concern. Safe yield, as addressed in the WRAPs, is the quantity of water available for man's use without causing unacceptable impacts to the water resources, associated natural systems, and existing legal users of water. Safe yield is established by the SWFWMD Governing Board based on determination of acceptable levels of impacts. The WRAP projects provide the District's Governing Board with the necessary water resource based technical information and tools necessary to establish safe yields for the project areas. The Southern Coastal

watershed is located within two of the District's four identified WRAP areas, the Eastern Tampa Bay and Southern District WRAPs. The WRAP areas were identified based on a number of factors including hydrologic regime, types of impacts observed, the profile of water use and future growth.

In 1989, the District's Governing Board declared the Eastern Tampa Bay WRAP area to be a Water Use Caution Area (WUCA). In conjunction with declaring the WUCA, the Governing Board implemented a strategy to address concerns within this area including the development and implementation of short-, mid- and long-term solutions. Short-term and mid-term solutions were comprehensive in nature and were designed to limit further impacts to the area, based on best available information at the time. Long-term solutions would be a refinement of the existing measures based on the results of the WRAP.

The Eastern Tampa Bay WRAP report (SWFWMD, 1993) concluded that saltwater intrusion was a currently active process and that saltwater would continue to replace freshwater in the Upper Floridan Aquifer if 1989 water use levels persisted. The report further noted that the Upper Floridan Aquifer is a highly transmissive, well-confined aquifer where ground water withdrawals several tens of miles inland have a significant effect on coastal ground water levels. Previous work showed water levels along the Highlands Ridge were similarly affected by equally distant withdrawals. Overall, ground water levels at any location in the SWCFGWB are affected by cumulative ground water withdrawals occurring tens of miles away. These findings were the basis for declaration of the Southern Water Use Caution Area (SWUCA) in 1994.

4.2.2 Available Data

A variety of local, regional, and state agencies compile data regarding the health of ground and surface water resources in the Southern Coastal Watershed. The District has a comprehensive hydrologic conditions monitoring program. Conditions that are monitored include rainfall, evaporation, lake levels, groundwater levels, springflow, various water quality parameters, and river discharge and stage elevation.

Hydrologic data are also collected by the District through regulatory programs. Public supply permittees and all permittees located in water use caution areas must report ground and surface water withdrawals where permitted withdrawals exceed 0.1 mgd. Other water use permittees are required to report pumpage if permitted withdrawals are greater than 0.5 mgd. Selected water use permittees are also required to report water levels and water-quality data. The United States Geological Survey also maintains a data base of stage, flow, and water-quality measurements which includes monitoring sites within the Southern Coastal Watershed.

4.2.3 Regulatory Authority and Special Rules

Water supply development throughout the Southern Coastal Watershed is subject to the District's Water Use Permit rule, Chapter 40D-2, Florida Administrative Code (F.A.C.).

Water supply withdrawals within the northern portion of the Southern Coastal Watershed, part of the existing Eastern Tampa Bay WUCA, are subject to additional permitting criteria. These criteria include the imposition of conservation and efficiency requirements for all water users and the setting of per capita water use standards and planning goals for public supply.

The District's well construction permitting program ensures both the protection of ground and surface water resources and the protection of water quality for potable uses. District rule, Chapter 40D-3, F.A.C., regulates well construction practices and water well contractor licensing. In addition, selected Florida Department of Environmental Protection rules incorporated into Chapter 40D-3, F.A.C., by reference, are intended to ensure that all water wells and test or foundation holes within the District are located, constructed, maintained, used and abandoned in a manner that protects water resources.

4.2.4 Regulatory Issues

As of Summer 1998, there were several outstanding permitting issues which have water supply implications for the Southern Coastal Watershed. The most notable of involves the evaluation of proposed additional water supply withdrawals from the Peace River. These additional quantities would be used, at least in part, by residents, businesses and industries located within the Southern Coastal watershed.

A key component to identifying acceptable withdrawal quantities for the Peace River and other water bodies within the District is the establishment of minimum flows and levels (MFLs). The term "minimum flow" refers to the limit in a watercourse at which further withdrawals would be significantly harmful to the water resources or ecology of an area. Similarly, "minimum water level" is statutorily defined as the level of ground water in an aquifer or surface water, such as a lake, at which further withdrawals would be significantly harmful to the water resources of an area.

Once established, MFLs are implemented through a variety of means, including the application of these flows and levels to the District's water use permitting program. As directed by Chapter 373.042, Florida Statutes (F.S.), the District may restrict withdrawals of water which would cause flows or levels to drop below their established minimums and which would be significantly harmful to the water resources or ecology of an area. The District's water use permitting rules, which include criteria to prevent adverse impacts from occurring as a result of withdrawals, effectively establish MFLs for specific sources throughout the District. Implementation of the pending Southern WUCA rules would expand the area affected to include the entire Southern Coastal watershed.

4.2.5 Other Governmental Activities and Watershed Initiatives

The following section briefly describes other governmental activities in the Southern Coastal Watershed that relate to water supply.

Peace River-Manasota Regional Water Supply Authority

The Peace River/Manasota Regional Water Supply Authority (PRMRWSA) completed its Water Supply Master Plan in 1990 (Boyle Engineering, 1990). The Plan identified three potential sources of water supply within the region that may be available for future development by the Authority. The Peace River, currently used as a withdrawal source by the Authority, was identified as having sufficient capacity to safely yield additional quantities of water. In addition, the Plan identified the northwest DeSoto County/southeast Manatee County and north-central DeSoto County areas as having favorable characteristics for additional ground water development from the Upper Floridan aquifer.

The Peace River was identified as the primary source of additional water supply quantities, pending public acquisition of the General Development Utilities Peace River Water Treatment Facility, which occurred in 1991. A renewed water use permit, issued by the District in 1995, provides for an incremental increase in allowable withdrawal rates up to a maximum daily average of 32.7 mgd. Permit provisions require independent scientific review and analysis prior to each phased increase. Withdrawals from the Peace River are restricted from exceeding 10 percent of river flow, as measured at the Arcadia gaging station, and are prohibited when river flow falls below 130 cubic feet per second (cfs). (SWFWMD, 1996).

4.3 Water Supply Issues

An overview of current water supply issues within the Southern Coastal Watershed is given below. Also included are strategies and actions to address these issues.

Enhance Coordination for Effective Water Resource and Land Use Planning

Strategy: Seek inclusion of water resource/land use planning as a consistency requirement for Local Government Comprehensive Plans.

To date, no clear linkages have been developed between District water resource planning activities and the land use planning activities of local governments (SWFWMD, 1995). The District is the agency charged with primary responsibility for water management decisions within its region and is a centralized source for water related research and information. Local governments exercise primary authority over land use through long-range (20-year) comprehensive plans. Existing statutes relating to land and water planning and management create two separate tracks with minimal connection and no requirements for consistency between them. Integration between land and water resource planning and management is essential for either to be effective. This issue was the subject of the Governor's Task Force on Land and Water Planning.

Actions:

1) Use the District's Needs and Sources report as the source document for water supply

availability.
2) Include land use and water resource planning consistency as part of the District's 1999 legislative agenda.
3) Seek opportunities to enhance linkages between the District and local governments as they relate to water resources and land use planning.

Strategy: Improve coordination between land and water planners

Enhanced coordination between District planning staff and local government planning staffs will further the linkage between land use and water resource planning.

Actions:

1) Increase District involvement with the Tampa Bay and Southwest Florida Regional Planning Councils and local government planning departments.
2) Develop an annual report summarizing the status of water supply, water resources, and new regulations for distribution to local land use planners and others.
3) Develop procedures with local governments so that District input becomes part of government decisions on land use planning.
4) Coordinate five-year planning documents, such as Comprehensive Plan Updates and Basin Plans, on the same time frame.

Continuation and Expansion of Conservation and Water Shortage Initiatives

Strategy: Promote conservation and reuse

In order to reduce demands on existing potable water resources within the Southern Coastal watershed, existing water conservation programs and initiatives should be continued and additional opportunities for water conservation should be sought.

Actions:

1) Continue existing conservation programs and reuse system expansion.
2) Continue interconnection and regionalization of reuse systems, where cost-effective, to improve efficiency and increase reclaimed water utilization.
3) Investigate opportunities to develop reuse systems in new areas.
4) Continue current funding levels and the associated programs and regulatory requirements for conservation and reuse.
5) Investigate financial incentives to offset the costs of industrial and commercial reuse and conservation programs.
6) Recognize and reward industries and other entities who have strong conservation and/or reuse programs.
7) Develop pilot projects for stormwater reuse.
8) Increase public awareness of the environmental costs of water use.
9) Investigate increasing funding levels for conservation and reuse programs.

Strategy: Improve compliance with water shortage restrictions and year-round conservation measures

Coordination with local governments is necessary to achieve effective enforcement of the District's year-round water conservation measures and water shortage restrictions, implemented during periods of District-declared water shortages.

Actions:

1) Educate the public on how year-round water conservation measures and water shortage restrictions affect them.
2) When noticing adjacent property owners regarding Water Use Permits, mention any water shortage restrictions included in the permit. For example, in noticing nearby homeowners when golf courses are issued water use permits, homeowners could be informed regarding the allowable golf course irrigation schedules and could assist in ensuring their compliance with water shortage restrictions.
3) Coordinate with local governments to identify means of enforcing watering restrictions.

Strategy: Develop alternative water sources.

Recognizing the limited availability of groundwater resources, the SWFWMD has developed a water supply policy which states that the SWFWMD will "encourage, assist in, and where appropriate require, the development and efficient use of alternative sources of water" (SWFWMD, 1995). Alternative water sources are sources other than traditional groundwater such as surface water, reclaimed water, stormwater reuse, aquifer storage and recovery, and brackish water or seawater desalination. To promote the development of alternative water sources, the SWFWMD established the New Water Source Initiative (NWSI) in 1993. The NWSI is a financial assistance and water supply planning program which assists local and regional agencies in developing alternative water supplies.

Actions:

1) Continue New Water Sources Initiative and Cooperative Funding Program to assist local governments in developing alternative supplies. Include alternative sources as a primary component of water supply plans.
2) Continue regulatory requirements/incentives for alternative water sources.
3) Optimize use of aquifer storage and recovery for reclaimed and surface water sources.

Minimum Aquifer Levels for the Intermediate Aquifer

Strategy: Adopt aquifer levels for the Intermediate aquifer to establish limits on withdrawals that will not cause significant harm to the water resources or the ecology of the area.

The District has scheduled to establish minimum aquifer levels for the Intermediate aquifer by 2011. Minimum flows and levels are defined in the Florida Administrative Code as "the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area." In establishing minimum ground water levels, the District will evaluate the demands on, and existing impacts to, the Intermediate aquifer to ensure the long-term viability of the resource.

Actions:

1) Collect and evaluate hydrologic and ecological information necessary to establish minimum levels ground water for the Intermediate aquifer.
2) Adopt minimum ground water levels for the Intermediate aquifer.

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CHAPTER V

FLOOD PROTECTION

5.1 Introduction

One of the most important aspects of flood protection is the recognition that flooding is a natural part of the hydrologic cycle. Flood prone lands provide a number of valuable functions. With respect to flood protection, Flood prone lands help regulate the timing, velocities and levels of flood discharges by providing temporary storage for stormwater runoff and overflow from water bodies. These lands also help maintain water quality and provide habitat for fish and wildlife. Flood prone lands include not only wetlands but also the less frequently flooded lands which make up the floodplain. Both are important in providing necessary storage for periodic inundations.

A primary concern of watershed management is the understanding of floodplain functions and the provision of safeguards within such areas, not only from damages when flooding occurs, but also for the natural systems and habitats. Effective floodplain management recognizes the importance of maintaining and/or restoring floodplain functions and related natural systems as a way of reducing flood related damages. The District recognizes the importance of maintaining floodplain functions as an effective component of watershed management.

The District has adopted a non-structural approach to flood control and has developed a variety of flood protection information and data resources for use by local governments identifying and managing Flood prone areas within their jurisdictions. District flood protection efforts include: funding and development of watershed management studies, including aerial mapping; maintenance and dissemination of geographic information system data, Federal Emergency Management Agency (FEMA) floodplain maps and other mapping resources; hydrologic monitoring and data collection; operation and maintenance of existing regional flood control structures; land acquisition; aquatic plant management; and, integration of the District's water resources planning with local government land use planning.

5.1.1 Overview of Watershed

Surface water features within the Southern Coastal Watershed include a variety of fresh and salt water wetlands and a number of coastal streams and sloughs. These streams and sloughs are typically intersected by manmade drainage canals which provide varying levels of stormwater conveyance during storm events. The extent and type of development, however, strongly influences the quantity and quality of stormwater runoff within each of the watershed sub-basins.

Regulation of land uses within flood prone areas is necessary in order to reduce potential flood damages and maintain the natural conveyance functions of floodplains. Local governments regulate development within the 100-year floodplain in order to participate in the National Flood Insurance Program (NFIP). The NFIP, administered by the Federal Emergency Management Agency, allows residents of participating local governments to purchase federally subsidized flood insurance. Areas of 100-year floodplain within the Southern Coastal Watershed are depicted in Map 5 in the Appendix.

The most significant area of 100-year floodplain is found on the Cape Haze Peninsula, a broad, relatively flat land mass located between Charlotte Harbor and the Gulf of Mexico. Significant flood events on the Peninsula generally occur from tidal inundation in association with land falling tropical storm or hurricane events. Land development activities have altered the natural drainage patterns on the Peninsula. Today, lands that historically drained south and southwest to Lemon Bay, Placida Harbor and Gasparilla Sound, now drain east into the northwestern portion of Charlotte Harbor.

Agricultural drainage within the Southern Coastal Watershed occurs primarily from citrus groves located west of Interstate 75 and rangeland situated at the headwaters of Phillippi Creek and Cow Pen Slough. One of the more significant agricultural drainage sub-basins within the watershed is Cow Pen Slough, which begins in southeastern Manatee County and traverses south-southwestward before terminating at the coast just north of the City of Venice. A number of smaller streams and sloughs provide drainage for other parts of the watershed. One of these systems, Oyster Creek, functions within its historic flow regime with the exception of peak events, when it discharges through the Newgate Waterway System (Chuck Walter, Charlotte County, pers. commun.).

Developed urban areas of the Southern Coastal watershed include the cities of Sarasota, Venice and Bradenton, and the barrier island communities of Longboat Key, Bradenton Beach, Holmes Beach and Anna Maria. Older urban development within the watershed has increased stormwater runoff resulting in increased non-point source pollution. Due to a variety of factors, identification of non-point sources of pollution is far more difficult than determining point source discharges. Stormwater runoff amounts, rainfall intervals, types and patterns of land uses, and the types of street debris and level of street cleaning are just a few of the factors that influence the quality of stormwater runoff.

Many water dependent ecosystems rely on the seasonal freshwater flows from the watershed's surface water features to maintain their health and viability. Modification of these features, either for water supply development, or more commonly for urban development, has the potential to reduce or change the hydrologic characteristics of these features.

Population and Growth

The population of the Southern Coastal Watershed is growing at a rapid pace (see Table III-1). Recent development trends are directing significant new growth to the areas around

the Interstate 75 corridor with this trend likely continuing into the foreseeable future. The coastal areas of the watershed, on the other hand, tend to be older development, much of it built prior to the implementation of current surface water management regulations. Limited infill development and redevelopment is occurring in these areas, however, with current stormwater management requirements generally applicable.

Historic Flood Events

Flood events within the Southern Coastal watershed typically result from tropical storm events and hurricanes which cause intense rainfall, excessive runoff and tidal surge influences. Previous years have recorded several storm events that have produced flood conditions within the Southern Coastal watershed. Two of the most significant storm events occurred, however, relatively recently in 1992 and 1995, causing severe flood impacts throughout the watershed.

The June 1992 storm event produced significant rainfall within the Southern Coastal watershed. A tropical disturbance in the Gulf of Mexico during June 24-30 produced 16-24 inches of rainfall. The July 1995 storm event also produced significant rainfall within the watershed. A tropical disturbance during the July 14-20 period produced 3-11 inches of rainfall in one 15 hour period. Rainfall and streamflow data for these events was collected from a variety of sites, both within and outside the watershed. During both events, local government staffs also attempted to document the extent of flooding within their jurisdictions by surveying high water marks.

As a result of these two events, significant watershed analysis and management activities were either initiated or their completion expedited by Sarasota County and other local governments within the watershed. The results and recommendations of these studies are outlined in following sections of this chapter.

5.2 Previous Studies

A number of planning documents, technical reports and studies related to flood protection issues in the Southern Coastal Watershed are available. These documents are summarized briefly below:

5.2.1 Flood Protection Studies and Reports

District Water Management Plan

The District Water Management Plan (SWFWMD, 1995) is a broad-based planning document that addresses activities related to water supply, flood protection, water quality, and natural systems. The plan identifies current programs, issues, and strategies for regional water management. The flood protection element of the DWMP addresses two subcategories of responsibility: (1) flood protection facilities and (2) flood-prone areas.

The Facilities subsection of the DWMP discusses the District's structural approach in providing flood protection, including its regulatory activities in the management and storage of surface waters. Although a non-structural approach to flood control is generally advocated today, the District is still responsible for the maintenance and operation of those existing facilities. Further, structural flood control will likely continue to serve a role in solving flood problems associated with previous development and in accommodating future growth and development in the region.

The Flood-prone Areas subsection of the DWMP describes District efforts aimed at identifying, evaluating, protecting and restoring the natural functions of flood-prone areas. Identified programs and initiatives include the current CWM Program, floodplain analysis, stormwater management master planning, aerial mapping, land acquisition, Environmental Resources Permitting, local government planning and technical assistance and the establishment of management levels for lakes.

Master Stormwater Management Plans

In recognition of the need to be more proactive in flood protection and watershed planning, Sarasota County initiated the development of drainage basin master plans in 1991 with the preparation of detailed master plans for the Phillippi Creek and Hudson Bayou watersheds. Each basin master plan includes a detailed study of existing and potential water resource problems within the watershed and identifies facility improvements necessary to provide an acceptable level of resource protection. Since then, development of master plans for a number of other watersheds have been completed or initiated (e.g., Briley, Wild and Associates, 1992; Kimley-Horn and Associates, Inc., 1994a, 1994b; Parsons Engineering Science, 1996, 1997; Gee and Jenson, 1997, 1998, etc.). As noted previously, significant flood events in 1992 and 1995 accelerated the process for completion of these plans by local governments within the watershed.

Cow Pen Slough Basin Master Plan

Cow Pen Slough's watershed extends from southern Manatee County south and west to its outfall into Dona Bay in Sarasota County. The watershed is characterized by flat topography and undefined drainageways, with primary drainage conveyed through approximately 14 miles of improved channel. Given the watershed's relatively rural nature, the Cow Pen Slough Master Plan (USDA, 1997) focuses on the conversion of land uses from agricultural to residential. Hydrologic studies were conducted to determine floodplain boundaries and level of service (LOS) deficiencies for both current and future land use scenarios. The Plan also analyzed the potential for wetlands restoration and enhancement.

The Cow Pen Slough watershed was significantly altered and expanded (68 square miles to 90 square miles) in the 1960s. As part of this watershed-wide assessment, it was noted that Cow Pen Slough is a large contributor of freshwater inflow to the Dona and Roberts Bay (DARB) system. These large influxes of fresh water disrupt the normal circulation and salinity distribution patterns within the DARB system, resulting in poor water quality. The

Southern Coastal Watershed Team has adopted a goal of determining the feasibility of using the excessive wet season flows from the Cow Pen Slough watershed to offset potable and/or non-potable water supply demands within the Southern Coastal Watershed, thereby reducing impacts to the DARB system.

5.2.2 Available Data

The following is a brief list of flood protection data resources available from the Southwest Florida Water Management District. Many of these reports, maps and electronic data sets can be accessed through the District's web site, http://swfwmd.state.fl.us. All the below-mentioned data can be accessed by calling the District's Brooksville headquarters at (352) 796-7211 or 1-800-423-1476 (Florida only).

Data Collection - The District maintains a comprehensive hydrologic conditions monitoring program. Conditions that are monitored include rainfall, evaporation, lake levels, groundwater levels, springflow, various water quality parameters, and river discharge and stage elevation. This data can be very useful for flood protection and flood forecasting activities, including development of watershed management plans.

Aerial Mapping and Floodplain Delineations - The District's aerial mapping program, initiated in the early 1970's, maintains an extensive inventory of aerial photography and aerial contour maps for use by local governments. These projects are funded by the Basin Boards on a cost-share basis with the local governments. Aerial contour mapping has been completed for the majority of the District. In addition, floodplain delineations have been completed for selected areas of the District since the early 1970s. This information is beneficial to local governments in regulating development in Flood prone areas.

GIS Data - Since the mid-1980's, the District's Mapping and Geographic Information Systems (MGIS) Section has developed a significant database of ARC/INFO data layers for use by District staff and local governments. Many of the District's data layers are useful for local government flood protection activities and have been provided to a number of local governments for use on their GIS. Such layers include drainage basin boundaries, land use/land cover, topography and soils.

Model Flood Protection Ordinance - The District's *Model Flood Management Ordinance* was produced in 1982 and distributed to all local governments within the District. The document contains valuable floodplain management information for local government planners, engineers and administrators (SWFWMD, 1982).

Technical and Financial Flood Protection Assistance - The District's Basin Boards have provided financial and technical assistance for the development and implementation of watershed management plans within the watershed. These management plans identify existing and potential flood problem areas, recommend preventive and remedial actions and provide detailed floodplain delineations suitable for use by local governments in regulating development within these areas.

5.2.3 Regulatory Authority and Special Rules

The following discussion briefly identifies the major laws and rules governing Florida's surface water resources. Since water quantity and quality issues are interrelated, the list does not attempt to segregate these two areas.

United States Environmental Protection Agency

The Federal Clean Water Act was amended in 1987 to require the establishment of the National Pollutant Discharge Elimination System (NPDES) and Municipal Separate Storm Sewer System (MS4) permitting programs. These programs require local governments to comply with certain conditions in order to obtain permits for existing and future stormwater management systems.

Southwest Florida Water Management District

Chapter 40D-2, Florida Administrative Code (FAC), "Basis of Review," includes stormwater system design criteria as well as technical and administrative information for applicants and permits.

Chapter 40D-4 and Chapter 40D-40 FAC, "Management and Storage of Surface Waters" (MSSW) states that the SWFWMD governs surface water permitting and stormwater runoff. Chapter 40D-4's Basis of Review specifies that post-development peak discharge rates for new development not exceed pre-development peak discharge rates for the 25-year, 24 hour event. In closed watersheds, i.e., those that do not have a surface outfall up to and including the 100-year, 24 hour event, post-development discharge volumes must not exceed pre-development discharge volumes for the 100-year, 24 hour event. In addition to regulating discharge, the District also restricts floodplain encroachment. District regulations require compensating storage be provided for fill placed within the 100-year floodplain. Rules also stipulate that activities affecting floodplains and floodways will not cause adverse impacts, i.e., increase flooding. Technical guidelines further clarify how to analyze and minimize impacts from activities in the floodplain.

Chapter 40D-6 FAC, "Works of the District," requires a permit to be obtained prior to connecting with, placing construction across, discharging into, or otherwise making use of works of the District. The rule protects existing works and works for which planning is underway (e.g., canals, water control structures, rights-of-way, lakes and streams) from actions which would impair their ability to function as intended.

Chapter 40D-8 FAC, "Lake levels Program," establishes guidelines (primarily in floodplains) for development bordering lakes, conservation water storage and recharge capabilities to lakes. It also provides for operation of lake control structures and a means for providing information on District consumptive use permitting activities.

Florida Department of Environmental Protection

Chapter 62-16 FAC, “Prohibition of Pollutant Discharges,” covers the powers and duties of the FDEP as they relate to prohibition of pollutant discharges, as defined in Florida Statutes 403.803(13), and the removal of prohibited discharges.

Chapter 62-25 FAC, “Regulation of Stormwater Discharge,” provides minimum criteria for discharge into surface waters and groundwater of the state. The rule’s basic objective is to achieve 80 to 90 percent removal of stormwater pollutants before discharging into receiving waters. This is generally achieved through treatment of runoff from the first inch of rainfall, although specific developments may be required to do more or less depending upon size and other criteria such as proximity to an Outstanding Florida Water (OFW).

Chapter 62-3 FAC, “Water Quality Standards,” provides minimum criteria which govern stormwater drainage necessary to protect the designated uses of State waters. The legislation provides detailed criteria for both surface water and ground water protection.

Chapter 62-302 FAC, “State Surface Water Quality Standards,” classifies surface waters into one of five different categories based upon the expected uses of each waterbody. It establishes minimum criteria for each surface water classification in order to protect public health and to enhance the quality of the waters of the State.

Chapter 62-312 FAC, “Dredge and Fill Activities,” requires permits for dredging and filling in, on, or over navigable waters and provides for mitigation criteria and exemptions.

Chapter 62-340 FAC, “Delineation of Wetlands and Surface Waters,” provides the methodology for delineating wetlands and surface waters.

Chapter 62-4 FAC, “Permits,” provides FDEP/SWFWMD rules regarding permit standards for issuing dredge and fill, stormwater, and water quality permits. It provides for the classification and exemption of certain waterbodies for permitting purposes and includes water quality standards. It also provides that permits cannot be issued for sewage facilities that directly discharge into OFWs which would lower ambient water quality, or for discharges that would degrade a downstream OFW.

Chapter 62-40 FAC, “State Water Policy,” addresses many different aspects of water resource management and protection. Stormwater and surface water management components are critical to addressing local government stormwater management systems and required levels of service.

The above regulations were developed as a result of historic legislation passed during the early and mid-1970s. This legislation includes: Chapter 373 Florida Statutes (FS), Florida Water Resources Act; Chapter 380 F.S., the Florida Environmental Land and Water Act of 1972; and, Chapter 403 F.S., “Water Resources Act.”

Local Government Regulations

The Southern Coastal watershed is primarily within the jurisdictions of Manatee, Sarasota and Charlotte Counties. Several municipalities also are located within the watershed, including the mainland cities of Bradenton, Sarasota, and Venice and the barrier island communities of Anna Maria, Holmes Beach, Bradenton Beach and Longboat Key. The following is a brief synopsis of their regulations as they relate to flood protection within the watershed.

Manatee

Existing County regulations require stormwater management systems to be designed to retain and treat the first inch of rainfall for the 25-year/24-hour design storm event. For systems that discharge within the Evers or Manatee Reservoir Watershed Overlay Districts, or to Outstanding Florida Waters or Aquatic Preserves, systems must be designed to provide 50 percent greater water quality treatment by retaining and treating the first one and one-half inch of rainfall.

Manatee County Ordinance 89-10, "Manatee County Floodplain Management Code," provides for the regulation of development within Federal Emergency Management Agency identified 100-year floodplain areas.

Sarasota County

Sarasota County Ordinance 89-117 establishes a Stormwater Environmental Utility (SEU) which is responsible for the funding, planning, development and maintenance of the County's storm and surface water management facilities. The SEU is also responsible for the permitting of stormwater facilities in private developments.

Sarasota County Ordinance No. 81-12, as amended, "Land Development Regulations," provides regulations which guide development as it pertains to the attenuation and drainage of surface water runoff. The ordinance stipulates facility design standards; provides for the attenuation and retention of stormwater with the rate of runoff to be equal to or less than pre-development conditions; and requires treatment of the runoff from the first inch of rainfall. Additionally, the ordinance regulates subdivision activities within the 25-year floodplain by withholding development approval "unless the developer submits substantial and competent evidence that all lands intended for use as building sites can be used safely for building purposes, without undue danger from flood or adverse soil or foundation conditions." Compensation is required on an equivalent basis for any loss of flood storage due to the filling of an area within a floodplain (Sarasota County, 1997).

Charlotte County

The Charlotte County Stormwater Management Ordinance #89-37 was enacted to protect, maintain and enhance both the immediate and long term health, safety and general welfare

of citizens. The ordinance sets requirements for the content, performance standards, and design standards of a Stormwater Management and Conservation Flood Plan which must receive county approval prior to the commencement of any development activity. The County's requirements for a stormwater permit are based upon determined pre-development runoff rates from a 25-year, 24-hour storm event and post-development runoff rates are not allowed to exceed these except for discharge going to tidally influenced water bodies. Additionally, the County is developing a Master Stormwater Management Plan to better understand its drainage basins and how they are affected by rainfall, especially the greater Port Charlotte area between the Myakka and Peace Rivers and areas south of the Peace River.

Municipalities

Similar to the counties, municipalities within the Southern Coastal watershed incorporate standards governing the release of runoff within the land development regulations. Most of the municipalities mimic the District's surface water management regulations. These regulations require stormwater management systems be designed to accommodate a storm event of 25-year return frequency, 24-hour duration. However, these regulations only address new development and selected redevelopment that meet District permitting thresholds. They do not address the construction of single family homes in existing platted subdivisions. In many cases, existing areas developed prior to District regulations also correspond to areas of identified flood problems. To address additional development within these areas, many local governments must undertake watershed studies to identify and correct existing and anticipated future stormwater management problems.

5.2.4 Other Government Activities

In addition to administering water quantity and floodplain regulations, governmental entities also impact flood protection through other activities. Some of these activities involve information collection, such as cataloging flood complaints by residents. Other government programs that affect flood protection include land acquisition and restoration programs, land use regulation, emergency management, and road and highway construction and maintenance.

Flood Complaints/Records

The District tracks and records flood complaints by section, township and range. Complaints are assessed to determine if there is a violation of District rules, and if so, actions are taken to correct the situation. Cities and local residents are also good sources of information. The Florida Department of Transportation keeps records of high water marks related to road design.

Land Acquisition Programs

Several agencies have land-buying programs that operate or may operate within the

watershed. These programs include the Department of Environmental Protection's Conservation and Recreational Lands (CARL) program, the District's Save Our Rivers (SOR) program, Sarasota County's Environmentally Sensitive Lands Acquisition Committee (ESLAC) and Manatee County's Environmental Lands Management and Acquisition Committee (ELMAC).

These programs typically emphasize the preservation of natural systems and enhancement/ preservation of water quality. Since the lands purchased often include flood-prone wetland areas, acquisition also serves to prevent development in these natural flood storage areas.

Land Use Regulation

Each of the counties and municipalities in the watershed regulates land use within their boundaries in accordance with a State-approved Comprehensive Plan. These plans specify the type and amount of development allowed in any given area. As a result, the plans influence where and to what extent development will be allowed in floodplains. To participate in the National Flood Insurance Program, FEMA requires the local governments to adopt floodplain management ordinances meeting their specifications. All Counties and municipalities within the watershed participate in the program.

Emergency Management

Many agencies and organizations are involved in emergency management, such as Federal agencies (including FEMA), State agencies, Regional Planning Councils, County and City government, and the Red Cross. Flooding requires actions such as evacuation planning and implementation (including operation of evacuation shelters and delivery of food and water), rescue operations, medical mobilization, flood control system operations, damage control and assessment, flood insurance compensation, delivery of federal aid, and repairs/replacement of damaged or destroyed infrastructure and buildings.

5.3 Flood Protection Issues

An overview of current flood protection issues within the Southern Coastal Watershed is given below. Included are strategies and actions to address these issues.

Data Management

Strategy: Enhance flood protection data collection and management.

Data management includes the collection, maintenance, update/revision and retrieval of data required to understand the water resource systems within the watershed. This data can be used to define and/or delineate flood prone areas. As watershed characteristics are constantly changing, the data used should be the most up-to-date to represent the current state of the watershed.

The ability of the District, government agencies, local governments and private consultants to complete accurate flood prone area analyses is dependent upon the quality of the data available. Limitations on the collection of quality data include the cost of data acquisition, physical constraints and lack of knowledge of what data is needed during the data collection phase of a project.

Actions:

1) Develop a data management system with appropriate standards to provide the information required to define the flood prone areas.
2) Provide the requirements necessary, in an ARC/INFO based GIS format, to allow the transfer and formulation of input and output data from numerical models to a GIS. This will support further data development for other predictive models (i.e., water quantity, water quality, ground water, natural systems). It will also provide access to the data and modeling results for regulation within the watershed.
3) Encourage the development of data transfer tools by the developers of stormwater management software. The goal is to have software with the capability to transfer the input data and output results to SWFWMD standards or to translate the information to data formats used by other stormwater management software and GIS.
4) Use of data management tools to update the database through the regulatory process by requiring Environmental Resource Permit (ERP) submittals to include the data in the District's data standards.
5) Perform aerial mapping with contour information (paper and digital formats) for areas in the watershed that have no such information or outdated information.
6) Promote cooperative agreements to build data collection responsibilities based on need and the capabilities of the agency (FEMA, SWFWMD, Counties, Cities).
7) Levels of Service (LOS) objectives should be set within project areas. These LOS's could be based on 25-year or 100-year, 24-hour events, and the number of homes affected, and length and classification of impacted roads, etc. could be used to develop a decision support matrix to evaluate the merits of multiple projects.

Flood Prone Area Analysis

Strategy: Obtain additional floodplain information.

Flood characteristics of the watershed can be used to decide what current and future actions are necessary. One of the primary issues concerning flood protection in the Southern Coastal watershed involves generation of flood estimates for those areas of the watershed with little or no available data. Those areas that have not already been studied should be targets for future data collection and analysis.

Actions:

1) Perform flood studies on unstudied areas.
2) Set priorities based on current development pressures.

3) Set priorities based on historic flooding problems.

Effective Flood Protection Regulation and Planning

Strategy: Address increased runoff volume due to development.

Development within a basin, whether in or out of the floodplain, increases the runoff from a given rainfall event. Current regulations prevent post-development peak discharge rates in excess of pre-development peak discharge rates. However, many areas still may experience increased flooding as the result of development. This stems from the fact that an increased volume of runoff is released from systems designed to regulate peak flow rates.

Use of several different strategies can help address the problem of increased runoff volumes. Analysis of various duration rainfall events for a specific return period can identify which event results in the greatest amount of flooding. In addition, current regulations could be modified to require detention or quicker release of increased runoff volumes so as not to coincide with peaks flows in the receiving water. Reuse of storm water for irrigation purposes primarily has water quality and water supply benefits. If built on an appropriately large scale, the volume available in storm water reuse holding ponds could also afford some flood protection.

Actions:

1) Require modeling of current tailwater conditions and impacts of upstream volumes and timing on a site proposed stormwater management system and the proposed systems receiving water for stormwater management system permits.
2) Permit applications should require "critical event" analysis.
3) Promote the reuse of stormwater for non-potable water uses to increase storage in flood prone areas in stormwater management system applications.

Strategy: Effective Regulation and Management of Floodplain Functions.

Inadequate regulations are created by a lack of information or errors made in identifying flood prone areas. Land alterations which have impacted the function of the flood prone areas have been allowed because such areas were not properly depicted on Flood Insurance Rate Maps (FIRM) developed by the Federal Emergency Management Agency (FEMA). In the pre-development analysis of a project site, the site's existing storage calculations should include potential storage volume. If the floodplain functions of a site are altered (post-development), any permitted stormwater management system will not provide the same floodplain function as the pre-developed site.

Actions:

1) Ensure that regulations are enforced. That is, lands necessary for the provision of

compensatory storage should be available when needed, systems should be designed to accommodate flooding during extreme events, and such systems should not increase the level of flood waters either upstream or downstream of the site.
2) Regulations should require conservative estimates of seasonal high groundwater elevations when determining the amount of compensating storage for encroachment into the floodplain.
3) During permitting, consider cumulative impacts of increased runoff volume in the watershed.
4) Include inspection of stormwater management systems for integrity of impoundments, embankments and other components of the system in current enforcement and inspection programs.

Strategy: Link water resource planning and land use planning.

The authority of cities and counties within the watershed, and the local decisions about the use of land that derive from this authority, have important consequences for water management. This is particularly true of flood-prone areas. Flooding problems occur where these natural areas are developed for residential or commercial use. A cooperative relationship is needed to link management of land and water resources to minimize flood damages and the loss of natural flood storage areas.

Actions:

1) Encourage local governments to establish levels of service for current (present) and targeted (build-out) conditions for the watershed's stormwater management infrastructure facilities for flood protection using methods developed by the Stormwater Level of Service (LOS) Conventions Committee.
2) Assist local governments in using LOS criteria in their comprehensive plans to measure the watershed's current flood management capacity. Cooperate with FDOT and local governments on the design of roads. The roads should be designed to meet LOS. Signage programs, including flood elevation levels, could be developed to warn drivers of flooding conditions.
3) Back legislation to require deeds or other documents for real estate to indicate if land is in a floodplain.
4) Determine and establish appropriate setbacks from riparian systems for any structure (i.e., landward of 100-year flood plain) or some distance from 10-year flood plain or wetland boundaries.
5) Coordinate with local and county governments to limit densities in floodplains.
6) Encourage current open land uses (i.e., agricultural, recreational corridors) in floodplain to remain instead of land uses that allow alterations to the floodplain.
7) Encourage conservation easements, green ways, and the efficient use of the required stormwater management storage, and placement of mitigation areas within existing flood prone areas.
8) Promote clustering of development outside the floodplain.
9) Encourage the use of density credits to cluster development outside flood plains,

incentive-based regulation.

Planning and Development of Future Flood Management Systems

Strategy: Adequately plan for future flood protection efforts.

Flood protection should be incorporated as part of stormwater management planning efforts. Some flooding problems in developed areas can be addressed without expensive remedies. For example, maintenance efforts keep existing ditches clean and existing detention facilities structurally sound. Acquiring lands to protect floodplains from alteration can help reduce potential flood damage. In addition, stormwater management master planning should address existing flooding problems with a focus on solutions that minimize environmental impacts, improve water quality and contribute to the water supply.

Actions:

1) Convince local governments that the entire watershed should be examined using a flood prone area analysis.
2) Encourage local governments to inventory existing drainage systems.
3) Encourage local governments to set goals for flood protection based on a consistent LOS policy.
4) Incorporate other planning elements in the Stormwater Management Plan method, i.e., transportation, major developments of regional significance, Greenway/Wildlife corridors, recreation/parks, agricultural development, water supply, and environmental management.
5) The Districts requirements for Stormwater Management Plans should develop a consistent framework for management throughout the watershed.
6) Pursue special development codes for building construction in floodplains (i.e., no fill for house pads in floodplains, signage required for depth of flooding, etc.).

Operation and Maintenance Responsibilities for Stormwater Management Systems

Strategy: Determine ownership, operation and maintenance responsibilities for flood management systems.

Flood management systems within the watershed provide stormwater conveyance and storage functions. The existing network is a combination of natural and manmade systems. Responsibility for the operation and maintenance of these systems varies, but may include the District, counties, municipalities or private entities.

Actions:

1) Determine the ownership of identified stormwater management systems.
2) Determine the responsible entity for operation and maintenance of identified stormwater management systems.

3) Develop operation and maintenance plans for the flood management systems within the watershed. This includes developing strategies for maintaining and operating the systems, obtaining easements or ingress and egress agreements with property owners, and naming the governments or other responsible parties to complete the work.

Revenues and Funding Sources

Strategy: Seek consistent source(s) of funding for flood management systems.

Revenues and funding sources are available for surface water management at the federal, state, regional, county and city government levels. Cooperative funding programs are available to help cost share on projects of special concern and for watersheds that extend beyond jurisdictional boundaries. Local governments fund stormwater management projects through a variety of funding mechanisms. A consistent source of funding is provided by some entities, while others fund inconsistently. Master plans address funding for problem areas without consideration of possible future funding from other entities who propose development or alterations within the watershed.

New development or land alteration projects require stormwater management systems. These systems function, however, as facilities for local governments, but are not necessarily funded, owned, or operated by the local government. Major conveyance systems and storage areas are typically funded by a variety of sources within a watershed. Often, there are no overall mechanisms to guide the development of stormwater management infrastructure within a watershed.

Actions:

1) Alternatives to general revenue sources should be considered for funding of stormwater projects.
2) Encourage the establishment of stormwater management utility fees.
3) Encourage the establishment of special assessment districts.
4) Encourage contributions to regional facilities developed based on a Stormwater Management Master Plan.
5) Develop an educational program implemented by the District for county and local governments that illustrate the available funding.
6) Encourage cooperative projects or piggyback scenarios where many agencies contribute to a project developed through a watershed-wide study. Possibly provide credits for developers, roadway improvements (FDOT, Counties, Cities) who tie into regional projects that provide efficient stormwater quality and quantity storage, wetland mitigation and protection of the floodplain and its function. Provide mechanisms for maintenance and operation funding.

Flood Management Awareness and Education

Strategy: Facilitate public education and understanding of flood protection are necessary

in order to build support for stormwater management projects or programs that protect the natural floodplain and its function.

Actions:

1) Educate public and elected officials that developments are often designed to flood relatively frequently (based on a probability of occurrence of a storm event), based on the level of service provided.
2) Educate the public on the hydrologic cycle and its interaction with the water resource and the impacts on water use.
3) Educate the public and elected officials that restricting development in the flood plain may result in significant monetary savings and enhance natural systems in the future.
4) Clarify District flood protection responsibilities.
5) Clarify the role of FEMA and their responsibilities and contribution to flood protection.
6) Promote cooperation between the responsible jurisdictions on flood protection issues.
7) Provide educational talks to technical groups.

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CHAPTER VI

WATER QUALITY

6.1 Introduction

In 1988, Sarasota Bay was chosen by the U.S. Environmental Protection Agency as an estuary of national significance. Subsequently, the Sarasota Bay National Estuary Program (SBNEP) completed a technical diagnosis of Sarasota Bay. The results of this diagnosis were compiled in the document "Framework for Action" (SBNEP, 1992), which set the stage for the SBNEP's "Comprehensive Conservation and Management Plan," (CCMP) which was completed in 1995.

In 1995, the Southwest Florida Water Management District (SWFWMD) selected Sarasota Bay to be included in its list of priority water bodies for the Surface Water Improvement and Management (SWIM) Department. Designation of Sarasota Bay as a SWIM priority water body allowed monies to be spent on the restoration and/or protection of Sarasota Bay from the SWIM Trust Fund, pending the approval of a Sarasota Bay SWIM Plan.

However, Dona and Roberts Bay (the Roberts Bay located next to Venice, not the Roberts Bay just north of Phillippi Creek) have not received the level of attention focused on Sarasota Bay. Neither has Lemon Bay. Additionally, Gasparilla Sound has not been the focus of any detailed examination of water quality or pollutant loads.

The challenge, therefore, of the Southern Coastal Watershed Management (SCWM) Program is to examine the possibilities of applying research, monitoring, and restoration techniques used in Sarasota Bay and other similar systems, and apply them (where practical) to Dona Bay, Roberts Bay, Lemon Bay and Gasparilla Sound.

6.1.1 Previous Studies and Available Data

Before inclusion in the National Estuary Program, Sarasota Bay was the focus of many studies. In the late 1980's, the National Oceanic and Atmospheric Administration's "Estuary of the Month" program produced a summary document focusing on Tampa Bay and Sarasota Bay. This document, "NOAA Estuary of the Month" (1987) contains seven chapters dealing with water quality, pollutant loads, and management issues within Sarasota Bay. These articles are listed in the literature cited section of this chapter.

In 1988, Mote Marine Laboratory summarized the results of ongoing and completed research in Sarasota Bay. This document, "Sarasota Bay Area Scientific Information Symposium" (1988) updated information from the earlier NOAA study, while focusing on Sarasota Bay alone. Also called "SARABASIS," this effort included preliminary recommendations for improving the management of Sarasota Bay and its watershed.

These articles are listed in the literature cited section of this chapter.

Four years after its inclusion in the National Estuary Program, SBNEP produced the "Framework for Action" (1992). This document summarized the entirety of research on Sarasota Bay conducted through the efforts of the SBNEP, and included over a dozen chapters dealing with water quality, pollutant loads, circulation patterns, fisheries, marine mammals and more. Again, these articles are listed in the literature cited section of this chapter. At the end of each chapter, individual authors made recommendations about what activities would best aid in the preservation and/or restoration of Sarasota Bay. These recommendations were the basis for a second SBNEP document, the "Comprehensive Conservation and Management Plan" (CCMP, 1995). The CCMP is meant to be the document through which local, state and federal agencies work with the local population to best manage the natural resources of Sarasota Bay.

In June of 1997, the Sarasota Bay SWIM Plan was formally accepted by FDEP. This document summarizes the information contained within earlier characterization efforts, and updates this information where necessary.

In addition, nearly two dozen articles, chapters, and reports not associated with these efforts have been published on the ecology of Sarasota Bay in the last two decades alone (see literature cited section). As well, data from past and ongoing water quality monitoring programs carried out by Manatee and Sarasota Counties must be submitted to the State of Florida's water quality storage and retrieval system, a.k.a. STORET, where they are summarized by the Florida Department of Environmental Protection in its biannual 305(b) reports. The electronic version of this report, accessible at http://ebase.dep.state.fl.us is the source of the most recent water quality data, which was used to produce the updated information on status and trends in water quality throughout the SCWM Program's area of interest.

For Dona and Roberts Bays, although water quality data are collected as part of ongoing monitoring programs, the exclusion of these waterbodies from the SBNEP's management boundaries is reflected in the smaller amount of summary documentation on issues of water quality and habitat loss. However, Mote Marine Laboratory coordinated a thorough investigation of the hydrology, water quality, and basic ecology of the Dona and Roberts Bays system. A compilation of findings, "The Ecological Status of Dona and Roberts Bays and its Relationship to Cow Pen Slough and Other Possible Perturbations" was published in 1975. A compilation of management strategies is included in this document.

For Lemon Bay, the most comprehensive assessment of water quality, natural resources, and potential management issues is the "Lemon Bay Aquatic Preserve Management Plan" published by the Florida Department of Natural Resources (now FDEP) in 1991. This document, which focused on identifying important management issues, is mostly descriptive in its assessment of the status of water quality and natural resources.

Very little information is available for Gasparilla Sound, even within the document "Charlotte

Harbor SWIM Plan," which was accepted by FDEP in 1993.

The most recent attempt to characterize the water quality within the Southern Coastal Watershed area of interest (other than Sarasota Bay) was carried out by Coastal Environmental, Inc. (1997). This project was funded by the Charlotte Harbor National Estuary Program (CHNEP), and includes summaries of water quality for the entirety of the Charlotte Harbor basin and watershed. Of interest to the SCWM Program, water quality status and trends information was assembled for the area of Dona and Roberts Bays, Lemon Bay, and Gasparilla Sound. However, Coastal Environmental, Inc. (1997) concluded that there was insufficient information available to determine trends in water quality in Dona and Roberts Bays, Lemon Bay, and Gasparilla Sound.

Clearly, the much higher level of funding available through the SBNEP has resulted in a much more detailed assessment of pollutant loads, circulation patterns, seagrass coverage, etc. for Sarasota Bay than for Dona, Roberts, and Lemon Bays and Gasparilla Sound.

6.2 Overview of Watershed-wide Issues

The Southern Coastal Watershed contains some of Florida's most beautiful and productive estuaries. However, population growth in the watersheds of Sarasota, Dona, Roberts, and Lemon Bays has been dramatic, especially in the post-World War II years. In 1989, the population in both Manatee and Sarasota Counties was estimated at 425,400 (SBNEP, 1989). By the year 1995, that number was predicted to be approximately 513,900. As population in these two counties was less than 150,000 in 1940, this represents nearly a fourfold increase in population in just more than fifty years. In 1960, population in the two counties was estimated at 163,000, showing a more than threefold increase in population in the last thirty years.

The rapid population growth that has occurred throughout Southwest Florida in the post-World War II years has caused substantial impacts to those natural resources most dependent upon careful management and the protection of water quality. To understand these issues better, a comparison of watersheds and basins follows.

For the chapters on water quality and natural systems, the estuarine areas and their associated basins within the Southern Coastal Watershed are delimited as follows (see Map 3 in Appendix):

- Upper Sarasota Bay (USB) - includes Palma Sola Bay, Anna Maria Sound, and Sarasota Bay proper south to Siesta Key Drive

- Lower Sarasota Bay (LSB) - includes Roberts Bay (the northern one), Little Sarasota Bay, and Blackburn Bay

- Dona and Roberts Bay (DARB) - includes Dona and Roberts Bays, and the mouth of Shakett Creek

- Lemon Bay (LB) - includes Lemon Bay south to the Gasparilla Island Causeway
- Gasparilla Sound (GS) - includes from the Gasparilla Island Causeway to a line roughly parallel between the southern tip of Cape Haze and the town of Boca Grande, and includes Turtle Bay and Bull Bay

An important consideration, when evaluating the health of any estuary, is the relative size of its watershed. Using this classification, the watersheds for the basins within the Southern Coastal Watershed vary in size from 59 square miles (Upper Sarasota Bay) to more than 90 square miles (Lower Sarasota Bay). The amount of open water that these watersheds drain into varies from just more than 1 square mile (Dona and Roberts Bay) to 45 square miles (Upper Sarasota Bay). For Gasparilla Sound, the irregular and highly indented shoreline creates much difficulty, when assessing both the area of open water, and the area of contributing watershed.

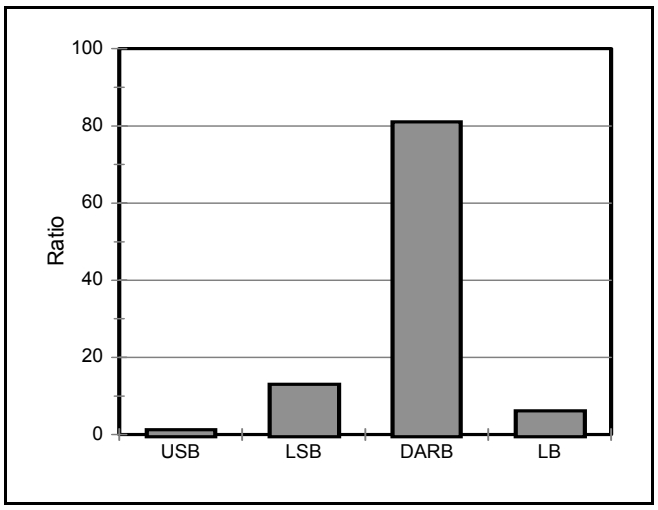

Figure VI-1 - Watershed to open-water ratio

The watershed to open-water ratio varies from less than 2 (USB) to more than 80 (DARB; Fig. VI-1). Consequently, even without anthropogenic influences, surface waters in the Upper Sarasota Bay system would be expected to have lower nutrient concentrations and greater water clarity than is the case in the Dona and Roberts Bay system, due to the greater degree of terrestrial influence in the Dona and Roberts Bay system.

Using data summarized in the 1994 FDEP's 305(b) report, nutrient data can be compared between these systems. All four systems have TN values less than the Median Value for Florida's estuaries (FDEP, 1994). Also, all four systems have TP values above the Median Value for Florida's estuaries (FDEP, 1994).

As a result of the elevated levels of TP in all four systems, N:P ratios vary from a low of 3.6 in Dona and Roberts Bay to 5.6 in Lower Sarasota Bay (Fig. VI-2). As

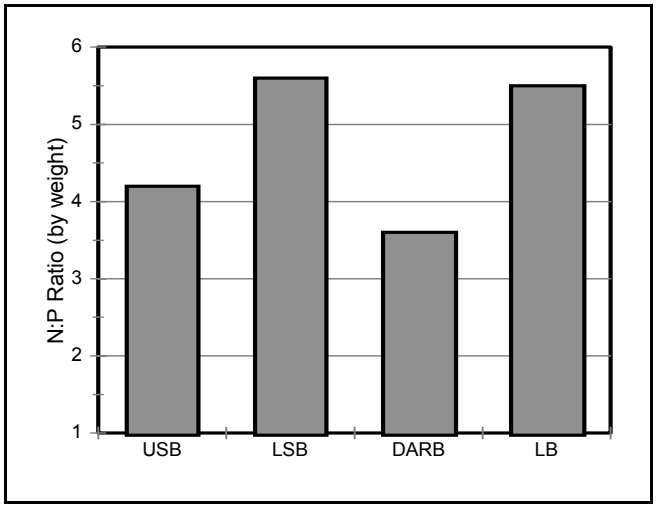

Figure VI-2 - N:P Ratio of Water Samples

such, all four systems are well within the range of N:P ratios that would suggest nitrogen limitation of primary productivity (i.e., < 10). Nutrient reductions for nitrogen would thus be of greater benefit than those for phosphorus, except (potentially) in those freshwater streams and lakes located throughout the watersheds.

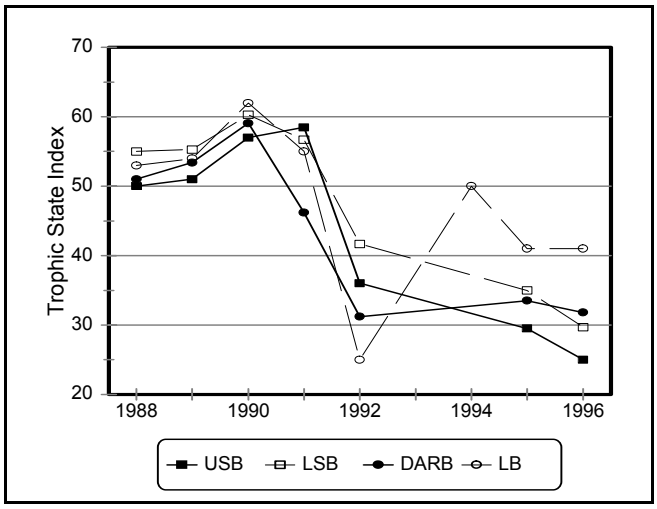

Figure VI-3 - Trophic State Index Values

Using the FDEP's criteria for developing Trophic State Index (TSI) values, the relative health of water quality within the estuaries of the Southern Coastal Watershed can be calculated. TSI values were downloaded from STORET, and average values for each basin are shown in Fig. VI-3. No data were available for Gasparilla Sound.

USB, LSB, DARB and LB all exhibit trends of improving water quality over the past several years, with most of the improvements occurring between 1990 and 1992. Prior to 1990, the average TSI values for all the systems were in the range of "fair" (50-59), with a single annual average (Lemon Bay, 1990) in the "poor" range (60-90). In contrast, post-1992 values only contain one annual average (Lemon Bay, 1994) not in the "good" range (< 50). However, a more recent analysis of water quality data, while supporting the finding of improved water quality in Sarasota Bay, showed that water quality appears to have degraded in the northern portion of Lemon Bay (the portion monitored by Sarasota County) during the period 1995 to 1998 (Dixon and Heyl, 1999).

The improvements in water quality that seem to have occurred between 1990 and 1992 are concurrent with the completion of nutrient removal technology upgrades to the City of Sarasota's wastewater treatment plant (in 1991), as well as the movement toward deep-well injection of effluent from facilities such as Manatee County's Southeast Treatment Plant and Atlantic Utilities discharge into Phillippi Creek. These changes in effluent quality and effluent disposal practices were a result of the Grizzle-Figg Act (403.086, Florida Statutes) which required advanced wastewater treatment (i.e., nutrient removal technology) for all surface water discharges into Tampa Bay, Sarasota Bay, Lemon Bay and Charlotte Harbor.

Unfortunately, insufficient data are available for determining the status of water quality in Gasparilla Sound.

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6.3 Priority Issues at the Basin Level

6.3.1 Sarasota Bay

Sarasota Bay, the most studied of the estuaries within the Southern Coastal Watershed, has experienced the following perturbations (data from Sarasota Bay National Estuary Program [SBNEP], 1992):

- Nitrogen loads have increased by approximately 300 percent, compared with pristine conditions
- Tidal wetlands have decreased by approximately 39 percent, when comparing 1950 to 1990 estimates
- Dredging has degraded 14 percent of the bay bottom
- Dredge and fill activities, as well as reduced water quality, have caused a 30 percent loss of seagrasses, when comparing 1950 to 1988 estimates
- Fisheries have declined substantially

However, recent improvements to wastewater and stormwater have occurred, and several habitat restoration projects have been completed. Regulatory actions and SBNEP-sponsored "early action demonstration projects" have resulted in the following:

- Nitrogen loads have decreased 25 percent bay-wide, when comparing 1998 to 1988 values
- Restoration projects have increased tidal wetlands in Sarasota Bay by approximately 3 percent
- Due to nitrogen load reductions at several locations (e.g., City of Sarasota, Manatee County), seagrasses have increased by approximately 1,682 acres between 1988 and 1996

For comparative purposes, the water body here after referred to as "Sarasota Bay" extends from Anna Maria Sound and Palma Sola Bay, in the north, to Venice Inlet, in the south, a total of 52 square miles of open water. The contributing watershed is approximately 150 square miles in size (Heyl, 1992).

The watershed is split between Manatee County and Sarasota County, and encompasses the City of Sarasota, as well as the island communities of Anna Maria, Holmes Beach, Bradenton Beach, and Longboat Key.

The largest tributary to Sarasota Bay is Phillippi Creek, which drains a watershed of 57

quare miles, or 38 percent of the Sarasota Bay watershed. Other major tributaries include South Creek, with a watershed of 20 square miles (14 percent of the total watershed), the Bowlees Creek system, which drains 13 square miles (8 percent of the total), and Whitaker Bayou, which drains 8 square miles (5 percent of the total).

During the post-World War II period of rapid growth, much environmental damage occurred, as a result of large-scale dredge and fill projects. These projects included the conversion of Bird Key into a finger fill canal community, and the dredging (in the 1960's) of the Intracoastal Waterway. The dredging of the Intracoastal Waterway may have increased the hydraulic instability of Midnight Pass, the movement of which resulted in its permitted closure and subsequent failed reopening in the winter of 1983 (Sheng and Peene, 1992).

Water quality in Sarasota Bay is undoubtedly influenced by the amount of watershed that drains into different parts of the Bay. In northern and central portions of the bay (i.e., Upper Sarasota Bay), 59 square miles of watershed drain into 45 square miles of open water. In the area of Roberts Bay south to Venice Inlet (Lower Sarasota Bay), 91 square miles of watershed drain into 7 square miles of open water. Thus, the watershed : open water ratio in the northern and central parts of Sarasota Bay (Upper Sarasota Bay) is 1.3, while in the southern part of Sarasota Bay (Lower Sarasota Bay), this ratio climbs to 13.4, a roughly tenfold increase.

When comparing segments against each other in terms of water clarity, a general pattern emerges. Areas closest to flushing passes tend to have the greatest water clarity (e.g., Anna Maria Sound, Longboat Pass, etc.). Areas farther away from the influence of the Gulf of Mexico tend to have the lowest water clarity (e.g., Palma Sola Bay, Little Sarasota Bay). However, Roberts Bay has poor water clarity, despite its proximity to Big Pass, and the waters just west of central Longboat Key have good water clarity, despite being located in a null zone for circulation (Sheng and Peene, 1992).
Using FDEP's methodology for determining "trophic state indices - TSI" (FDEP, 1994), and excluding stations located in tributaries, all bay segments had TSI values in the "good" range, except for Midnight Pass, which had a TSI value in the "fair" range (Lowrey, 1992). Comparisons of TSI values suggest that overall water quality in Sarasota Bay is better than upper and middle portions of Tampa Bay, and about the same as lower Tampa Bay (Lowrey, 1992). Comparisons with Charlotte Harbor TSI values suggest water quality in Sarasota Bay is roughly equivalent to that of Charlotte Harbor, but substantially better than water at the mouth of the Caloosahatchee River (Lowrey, 1992). However, recent improvements in water quality in Sarasota Bay (Fig. VI-3) may make the assessment of water quality performed by Lowrey (1992) somewhat dated.

Between 1970 and 1992, the majority of Sarasota Bay had become less saline (Lowrey, 1992). This change has occurred despite the lack of a trend in rainfall in the immediate watershed during the same period (Tomasko, unpublished data), and is thought to be related to increases in the amount of impervious surface area that have accompanied the increased urbanization of the watershed.

Out of 17 bay-wide segments used to delineate Sarasota Bay (SBNEP, 1995), 11 showed trends of decreasing chlorophyll a concentrations (Lowrey, 1992), an indication of increasing water quality. Additionally, 5 bay segments showed trends of increasing water clarity, 5 showed decreasing trends for total nitrogen concentrations, 7 showed improvements for total phosphorus concentrations, and 4 showed improving trends for total suspended solids concentrations.

Areas with multi-parameter documented increases in water quality in recent years include the waters offshore Tidy Island, the area influenced by the City of Sarasota's wastewater outfall, and Little Sarasota Bay, respectively. Improvements to Manatee County's wastewater irrigation practices are thought to be responsible for improvements in water quality offshore Tidy Island, while upgrades to the City of Sarasota's wastewater treatment plant are thought to be responsible for improvements in water quality in the area influenced by the City of Sarasota's wastewater outfall. Determining the causes of recent increases in water quality in Little Sarasota Bay is more problematic.

In contrast, water quality may be declining in the eastern portion of Sarasota Bay between Stevens Point and Bowlees Creek. Water quality in Roberts Bay and Palma Sola Bay did not appear to be either increasing or decreasing (Lowrey, 1992).

Sarasota Bay is characterized by areas with strong tidal influence in and near its major passes, as well as areas with much reduced flushing. Areas of reduced flushing can be associated with "dead ends" such as Palma Sola Bay, as well as "null zones" for circulation where tidal waves coming in from adjacent inlets meet (i.e., Little Sarasota Bay).

Turnover times for the water within different bay segments vary substantially. Turnover times in Anna Maria Sound and that portion of the bay adjacent to Big Pass and New Pass average 12 to 13 days (Sheng and Peene, 1992). In the area off Tidy Island, turnover times average 15 to 16 days, and in Roberts Bay, turnover time was estimated at 19 days. In contrast, Palma Sola Bay and Little Sarasota Bay have turnover rates of between 32 and 37 days, respectively (Sheng and Peene, 1992).

Due to the closure of Midnight Pass, turnover times for the water in Little Sarasota Bay increased from 14 to 37 days (Sheng and Peene, 1992). However, due to the shift from two null zones between Venice Inlet and New Pass to one null zone in Little Sarasota Bay, turnover time in Roberts Bay decreased from 19 to 13 days (Sheng and Peene, 1992).

The relatively low turnover time for the waters of Little Sarasota Bay (37 days) thus coincides with the much higher watershed to open water ratio found in this area. From this consideration alone, it would be expected that water quality in Little Sarasota Bay would be lower than in the central and northern portions of the bay.

Seagrass coverage varies throughout the bay. Excluding passes, areal coverage ranges from 51 percent of the bay bottom in Anna Maria Sound to 6 percent of the bottom in the eastern portion of the bay offshore of the City of Sarasota. Bay-wide, seagrasses cover

approximately 32 percent of the bay bottom (Kurz et al., 1999 - in press). The depth to which seagrasses grow also varies bay-wide, from less than 50 cm below mean sea level (MSL) in Roberts Bay, to more than 2 m (MSL) in Anna Maria Sound (Tomasko et al., 1992). As water clarity is the primary factor controlling the depth to which seagrasses grow in Sarasota Bay (Tomasko et al. 1992), improvements in water quality have the potential to increase seagrass coverage by allowing seagrasses to grow down into deeper, farther offshore portions of the bay.

Increases in seagrass coverage have been used as "bio-indicators" of improving water quality in Tampa Bay (Johansson, 1991). In years past, the part of Sarasota Bay near the mouth of Whitaker Bayou (segment 11) lost a substantial amount of seagrasses, a phenomenon mostly attributed to the discharge of secondarily treated wastewater from the City of Sarasota (Dr. Robert Orth, personal communication). Improvements to the City of Sarasota's wastewater treatment plant during the early 1990's are thought to be responsible for a dramatic improvement in water quality in these same areas.

Associated with the implementation of nutrient removal technology and increased re-use of treated effluent, loads of nitrogen into Whitaker Bayou have decreased by approximately 95 percent during the past 10 years (Camp, Dresser, & McKee, Inc., 1992; Tomasko et al., 1992). This load reduction amounts to a 43 percent decline in loads throughout the central portion of the bay (Camp, Dresser, & McKee, Inc., 1992). During this period, nutrient levels decreased in the waters offshore of Whitaker Bayou (Lowrey, 1992). Between 1988 and 1996, seagrass coverage in central Sarasota Bay increased by 669 acres (Kurz et al., 1999 - in press). Further reductions in nutrient loads have the potential to further increase the amount of seagrass coverage in Sarasota Bay (Tomasko et al., 1992).

The engineering firm Camp, Dresser & McKee, Inc. was tasked by SBNEP to determine the relative contributions of five sources of pollution (stormwater, point sources, atmospheric deposition, baseflow, and septic tanks) for four different pollutants (nitrogen, phosphorus, lead, and zinc). The information presented here is derived from three major reports (Phases I, II, and III of Camp, Dresser, & McKee, Inc., 1992) and two summaries of these data (Heyl, 1992; Tomasko et al., 1992).
Nitrogen, rather than phosphorus, seems to be the limiting nutrient for algal growth in Sarasota Bay, as N:P ratios (mg/l) average less than six (Fig. VI-2). Nitrogen loads are thought to be approximately three times as high as that which would be expected from a pristine, undeveloped watershed (Camp, Dresser, & McKee, Inc., 1992) Consequently, the elevated nitrogen loads entering Sarasota Bay would be expected to result in increased abundances of phytoplankton (capable of reducing water clarity and shading seagrasses), epiphytic algae (capable of shading seagrasses and interfering with gas exchange across seagrass blades), and macroalgae (capable of shading seagrasses and producing recurrent hypoxia in shallow waters).

Baywide, 46 percent of the nitrogen loaded into Sarasota Bay comes from stormwater runoff (data from Heyl, 1992). Runoff from residential land uses accounts for 60 percent of the 46 percent due to runoff, or approximately 28 percent of all loads. The high level of

nitrogen loads coming from residential runoff is attributed to two factors: residential land uses account for 42 percent of the watershed, and event mean concentrations of nitrogen for residential land uses are second only to those from row crops, being higher even than those associated with runoff from citrus groves (Camp, Dresser, & McKee, Inc., 1992; Heyl, 1992).

Atmospheric deposition accounts for 27 percent of the bay-wide nitrogen load. However, atmospheric deposition is the dominant loading source in the northern portions of the Bay, associated with the low watershed to open water ratio in these areas. Overall, these same portions of the bay where atmospheric loads are proportionally and quantitatively greatest (i.e., Anna Maria Sound and areas just to the south) are also areas with the best water quality (Lowrey, 1992), the greatest water clarity (Tomasko et al., 1992), and the deepest growing seagrasses (Tomasko et al., 1992). As important as atmospheric deposition is in terms of loading models, there is the potential that atmospheric loads of nitrogen do not have the same biological consequences as sources such as stormwater and wastewater (i.e., loading associated with low concentrations "applied" over large areas, as opposed to high concentrations loaded into more restricted areas).

Baseflow, that portion of the nitrogen load coming from uncontaminated groundwater, accounts for 9 percent of bay-wide loads (Heyl, 1992).

Although septic tanks only contribute approximately 10 percent of the bay-wide nitrogen loads, they can be locally important in areas where they are the predominant means of sewage disposal (SBNEP, 1995). In Roberts Bay, septic tank nitrogen loads are estimated at 21 percent of the total (SBNEP, 1995). Due to the combination of locally important nitrogen loads and recurrent health problems associated with dramatically elevated bacterial abundances in Phillippi Creek, the replacement of septic tanks with central sewers in priority areas is a recommendation of the SBNEP's Comprehensive Conservation and Management Plan (1995).

6.3.2 Dona and Roberts Bay System

Undoubtedly, the largest human influence on the ecology of Dona and Roberts Bay was the modification of the Cow Pen Slough Watershed in the 1960's. This modification changed the size of the watershed from 68 square miles to nearly 90 square miles (Mote Marine Lab, 1975). This effort, coordinated through the combined efforts of the U.S.D.A. Soil Conservation Service, the Sarasota Soil Conservation District, the Sarasota County Board of Commissioners and the Manatee River Soil Conservation District, was designed to reduce flood damage in upstream vegetable producing areas and pasture land (Mote Marine Lab, 1975). Thus, the very high watershed to open water ratio of the Dona and Roberts Bay system (Fig. VI-1) reflects both natural and human influences.

The watershed of the Dona and Roberts Bay system is dominated by agricultural land-uses, although the coastal fringe is mostly residential in nature. In the 1970's and 1980's various projects were undertaken to improve water quality within Cow Pen Slough (Gary Reckner,

pers. comm.) These projects included the fencing off of Cow Pen Slough to prevent cattle from eroding the banks and contaminating the water with their feces. Perhaps associated with these activities, TN concentrations within the Dona and Roberts Bay system have declined in recent years (Fig. 3) and are presently lower than the Florida Median Value (FDEP, 1994). The high TP concentration in the Dona and Roberts Bay system appears to be responsible for the strong nitrogen limitation in these waters (Fig. VI- 2).

In addition to their influence on water quality, freshwater influxes from the Cow Pen Slough drainage system disrupt the normal circulation and salinity distribution patterns throughout the Dona and Roberts Bay system. The large and rapid fluctuations in salinity that occur throughout the Dona and Roberts Bay system are thought to have created a depauperate flora and fauna within the outer portions of the bays (Mote Marine Laboratory, 1975).

Not only do fluctuations in salinity make it difficult for the long-term survival of seagrasses, but during periods of high inflow, incoming tides can be kept from entering the bays themselves. This phenomenon can reduce the settlement and survival in Dona and Roberts Bays of larval and juvenile stages of those animals that spawn in the spring and summer (Mote Marine Laboratory, 1975).

Also associated with the large influxes of freshwater during the wet season, large rafts of freshwater plants such as Elodea sp. and Hydrilla sp. are brought into the outer bays. Once these plants are exposed to the higher salinities of the outer portions of the Dona and Roberts Bay system, they die en masse. The decay of these large quantities of plant material usually occurs in the same parts of the Dona and Roberts Bay system where the highest sediment organic contents and lowest bottom water dissolved oxygen levels are found (Mote Marine Laboratory, 1975).

Clearly, any efforts to restore a more natural hydrology in the Dona and Roberts Bay system would have beneficial effects on the ecology of this system. Additionally, the removal and/or better management of the large rafts of soon-to-decay freshwater plants brought down into the Dona and Roberts Bay system from the upper reaches of Cow Pen Slough would also have beneficial effects.

6.3.3 Lemon Bay

Lemon Bay was designated an aquatic preserve in 1986. Designation is meant to ensure that the water quality and natural systems of Lemon Bay will be protected even as the contributing watershed continues to attract a growing population.

Elevated levels of fecal coliform bacteria have been detected in the tributaries to Lemon Bay, and in the surface waters of the Bay itself (FDNR, 1991). Concerns over these findings have prompted the Englewood Water District to propose that the approximately 9,000 septic tanks in the Lemon Bay watershed be replaced with centralized wastewater treatment (Palermo, 1996).

Despite the potential role of septic tanks in contributing to bacterial contamination of groundwater and surface waters, water quality in Lemon Bay is presently classified as "Good" (see Fig. VI-3). Perhaps associated with the generally good water quality in Lemon Bay, seagrass coverage is extensive in the Bay, where they can be found down to a depth of 7 feet (FDNR, 1991).

Ongoing studies by the District and FDEP suggest that water clarity in Lemon Bay is correlated with phytoplankton levels (Fig. VI-4), which themselves appear to be nitrogen limited (see Fig. VI-2). These results suggest that increased nitrogen loads (associated with increased urbanization of the watershed) would be expected to bring about a reduction in water clarity, and thus a potential decrease in seagrass coverage.

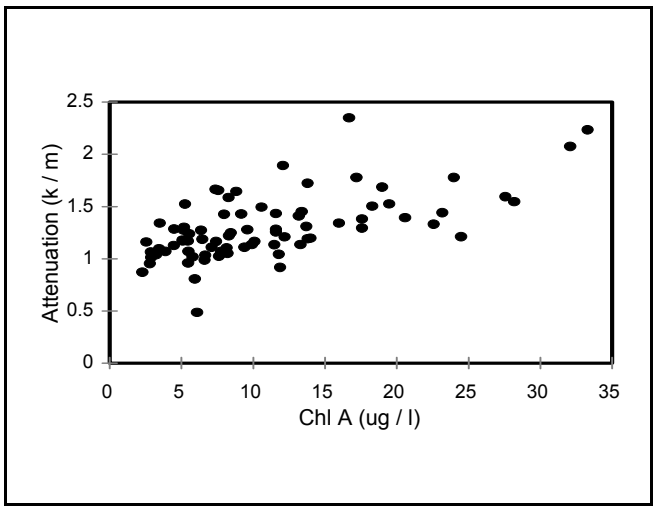

Figure VI-4 - Plot of attenuation coefficients vs. chlorophyll a concentrations in Lemon Bay

A recent assessment of nitrogen loads in Lemon Bay suggests that urban stormwater runoff is less important than the nitrogen loaded into this system from natural forested systems and range land (Coastal Environmental, Inc. 1997). This loading assessment, however, did not include loads from atmospheric deposition, septic tanks, and point sources.

The further refinement of a nitrogen loading model for Lemon Bay is thus necessary to better understand the potential implications of increased nitrogen loads into Lemon Bay, and how to best manage the water quality and natural resources of Lemon Bay.

6.3.4 Gasparilla Sound

As discussed above, the complexity of this area makes it difficult to establish even the most basic information on watershed to open water ratios. Concerning water quality, the most intensive assessment to date for this area (Coastal Environmental, Inc. 1997) concluded that “No comprehensive data bases were identified which allowed a comprehensive assessment of long-term and current water quality conditions . . . ”

Clearly, both Gasparilla Sound and Lemon Bay require more intensive assessments of water quality and pollutant loading potentials.

6.4 Water Quality Issues

Monitoring and Data Management

Currently, water quality data are collected by the following entities: Manatee County, Sarasota County, Florida Department of Environmental Protection (FDEP), Southwest Florida Water Management District, and the U.S. Geological Survey (USGS). Manatee County monitors water quality within the estuarine waters of Sarasota Bay on a monthly basis, using county staff. Sarasota County monitors water quality within the estuarine waters of Sarasota Bay, Dona and Roberts Bays, and the northern portion of Lemon Bay, by subcontracting this work out to private contractors. In the southern portion of Lemon Bay (the portion in Charlotte County), water quality monitoring is mostly performed by volunteer efforts coordinated by FDEP staff.

With the exception of the USGS, the other agencies are required to upload water quality data into STORET, the official repository of water quality data for the State of Florida. Numerous projects have downloaded water quality data from STORET to determine status and trends in water quality in Sarasota Bay (SBNEP, 1992; FDEP, 1994), Dona and Roberts Bay (FDEP, 1994), and Lemon Bay (FDEP, 1994). However, a more integrated water quality monitoring program is called for, to ensure that ongoing water quality monitoring programs are coordinated and are assured of continued funding.

Strategy: Continue ongoing monitoring and data management activities in Sarasota and Manatee Counties.

Actions:

1) Through the District's cooperative funding program, determine those water quality monitoring programs in need of support and/or enhancement though the use of District staff and/or funding.

2) Through the District's cooperative funding program, continue to support efforts focused on determining the status and trends (if any) in water quality.

Strategy: Expand ongoing monitoring and data management activities into Charlotte County.

Actions:

1) Through the District's cooperative funding program, and in coordination with the Charlotte Harbor NEP, develop a coordinated water quality monitoring program for Lemon Bay and Gasparilla Sound.

Improving Water Quality

The depth to which seagrasses grow in Sarasota Bay is related to water clarity and water quality. A similar relationship probably occurs in Dona and Roberts Bays and Lemon Bay, as well. Activities which reduce nitrogen loads, and thus improve water quality, would be expected to increase the coverage of these important fisheries nursery habitats, thus resulting in increased fisheries resources. Lemon Bay appears to be susceptible to

decreases in seagrass coverage, should continued urbanization of its watershed occur, given expected population growth. In addition, hydrologic modifications to Cow Pen Slough could potentially benefit living resources in Dona and Roberts Bays.

Consistent with the Sarasota Bay NEP's Comprehensive Conservation and Management Plan, and the Sarasota Bay SWIM Plan, the District should continue to work with local, state and federal agencies to address ongoing issues of wastewater and stormwater.

Strategy: Determine the potential ecological consequences associated with further development of the Lemon Bay watershed.

Actions:

1) In coordination with the Charlotte Harbor NEP and the SWIM Program, develop a detailed pollutant loading model for Lemon Bay, with special attention paid to generating potential scenarios associated with increased nitrogen loads into Lemon Bay.

Strategy: Better understand the ecological impacts of present-day flood control practices in Cow Pen Slough, and determine the potential for utilizing high flows as a supplement to potable and/or non-potable water supplies in Sarasota County.

Action:

1) Through the District's cooperative funding program, and in coordination with the Charlotte Harbor NEP and the SWIM Program, develop a detailed hydrologic model of Cow Pen Slough, Shakett Creek and Dona and Roberts Bays, to better understand the ecological impacts of present-day flood control practices.

Strategy: Reduce wastewater-related point and non-point source pollutant loads to the freshwater and estuarine waters of the Southern Coastal Watershed.

Actions:

1) Support local governments in their efforts to require wastewater treatment policies consistent with either nutrient removal technology, or advanced secondary treatment with effective reuse.

2) Develop a multi-county wastewater reclamation program to minimize the discharge of treated wastewater to the freshwater and estuarine waters of the Southern Coastal Watershed.

Strategy: Reduce stormwater-related non-point source pollutant loads to the freshwater and estuarine waters of the Southern Coastal Watershed.

Actions:

1) Promote pollution prevention through improved landscape design and maintenance of residential areas.

2) Continue ongoing efforts to implement the Sarasota Bay NEP's "Florida Yards and Neighborhoods Program."

3) Develop and implement stormwater management master plans for tributaries identified as "hot spots" for toxic and/or sediment loadings.

4) Continue ongoing efforts to maintain stormwater management and treatment systems for maximum efficiency in reducing pollutant loads.

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CHAPTER VII

NATURAL SYSTEMS

7.1 Introduction

Much of the variation in water quality affecting the numerous estuarine and riverine systems in the Southern Coastal Watershed can be explained by two basic factors: the watershed to open water ratio, and the degree of urbanization of the contributing watershed. As discussed in the Water Quality chapter, areas with relatively low watershed to open water ratios tend to have the best overall water quality (e.g., Upper Sarasota Bay, Lemon Bay) while areas with high ratios tend to have lower overall water quality (e.g., Lower Sarasota Bay, Dona and Roberts Bays). However, the degree of urbanization of the watershed strongly influences the quantity and quality of stormwater runoff from these landscapes.

In this chapter, the variation in landscapes between different watersheds will be examined, with particular attention focused on the types of natural systems found throughout the Southern Coastal Watershed.

7.1.1 Previous Studies and Available Data

Information used to assess general patterns of the locations and amounts of natural systems in the Southern Coastal Watershed came from several sources. For the Sarasota Bay watershed (i.e., USB and LSB) information was derived from Heyl (1992), Estevez (1992), and Beaman (1992). For Dona and Roberts Bays and Lemon Bay, data came from Coastal Environmental, Inc. (1997). Other sources of information included "The Ecological Status of Dona and Robert's Bays," produced by Mote Marine Laboratory in 1975, and the "Lemon Bay Aquatic Preserve Management Plan," published in 1991 by the Florida Department of Natural Resources. The U.S. Department of Agriculture's "Soil Survey of Sarasota County" (1991) was also used. In addition, much emphasis is placed on GIS-based data analysis of aerial photography acquired by the District in 1995.

7.2 Overview of Watershed-wide Issues

This chapter will focus on two overall categories of natural systems - inland systems (i.e., those associated with upland communities and freshwater systems), and coastal systems (i.e., salt marshes, mangroves, and seagrass and unvegetated benthic communities).

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Inland systems

A variety of land uses are found within the watersheds of each of the major basins within the Southern Coastal Watershed (Map 4 in Appendix). Table VII-1 summarizes land use characteristics for each of the four major basins within the Southern Coastal Watershed.

Table VII-1. Estimated 1995 land use / land category percentages (Data from SWFWMD).

Land Use	USB	LSB	DARB	LB	GS
Residential	73	57	22	44	43
Commercial	4	3	3	1	0
Agricultural	8	19	37	21	6
Forested	4	12	21	19	9
Wetlands	10	9	17	14	42
Other	1	0	0	1	0

For the watershed of Upper Sarasota Bay (USB), the percentage of the watershed within the residential land use category is the highest of the four Southern Coastal Watershed basins. Upland forests account for the smallest percentage of the four basins.

For the Lower Sarasota Bay (LSB) basin, residential areas accounted for the second highest percentage of land use of the four basins. The percentage of the watershed consisting of wetlands was the smallest of the four basins.

In the watershed of the Dona and Roberts Bays (DARB) basin, residential areas were the lowest percentage of land use of the four basins within the Southern Coastal Watershed. Forested areas were a larger percentage of the watershed than any other basin. Agricultural areas were also the largest percentage of land use of any of the Southern Coastal Watershed basins.

In Lemon Bay's watershed, commercial areas were the lowest percentage of land use of the four basins. Wetlands accounted for the second highest percentage of the watershed of the four basins. The percentage of the LB watershed in the forested land category was second only to DARB's watershed.

The Gasparilla Sound watershed had the largest percentage of land cover as wetlands. A major issue in this watershed, is the amount of platted land that was partially developed and then abandoned. For example, large tracts of land in the area south and east of Rotunda have been cleared of native vegetation, access roads have been constructed,

but no houses have been built. As such, while these areas are mapped as "urban and built-up" land use categories in the District's 1995 land use/cover mapping efforts, they tend to have little in common with most people's perception of this land use classification.

Significant tracts of natural systems include the substantial amount of upland forests (mostly slash pines and southern slash pines) in the LSB basin, particularly in the area of Oscar Scherer State Park. In addition, large areas of upland forests are found in the Lemon Bay watershed; particularly in the headwaters of Forked, Godfrey, and Oyster Creeks (Map 4 in Appendix). Large tracts of rangeland exist in the DARB watershed, especially in the headwaters of Cow Pen Slough.

Non-forested freshwater wetlands are found in significant quantities in the USB and LSB basins, especially in the upper reaches of South Creek. Non-forested wetlands are also common in the DARB basin, and as fragmented parcels in the eastern portions of the LB watershed. A large area of non-forested freshwater wetlands is found in the northern portion of the GS watershed, where a weir placed across the upper reaches of the West Branch of Coral Creek has resulted in the formation of an extensive marsh system dominated by cattails (Map 4 in Appendix).

Beaman (1992) noted that the rate and quantity of loss of freshwater wetlands in Florida far exceeded those for saltwater (or tidal) wetlands. In the Sarasota Bay watershed, freshwater wetlands declined by approximately 35 percent between 1975 and 1991, with rates of loss in the USB basin exceeding those for the LSB basin. Beyond outright loss and/or destruction, Beaman (1992) also documented the impacts of physical damage to existing wetlands (e.g., altered hydrology) and also impacts from invasion by exotic species such as Brazilian Pepper and Australian Pine.

Coastal Systems

For the purposes of this chapter, coastal systems will be divided into the following categories - salt marsh and mangrove systems, seagrass meadows, and non-vegetated creek and estuarine benthic communities.

While much work has been done on the distribution of salt marsh and mangrove communities in Sarasota Bay (USB and LSB), not much detailed information exists for DARB, LB and GS. For the Sarasota Bay area, Estevez (1992) estimated that 39 percent of saltwater wetlands (both salt marshes and mangroves) had been lost between 1950 and 1990. In addition, remaining tidal wetlands tend to be smaller and more fragmented than in years past. Besides impacts from mangrove pruning, tidal wetlands are also adversely affected by infestation by exotic species such as Brazilian Pepper and Australian Pine.

Along the shoreline of Lemon Bay and its tributaries, mangrove forests are a common feature. While the relatively steep shoreline prevents extensive mangrove development, mangroves are a dominant coastal feature on the mainland shoreline north of Forked Creek, on the northern portion of Manasota Key's eastern shoreline, and along the barrier

island shoreline from Stump Pass to Gasparilla Sound (FDNR, 1991). Much of the shoreline and adjacent uplands in the Gasparilla Sound watershed consists of existing conservation areas and "Strategic Habitat Conservation Areas" identified by the Florida Game and Freshwater Fish Commission (see Map 6 in Appendix).

Seagrasses are found throughout the shallow estuarine waters of the Southern Coastal Watershed. While much information exists on the status and trends of seagrass coverage in Tampa Bay and Charlotte Harbor, less information is available for Sarasota Bay and Lemon Bay. Little information is available for Dona and Roberts Bays. However, the SWIM Program has mapped seagrass coverage in the Southern Coastal Watershed area for 1988, 1994 and 1996, to examine the status and trends of this important benthic community. Listed below are estimates of the abundance of seagrasses (in acres) for USB, LSB and LB for the years 1988, 1994 and 1996.

Segment	1988	1994	1996	1988-1996 Change
USB	7,377	7,920	8,856	20 % increase
LSB	1,273	1,344	1,477	16 % increase
LB	2,606	2,653	2,605	<1 % decrease

The increased coverage of seagrasses in the Upper Sarasota Bay is mostly attributed to two major activities - improvements to the disposal and reuse practices of the Manatee County Southwest Regional Wastewater Treatment Plant, and upgrades to the nutrient removal processes of the City of Sarasota's Wastewater Treatment Plant (Tomasko and Ries, 1997). For Lower Sarasota Bay, 184 of the 204 acre increase in coverage between 1988 and 1996 (90 % of the total increase) occurred in Little Sarasota Bay, which might reflect a recovery of this system from the stresses it initially received after the closure of Midnight Pass in 1983. For Lemon Bay, the small change in distribution between 1988 and 1996 suggests a system in somewhat of an equilibrium status.

For non-vegetated creek and estuarine benthos, data from Sarasota Bay (Dixon, 1992) suggests that oyster reefs are much more common in the LSB system than in USB, although oysters can be found in significant quantities in the Palma Sola Bay sub-basin of USB, and also along the mainland shoreline of USB near Bowlees Creek. The greater coverage of oyster reefs in LSB, compared with USB, is most probably associated with the higher watershed to open water ratio of LSB, which results in the lower salinity conditions that favor oyster reef development.

While their distribution is not mapped as well as in USB and LSB, oyster reefs are a common feature in the DARB system, again probably reflecting the fact that the DARB system has the highest watershed to open-water ratio of the four basins within the Southern Coastal Watershed.

Oyster reefs are not a dominant feature in the LB system, except in the tributaries along the mainland shoreline. However, oysters can be found growing attached to the prop roots

of red mangroves in all four basins.

7.3 Priority Issues at the Basin Level

7.3.1 Sarasota Bay

In the Upper Sarasota Bay (USB) basin, residential and commercial development has resulted in the conversion of a substantial amount of natural systems to houses, roadways, shopping centers, and associated land uses. As a result, the USB basin has lost the greatest percentage of its original freshwater wetlands coverage, compared with the other four basins in the Southern Coastal Watershed. The loss of these wetlands has occurred mostly through traditional ditch and drain activities. As a result, the storage capacity, water purification, and habitat value of these natural systems have been reduced dramatically. The reduced acreage of freshwater wetlands would be expected to alter the hydrology of the area such that tributaries to Sarasota Bay would exhibit more of a "feast or famine" response to fluctuations in rainfall. That is, drainage of wetlands for development accelerates the delivery of large pulses of freshwater to receiving water bodies, which then decreases the ability of tributary systems to "cleanse" these pulses of water through the processes of uptake and sedimentation. In addition, this drainage activity reduces the volume of water discharged in the dry season, decreasing the amount of critical low-salinity habitat needed for juvenile stages of various species of commercially and recreationally valuable finfish and shellfish.

With most of its natural landscape altered by the rapid and extensive development of its watershed, the USB basin has the smallest percentage of its total land use in those categories (uplands and wetlands) with the greatest habitat value to wildlife.

Somewhat in contrast, development pressures in the LSB basin have not yet resulted in the degree of loss of natural systems that has already occurred in the USB basin. The overall impacts are not quite as severe as in areas just to the north. Estevez (1992) suggested that the USB basin was mostly affected by development pressures that focused on the inland areas, while the LSB basin was mostly affected by development pressures that focused on the shorelines and barrier islands. Thus, while the USB basin has lost a greater percentage of its freshwater wetlands and native uplands, its shoreline has remained mostly in a natural state. Conversely, while the LSB basin has lost a significant amount of its tidal wetlands to development, significant areas of its freshwater wetlands and native uplands have persisted, although most of them in a damaged state.

7.3.2 Dona and Roberts Bays

Without question, the biggest alteration to the natural systems of Dona and Roberts Bays (DARB) was the development and expansion of the Cow Pen Slough drainage system in the 1960's. Because of these activities, the watershed of DARB increased from 68 square miles to nearly 90 square miles (Mote Marine Lab, 1975). The historic watershed to open water ratio of DARB of 62: 1 was already much higher than that of the second highest

ratio of the four Southern Coastal Watershed basins (LSB; 13:1). With the expansion of the Cow Pen Slough watershed, coordinated through the combined efforts of the USDA Soil Conservation Service, the Sarasota Soil Conservation District, the Sarasota County Board of Commissioners and the Manatee River Soil Conservation District, this ratio climbed to 89: 1, a value nearly seven times higher than the second highest ratio in the Southern Coastal Watershed.

Large influxes of freshwater inflow from the Cow Pen Slough drainage system disrupt the normal circulation and salinity distribution patterns throughout the Dona and Roberts Bay system, which is associated with reduced water quality and the diminished abundance and diversity of the flora and fauna within the outer portions of DARB (see Chapter VI - Water Quality).

As much of the land use in the DARB watershed is in agricultural and upland forested categories, potential areas might be available for developing "diversion marshes" which might be capable of reducing peak wet season flows from Cow Pen Slough into DARB, as was called for in Mote Marine Laboratory (1975) and Coastal Environmental, Inc. (1997). In addition, the potential for diverting wet season flows and utilizing them to offset a portion of the potable and/or non-potable needs for the City of Venice and Sarasota County merits further investigation (see Chapter IV - Water Supply).

7.3.3 Lemon Bay

According to estimates from Coastal Environmental, Inc. (1997), the population of the Lemon Bay watershed is expected to increase dramatically during the next 10 to 15 years. Using data supplied by the Southwest Florida Regional Planning Council, Coastal Environmental, Inc. (1997) predicted that residential land uses, which comprised approximately 44 percent of the watershed in 1995, would increase to approximately 84 percent of the watershed by the year 2010. This would represent an approximate doubling of the amount of the watershed devoted to residential land uses. While estimates of population increases must be viewed with skepticism, the implications of such rapid growth, if they occurred, would be dramatic.

It would be expected that if Lemon Bay's watershed underwent a change as drastic as that which is described above, several phenomena would occur: 1) remaining natural uplands would be the most likely land use to be converted to residential purposes, 2) flora and fauna dependent upon these natural upland communities would decline in number, 3) remaining wetlands and surface water bodies would receive increased loads of stormwater pollution from increased development, 4) water quality would be expected to decrease in the tributaries to Lemon Bay and the bay itself, 5) natural systems that are dependent upon good water quality (e.g., seagrasses, oyster reefs) would be expected to decrease in abundance and vigor, and 6) fish and wildlife dependent upon these estuarine systems would be expected to decline in number.
The above-described scenario is essentially the same process that has already occurred in the more heavily developed areas north of Lemon Bay. Consequently, the degree of

degradation of water quality and the loss of water quality-dependent benthic communities that has occurred in Sarasota Bay (i.e., decline in seagrass coverage vs. historic levels) might be expected to occur. As much of Lemon Bay suffers from the lack of a state and/or local government-administered water quality monitoring program, the water quality data collected to date was viewed as less than adequate for assessing the status and trends in water quality for Lemon Bay (Coastal Environmental, Inc., 1997). More detailed water quality and pollutant assessment studies are needed, to better understand the consequences of potential development pressures in Lemon Bay.

7.3.4 Gasparilla Sound

As with the assessment of water quality, the lack of detailed information (other than basic land use mapping efforts), makes assessments of the natural systems of Gasparilla Sound's watershed a casual exercise. However, completed, ongoing and planned activities to purchase land in the Gasparilla Sound watershed (i.e., the State of Florida's Charlotte Harbor Buffer Preserve, the potential addition of the "Cape Haze Parcel" via CARL and SOR/P-2000) seem to be the best way to ensure that the functions associated with the existing saltmarsh, mangrove and salt flat acreage of the Gasparilla Sound watershed will be provided into the future.

7.4 Natural Systems Issues

Since 1950, intertidal wetlands in Sarasota Bay's watershed have declined by approximately 40 percent. Although not as well documented, similar losses have also occurred in the watersheds of Dona and Roberts Bays and Lemon Bay. Wetlands loss in Gasparilla Sound is not as extensive as in the other basins. These wetlands provide a number of benefits to the Southern Coastal Watershed, including roles played in shoreline stabilization, water quality improvement, and fish and wildlife utilization.

In addition, uplands habitats in the Southern Coastal Watershed have undergone dramatic modification in recent decades, with much of the native upland communities converted to residential and/or commercial land uses.

Strategy: Continue ongoing efforts focused on protecting and restoring wetlands in the Southern Coastal Watershed.

Actions:

1) Through the SWIM Trust Fund, and the District's Cooperative Funding Program, continue ongoing efforts to enhance, restore and create wetlands throughout the Southern Coastal Watershed.

2) Provide proactive, cooperative consultation to the private and public sectors on development proposals and regulatory issues that impact wetlands.

Strategy: Protect natural systems within the Southern Coastal Watershed through land acquisition (fee simple) and other land conservation methods (e.g.,

conservation easements).

Actions:

1) Identify and prioritize conservation lands within the watershed using the Florida Game and Freshwater Fish Commission's "Closing the Gaps" reports, as well as recent efforts by local governments and the District's SOR/P2000 Program.
2) Coordinate land acquisition and other conservation efforts among federal, state, regional, and local governments.
3) Educate land owners of significant undeveloped areas (e.g., ranchers in eastern Sarasota County) about protection and management of listed species habitats.

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