Indian River County
2020 Comprehensive Plan

Chapter 3E
Stormwater Management Sub- Element

Indian River County Community Development Department
Adopted: March 17, 1998

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PURPOSE

The purpose of the Stormwater Management Sub-element is to identify the natural conditions which affect the quantity and quality of stormwater runoff, inventory and analyze existing stormwater management facilities, and develop policies and implementation strategies for stormwater management.

INTRODUCTION

Between 1919 and 1928, three (3) F.S. 298 Special Drainage Districts were created in Indian River County by the Florida Legislature. Under F.S. 298, those drainage districts were granted the authority to levy taxes on landowners to construct drainage projects so that land could be used for the cultivation of citrus and vegetable crops. The network of drainage canals constructed by the drainage districts altered the natural drainage pattern of the County by artificially expanding the Indian River Lagoon (IRL) watershed.

As Indian River County began to experience urbanization, the County and private developers adopted a strategy, known as "ditch it and drain it", to protect development from flooding by modifying natural systems to convey stormwater runoff away from developed sites more rapidly. Prior to the mid-1970's, Indian River County had experienced only minor urbanization. Within the past two decades, however, growth has increased significantly throughout the County. This growth has resulted in further alteration of natural drainage patterns. Additionally, development has increased the amount of impervious surfaces, such as streets and parking lots, thereby altering stormwater discharge rates.

Increased growth has coincided with more stringent and comprehensive federal, state and local stormwater management regulations. Thus, even though recent development has increased significantly, the capacity of stormwater management facilities throughout much of the County has remained adequate. As a result, only a few areas in the unincorporated County experience periodic localized drainage problems.

In addition to stormwater quantity issues, the past strategy of "ditch it and drain it" has produced some detrimental effects on water quality. The increased velocity and discharge of stormwater runoff has disrupted natural drainage features and contributed to sediment loading. Also, changes to the land surface resulting from urban development have increased non-point source pollutant loadings to receiving waterbodies. Mostly, it is the IRL that is the recipient of these pollutants.

At the present time, stormwater management facilities are required to control the quantity and quality of stormwater runoff. When faced with issues of managing both the quantity and quality of stormwater runoff, government agencies have undertaken strategies which attempt to enhance and/or replicate natural systems.

Effective stormwater management entails the use of structural and non-structural facilities to ensure that the volume, rate, timing, and pollutant loading of post-development stormwater runoff is similar to that which occurred prior to development. The objective has been to utilize a combination of both techniques to effectively provide adequate pollution removal and flood protection in the most economical manner possible within Indian River County.

DEFINITIONS

The following section contains definitions for the terms associated with stormwater management referenced in this Sub-element:

Best Management Practices (BMPs): These refer to practices used to achieve satisfactory water quality at a minimum cost. Structural BMPs emphasize preservation and/or simulation of natural drainage features to promote infiltration, filtration, and reduced peak discharges. Examples include: retention/detention ponds, infiltration trenches/basins and grassed swales. Examples non-structural BMPs include: watershed management, facilities maintenance, land use planning and public education.

Design Storm Event: This is a measure of capacity for which drainage facilities are designed. The design storm event is calculated by the intensity, duration, and frequency of the storm.

Drainage Basin: This is the area defined by topographic boundaries which contributes stormwater runoff, including all areas artificially added to the basin.

Detention Structure: This is a structure which collects and temporarily stores stormwater for the purpose of treatment through physical, chemical, or biological processes with subsequent gradual release of the stormwater. The benefits of on-site storage of stormwater include: reduced velocity of stormwater runoff, settling and filtration of pollutants, and recharge of aquifers.

First Flush: This describes the washing action that stormwater runoff has on accumulated pollutants. Studies indicate that the first inch of stormwater runoff transports as much as 90 percent of the non-point source pollution originating from a storm.

Floodplain: This is an area with a high probability of being inundated during a 100-year flood event. A generalized map of floodplains within Indian River County is depicted in Figure 2.

Flood Zones: Areas that have been designated as "special flood hazard areas" have been delineated by the FEMA's National Flood Insurance Program (NFIP) as "A" zones or "V" zones on Flood Insurance Rate Maps (FIRMs).

Designated flood zones as defined by the FEMA are listed below:

Zone "A" - Base flood elevations have not been determined.
Zone "AE" - Base flood elevations determined.
Zone "AH" - Base flood elevations determined; flood depths of 1 to 3 feet (usually areas of ponding).
Zone "AO" - Average depths determined; flood depths of 1 to 3 feet.
Zone "D" - Areas in which flood hazards are undetermined.
Zone "V" - Coastal flood area with velocity hazard (wave action); no base flood elevation determination.
Zone "VE" - Coastal flood area with velocity hazard (wave action); base flood elevations determined.
Zone "X" - 1) Areas outside a 500 year flood; 2) Areas of 500 year flood (outside 100 year flood); or, 3) Areas of 100 year flood with average depths less than 1 foot, with drainage areas less than 1 square mile, or areas protected by levees from a 100 year flood.
COBRA Zone- Flood insurance not available for new or substantially improved structures after a specific deadline on designated coastal barrier islands.

Flow Rate: Area X Velocity = Quantity per unit of time, or discharge rate. AxV=Q is the formula for determining the capacity of drainage facilities. "A" represents the area of the cross section of the drainage facility and is expressed in square feet. "V" represents the velocity speed and duration of the water and is expressed as a rate in feet per second (ft/s). The product of "A" and "V" equals "Q" the quantity of water per unit of time. "Q" is expressed in cubic feet per second (cfs).

Impervious surface: This refers to a substance or surface, such as roads, parking lots and buildings, which will not allow the passage of water or other liquids (impermeability).

Natural Drainage Features: These are naturally occurring attributes of an area which accommodate the flow of stormwater, such as land cover, streams, rivers, lakes, and wetlands. Generally, unaltered/ unimproved natural features are capable of accommodating a 2 year storm event.

Nonpoint source pollution: This is the introduction of physical, chemical, and/or biological impurities into a water column from diffuse and undocumented/unknown sources.

One Hundred (100) Year Storm Event: This is the eschewed probability of a storm capable of producing an amount of rainfall that has a one (1) percent chance of being equaled or exceeded in a given year.

Pre-development conditions: These are the conditions (relief, land cover, and the rate, volume and direction of stormwater runoff) which are present at a site prior to the commencement of land disturbing activities.

Post-development conditions: These are the conditions (relief, land cover, and the rate, volume and direction of stormwater runoff) which are present at a site following the completion of land disturbing activities.

Retention Structure: This is a structure designed to collect and prevent the release of a given amount of stormwater by complete on-site storage. The benefits of on-site storage of stormwater include: reduced velocity of stormwater runoff, settling and filtration of pollutants, and recharge of aquifers.

Stormwater runoff: This is the flow of water which results from a rainfall event.

Stormwater Management Facilities: These are man-made structures and/or enhanced natural drainage features designed to collect, convey, hold, divert or discharge stormwater, and includes stormwater sewers, swales, canals, detention structures, and retention structures.

Swale: This is a stabilized and/or grassed trench with side slopes less than three (3) feet horizontal to one (1) foot vertical. A properly functioning swale should convey stormwater runoff while providing some water quality treatment, and requiring minimal maintenance.

Ten (10) Year Storm Event: This is the eschewed probability of a storm capable of producing an amount of rainfall that has a ten (10) percent chance of being equaled or exceeded in a given year.

Twenty-five (25) Year Storm Event: This is the eschewed probability of a storm capable of producing an amount of rainfall that has a four (4) percent chance of being equaled or exceeded in a given year.

The following soil characteristics are defined by the United States Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) in the 1987 Soil Survey of Indian River County:

Excessively Well Drained: These are soils in which water is removed from soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow.

Somewhat Excessively Drained: These are soils in which water is removed rapidly. Many are sandy and rapidly pervious.

Well Drained: These are soils through which water is removed readily, but not rapidly and are commonly medium textured.

Moderately Well Drained: These are soils in which water is removed somewhat slowly during some periods. They commonly have a slowly pervious layer in or directly below the upper part of the soil profile, or periodically receive high rainfall, or both.

Somewhat Poorly Drained: These are soils in which water is removed slowly enough that the soil is wet for significant periods during the growing season. These soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these elements.

Poorly Drained: These are soils in which water is removed so slowly that the soil remains saturated for long periods. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very Poorly Drained: These are soils in which water is removed so slowly from the soil that free water remains at or near the surface during most of the growing season.

AGENCIES INVOLVED IN STORMWATER MANAGEMENT

Many governmental agencies at various levels of government have stormwater jurisdiction within Indian River County. The federal-state-regional-local intergovernmental relationship is displayed in Figure 3.E.1. A description of government agencies and their responsibilities follows:

Federal Government

Federal Emergency Management Agency (FEMA)

The FEMA indirectly regulates stormwater management and flood protection in Indian River County. It does so by establishing regulations for the federal flood insurance program.
As a participating community in the program, Indian River County must comply with FEMA requirements.

In 1988, FEMA prepared a flood insurance rate study for Indian River County. This study (performed under contract by Gee and Jensen Consulting Engineers, West Palm Beach, FL) included a technical analysis of the entire county to determine the limits of coastal flood zones, the 100-year flood plain, and the 500-year flood plain. Classic floodways and man-made channels were analyzed using the U.S. Army Corps of Engineers HECI and HECII Stormwater Computer Models. This comprehensive analysis of flood elevations has provided useful data to regulate flood plain and flood way encroachment.

Natural Resource Conservation Service (NRCS)

The former Soil Conservation Service (now the NRCS) completed a detailed soil survey for Indian River County in 1987. This soil survey is useful in determining the drainage and percolation capacity of soils. The soil survey was recently digitized and will be used to analyze watershed conditions.

FIGURE 3.E.1

STORMWATER MANAGEMENT
INTER-GOVERNMENTAL RELATIONSHIP

FEDERAL

	FEMA	EPA
Authorization:		Clean Water Act (1987)
Responsibilities:	National Flood Insurance Program Flood Insurance Rate Maps	NPDES Permitting Requirements National Estuary Program

STATE OF FLORIDA

	FDEP	DCA
Authorization:	Chapter 17-40, F.S. Chapter 17-302, F.S. Chapter 17-25, F.S.	Rule 9J-5 Chapter 187, F.S. Chapter 163, F.S.
Responsibilities:	Water Quality Standards	State Comprehensive Plan Review Local Comprehensive Plans

REGIONAL

	SJRWMD	TCRPC
Authorization:	Chapter 40C-4, F.S. Chapter 40C-40, F.S. Chapter 40C-42, F.S.	
Responsibilities:	SWIM Plan; Land Acquisition; District Water Management Plan; Technical Expertise; Pollutant Load Reduction Goals	Regional Policy Plan Review Development of Regional Impact

LOCAL

	SPECIAL DISTRICTS	MUNICIPALITIES
Entities:	IRFWCD SJWCD SRWCD FFWCD	Indian River County City of Vero Beach City of Sebastian City of Fellsmere Town of Indian River Shores
Authorization:	Chapter 298, F.S.	Local Ordiances/LDRs Level of Service Standards (if adopted) Comprehensive Plans Stormwater Master Plans (if adopted)
Responsibilities:	Flood Control; Irrigation	Review Development Proposals Construct/Maintain Stormwater Facilities

Source: IRC Planning Department (1997)

Environmental Protection Agency (EPA)

The EPA reviews dredge and fill permit applications under the U.S. Army Corps of Engineers (ACOE) permitting authority. Both agencies monitor and permit fill activity along the Indian River Lagoon (IRL), where flood prone wetlands provide floodwater storage. Also, under authority of the Water Quality Act of 1987 (a.k.a Clean Water Act (CWA)), the EPA is responsible for issuing National Pollutant Discharge Elimination System (NPDES) permits for point and non-point source discharges.

In addition to the NPDES program, the CWA of 1987 established the National Estuary Program (NEP). Under this program, the Indian River Lagoon was identified as being an estuary of national significance threatened by pollution, overuse, and development. In 1991, the EPA initiated the Indian River Lagoon National Estuary Program (IRLNEP). The IRLNEP was charged with developing a Comprehensive Conservation and Management Plan (CCMP) to ensure preservation of the IRL's ecosystem through consensus-driven decision making and problem solving. Final adoption of the IRLCCMP was completed in 1996. The four program goals adopted in the IRLCCMP are as follows:

- To attain and maintain water and sediment of sufficient quality to support a healthy estuarine system;
- To attain and maintain a functioning healthy ecosystem which supports endangered and threatened species, fisheries, commerce and recreation;
- To achieve heightened public awareness and coordination of interagency management of the Indian River Lagoon ecosystem; and
- To identify and develop long-term funding sources for prioritized projects and programs to preserve, protect, restore and enhance the Indian River Lagoon system.

(Indian River Lagoon Comprehensive Conservation and Management Plan, 1996).

State of Florida

Florida Department of Environmental Protection (FDEP)

The FDEP, under the authority of FAC Chapter 62-3, reviews and permits stormwater discharge into waters of the State to ensure that state water quality standards are not exceeded. In 1986, permit authority was delegated to the St. Johns River Water Management District.

In 1969, two (2) aquatic preserves were established in Indian River County. Aquatic Preserve #7 extends from Malabar in Brevard County to the northern City limits of Vero Beach. Aquatic Preserve A-9 extends from the southern City limits of Vero Beach to Ft. Pierce Inlet in St. Lucie County. In 1975, the Florida Aquatic Preserve Act delegated the responsibility of managing these aquatic preserves to the Florida Department of Natural Resources (now FDEP). The location of these aquatic preserves is depicted in Figure 3.E.2.

St. Johns River Water Management District (SJRWMD)

The SJRWMD, under the authority of 40C-4, Florida Administrative Code, regulates the management and storage of surface waters within the St. Johns River Basin. The SJRMWD encompasses an area of over 12,400 square miles. Within its boundaries are the St. Johns River Basin, the Nassau River Basin, the Florida portion of the St. Mary's River Basin, and several coastal drainage basins, including a majority of the Indian River Lagoon (IRL). Located within the upper basin or headwaters of the St. Johns River, Indian River County, is one of 18 counties that are under the jurisdiction of the SJRWMD. The SJRWMD purchased over 88,000 acres of the St. Johns Marsh in the western portion of the County. The District actively manages this multi-use property for water conservation, flood control purposes, and other purposes.

The Surface Water Improvement Management (SWIM)Act of 1987 directed the SJRWMD to develop a SWIM Plan for the IRL. The scope of the IRL SWIM Plan is similar to that of the IRLCCMP. Due to the mutual similarities of these two programs, the IRLNEP was integrated with the IRL SWIM program upon adoption of the IRLCCMP.

Florida Department of Transportation (FDOT)

The FDOT, under the authority of Florida Statutes Chapter 335.02, owns and maintains numerous drainage facilities which provide drainage for major arterial roads within Indian River County. The U.S. Highway 1 corridor is drained by many outfall ditches and canals. These canals have defined many drainage basins east of the Atlantic Coastal Sand Ridge. The FDOT permits connections to stormwater management facilities within FDOT rights-of-way.

Local Agencies

Due to the multi-jurisdictional nature of stormwater management within Indian River County, stormwater management requires a cooperative intergovernmental approach.

Indian River County

Indian River County has primary stormwater jurisdiction over major outfalls within the following areas:

- Unincorporated areas not included within the limits of Special FS Chapter 298 Drainage Districts, State of Florida road rights-of-way, private undeveloped land where no development has occurred, and property owned by the State of Florida or Indian River County School District.

- Incorporated areas within a County Road right-of-way.

- Secondary Drainage facilities (minor swales and facilities leading to outfalls) which are maintained by the County and located within dedicated easements or rights-of-way in the unincorporated area. County Ordinance 82-28 established the authority to regulate stormwater management practices. The Flood Protection and Stormwater Management ordinance was amended in 1990 by LDR Chapter 930. The Indian River County Public Works Department is charged with administering LDR Chapter 930.

F.S. 298 Special Drainage Districts

Water Control Districts have the authority to construct and maintain primary drainage facilities within their statutory boundaries. At the present time, there are four (4) active drainage districts within Indian River County. These include the following: the Indian River Farms Water Control District (IRFWCD), the Sebastian River Water Control District (SRWCD), the Fellsmere Water Control District (FWCD), and the St. Johns Water Control District (SJRWCD).

Incorporated Municipalities

Incorporated municipalities have home rule powers to construct and maintain stormwater management facilities within their city owned easements, rights-of-way, and property. The incorporated municipalities within Indian River County include: the City of Vero Beach, the City of Sebastian, the Town of Indian River Shores, the City of Fellsmere and the Town of Orchid.

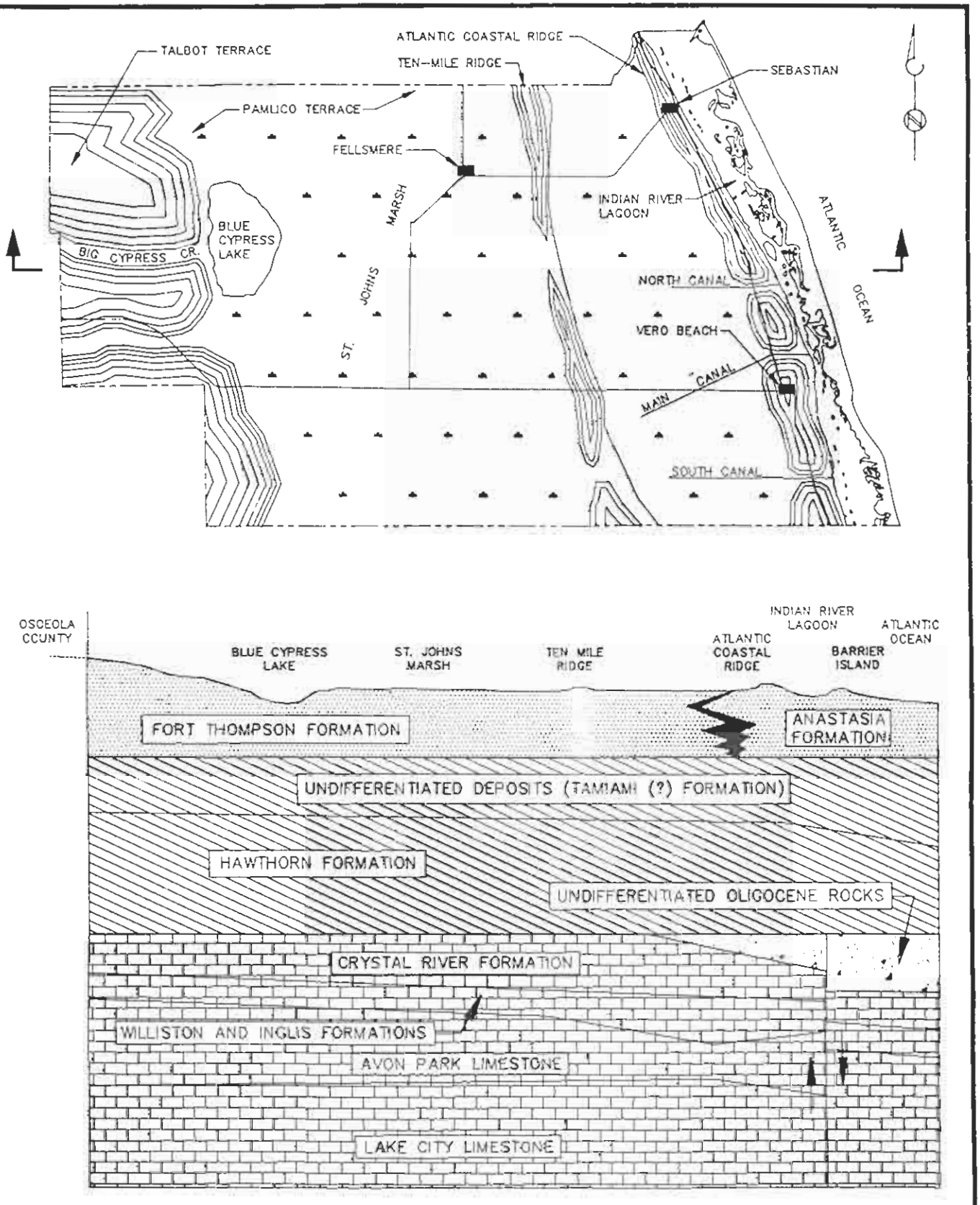
Private Systems

Privately owned agricultural operations and developments within the county own and maintain private stormwater management facilities.

EXISTING CONDITIONS

Indian River County is located within the Gulf and Atlantic Coastal Plains of the United States. Generally, the topography of the coastal plain is low and flat. Within this area, there is a north-south banding of physiographic regions oriented approximately parallel to the Atlantic Ocean. Two regions of low relief, the Eastern Valley and the Central Valley, comprise most of this area. Throughout most of its course, the St. Johns River along with the Atlantic Coastal Sand Ridge separate the Eastern Valley from the Atlantic Ocean. Approximately 60% of the county consists of marshlands. Maps of the natural drainage features of Indian River County are depicted in Figures 3.E.2, 3.E.3, and 3.E.4.

FIGURE 3.E.2



Brown and Caldwell
Consultants
ORLANDO, FLORIDA

STRATIGRAPHIC SECTION THROUGH INDIAN RIVER COUNTY

FIGURE 3.E.3

GENERAL SOIL MAP

INDIAN RIVER COUNTY

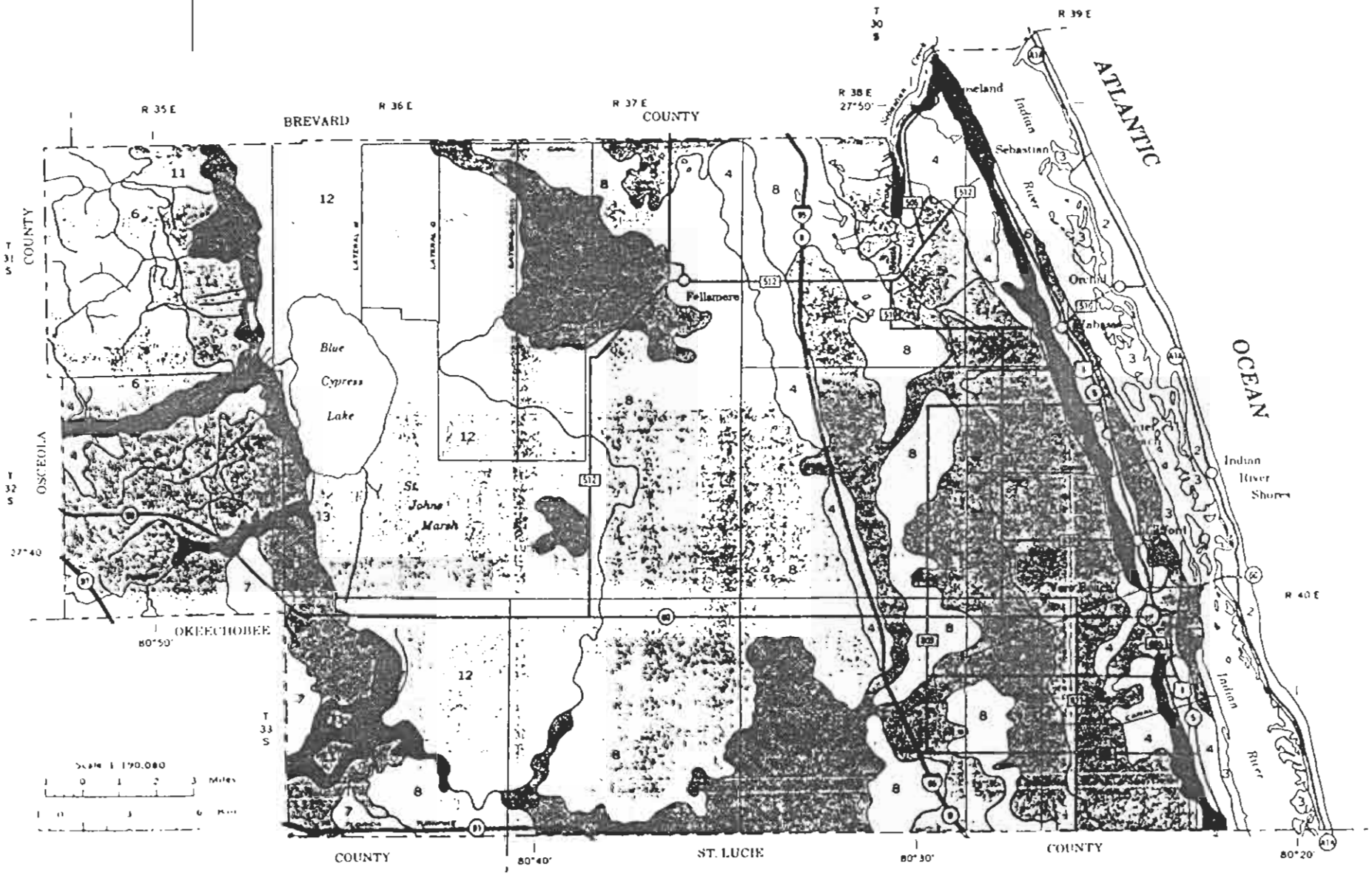


FIGURE 3.E.3
LEGEND

SOILS OF THE SAND RIDGES

ASTATULA-ARCHBOLD-ST. LUCIE: Nearly level to gently sloping, excessively drained and moderately well drained soils that are sandy to a depth of 80 inches or more

SOILS OF THE COASTAL ISLANDS AND TIDAL MARSHES

2 CANAVERAL-CAPTIVA-PALM BEACH: Nearly level to gently sloping, somewhat poorly drained to moderately well drained, and well drained to excessively drained, sandy soils that contain shell fragments

3 MCKEE-QUARTZIPSAMMENTS-ST. AUGUSTINE: Level, very poorly drained, loamy soils that have very low soil strength, some nearly level, somewhat poorly drained to moderately well drained soils sand and shell fragments, and some level, somewhat poorly drained soils that are mixed sand and shell fragments

SOILS OF FLATWOODS, LOW KNOLLS, AND RIDGES

4 IMMOKALEE-MYAKKA-SATELLITE: Nearly level, poorly drained and somewhat poorly drained soils; some are sandy throughout, and some have a dark sandy subsoil

EAUGALLIE-OLOSMAR-WABASSO: Nearly level, poorly drained soils that have a dark sandy subsoil; some have a subsoil that is underlain by loamy material at a depth of less than 40 inches, and some have a subsoil that is underlain by loamy material at a depth of more than 40 inches

MYAKKA-IMMOKALEE: Nearly level, poorly drained soils that have a dark sandy subsoil

7 EAUGALLIE-MYAKKA-RIVIERA: Nearly level, poorly drained soils; some have a loamy subsoil at a depth of less than 40 inches, some have a dark sandy subsoil at a depth of 20 to 30 inches, and some are sandy throughout and have a dark sandy subsoil at a depth of 20 to 30 inches

SOILS OF THE SLOUGHS, POORLY DEFINED DRAINAGEWAYS, AND HAMMOCKS

8 RIVIERA-PINEDA-WABASSO: Nearly level, poorly drained soils; some have a loamy subsoil at a depth of 20 to 40 inches, and some have a dark sandy subsoil underlain by loamy material at a depth of less than 40 inches

WINDER-RIVIERA-MANATEE: Nearly level, poorly drained and very poorly drained soils that have a loamy subsoil at a depth of 20 inches or at a depth of 20 to 40 inches; some are loamy throughout and have a dark surface layer

BOCA-WABASSO-RIVIERA: Nearly level, poorly drained soils; some have a loamy subsoil underlain by hard limestone at a depth of 40 inches, some have a dark sandy subsoil underlain by loamy material at a depth of less than 40 inches, and some have a loamy subsoil at a depth of 20 to 40 inches

MYAKKA-HOLOPAW-POMPANO: Nearly level, poorly drained soils that are sandy to a depth of more than 40 inches; some have a dark sandy subsoil at a depth of 20 to 30 inches, and some have a loamy subsoil at a depth of more than 40 inches

SOILS OF THE FRESHWATER SWAMPS AND MARSHES

12 TERRA CEIA-GATOR-CANOVA: Nearly level, very poorly drained soils; some are organic throughout, some have a moderately thick organic layer underlain by a sandy clay loam subsoil, and some have a thin organic surface layer underlain by a loamy subsoil at a depth of 20 to 40 inches

FLORIDANA-DELRAY-HOLOPAW: Nearly level, poorly drained to very poorly drained soils; some have a loamy subsoil at a depth of 20 to 40 inches, some have a loamy subsoil at a depth of more than 40 inches, and some have a dark surface layer that is 10 inches or more thick

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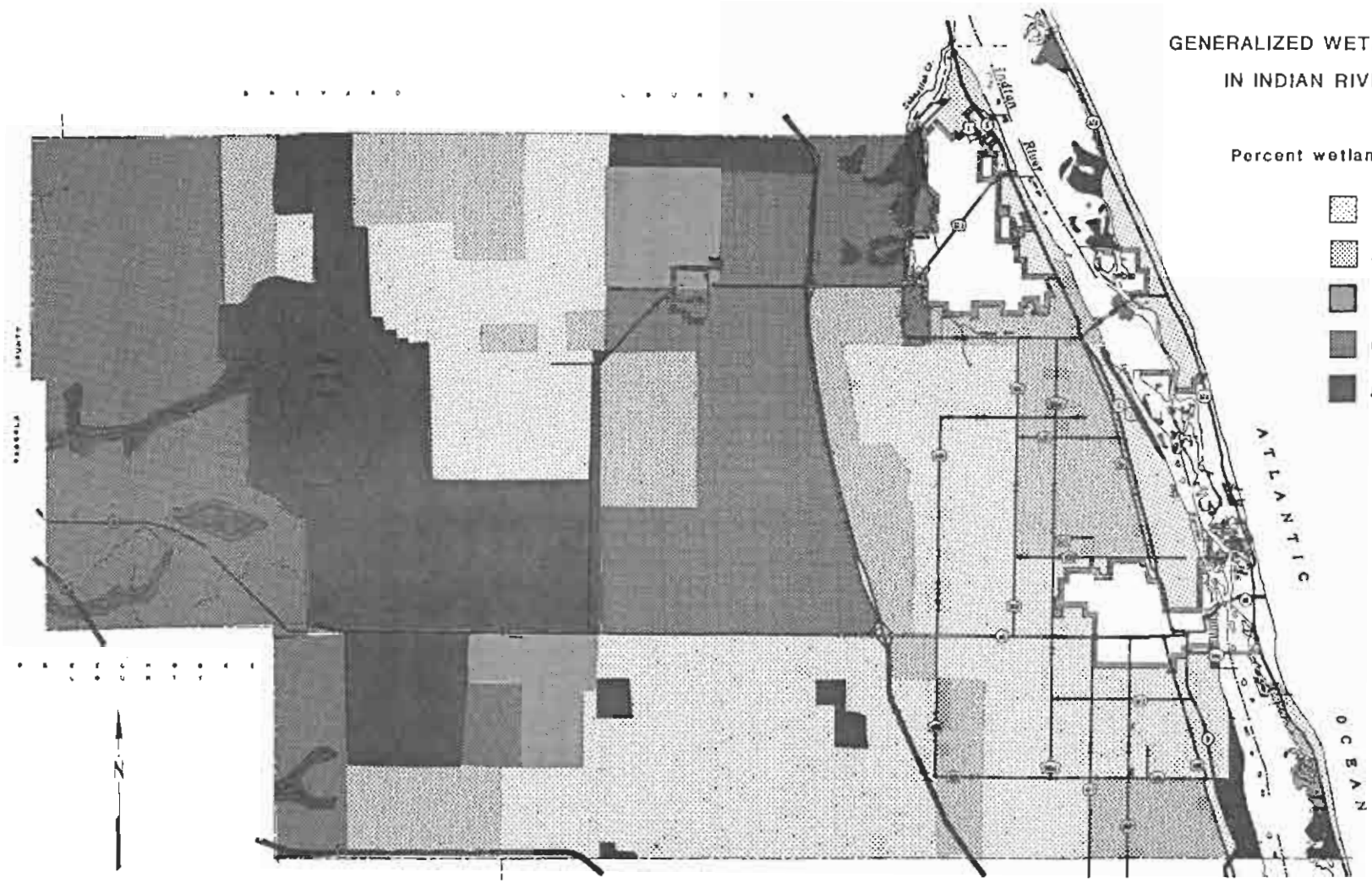
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF FLORIDA
INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES
AGRICULTURAL EXPERIMENT STATIONS
SOIL SCIENCE DEPARTMENT
FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

GENERAL SOIL MAP
INDIAN RIVER COUNTY
FLORIDA

8.3

FIGURE 3.E.4



Source: USFWS National Wetlands Inventory (1984)
Indian River County Planning Division

SCALE 0 1 2 3 4 Miles	INDIAN RIVER COUNTY	Date: May 1989

Topography and Physiography

Indian River County is an area of low relief representing several ancient marine terraces, each marking the ocean bottom at times when the sea level was at a higher elevation. Two terraces, the Pamlico Terrace and the Talbot Terrace, traverse the county. The Pamlico Terrace covers the area from the coast inland about 24 miles to the western edge of the St. Johns Marsh. Most of the terrace is less than 25 feet above sea level. The terrace is broken by three (3) distinct ridges. These ridges are: the Coastal Barrier Island, the Atlantic Coastal Sand Ridge, and the Ten Mile Ridge. Additional information regarding the topography and physiography of Indian River County is contained in the Conservation Element.

Coastal Barrier Island

The easternmost ridge is the Barrier Island. This ridge is the present beach area of the county and rises to approximately 20 feet above sea level. Behind the Barrier Island lies the shallow Indian River Lagoon (IRL).

Atlantic Coastal Sand Ridge

Approximately one-half (½) to one (1) mile west of the IRL lies the Atlantic Coastal Sand Ridge. This ridge is overlain by the Florida East Coast Railroad (FECRR) and U.S. Highway #1. The ridge has a historic maximum height of approximately 54 feet, but several places along the ridge have been reduced in elevation due to excavation associated with sand mining and development.

Ten Mile Ridge

Known locally as the Ten Mile Ridge, this ridge overlain by the Interstate 95 corridor. The Ten Mile Ridge pre-dates the Atlantic Coastal Sand Ridge and has a maximum height of approximately 35 feet. Both ridges contribute to the recharge of the surficial "shallow" aquifer.

Inter-ridge Area

Between the Atlantic Coastal Sand Ridge and the Ten Mile Ridge lies a flat shallow depression referred to as the Inter-ridge basin. In its original state, this drainage basin historically drained northward to the South Prong of the St. Sebastian River. Today, the southern end of the Inter-ridge basin is traversed by a network of drainage canals; so only a small portion of the basin in the north part of the County still drains to the St. Sebastian River.

St. Johns Marsh/Upper St. Johns River Basin

West of the Ten Mile Ridge is the broad flat area of the St. Johns Marsh. The western edge of the marsh is relatively flat and about 25 feet above sea level. Near the Indian River-Osceola County

line, the elevation rises to approximately 40 feet above sea level. This formation is known as the Talbot Terrace. The area between the Talbot Terrace and Interstate 95 is marshy and poorly drained with some drainage improvements having been made to benefit agricultural interests, including citrus groves and cattle ranches.

A large portion of western Indian River County is covered by the St. John's Marsh, making the marsh a major part of the natural drainage system. Although the marsh is the headwaters of the St. Johns River, the river's channels are not well defined within the marsh. Part of the St. Johns River system is the Blue Cypress Lake which is the largest body of freshwater in the county. Throughout the marsh, the natural drainage is to the north. Much of this area is owned and managed by the SJRWMD for flood control and irrigation.

The SJRWMD recently completed a major restoration project for the Upper St. Johns River Basin. This project consisted of a number of water control structures and reversion of agricultural lands to wetlands. A benefit of the project is that it reduces the need for freshwater discharge into the IRL via the C-54 canal. By reducing the amount of freshwater flow from the C-54 canal to the IRL, the restoration project has improved water quality in the IRL. Additional information about the Upper St. Johns River Basin is contained in the Conservation Element.

Climate

Rainfall is unevenly distributed throughout the year in Indian River County. Historically, the most rainfall has been recorded in the month of September, followed in order by August, July and June. Nearly 50 percent of the annual rainfall occurs in these four (4) months. For the 20 year period from 1969 to 1988, rainfall averaged 54.4 inches per year. Rainfall can also vary considerably from year to year. The highest and lowest rainfalls recorded during this period were 81.7 inches in 1982, and 39.7 inches in 1980 (Brown and Caldwell, 1993).

Soils

Within Indian River County, there are 58 different soil types. Based upon drainage characteristics, these soil types have been grouped into three (3) general categories: poorly drained soils; moderately drained soils; and excessively drained soils. A specific description for each of the drainage characteristics is contained in the Definitions section.

"Excessively drained" soils consist of deep sandy soils that are found on nearly level to strongly sloping dune-like ridges and uplands. These soils are often formed in marine or aeolian sand and are associated with sand pine scrub areas consisting of blackjack oak, live oak, and sand pine. Examples of understory vegetation include saw palmetto, sand heath, grassleaf goldenastar and Indian grass.

"Moderately drained" soils are typically deep sandy soils that are formed in marine and aeolian sand sediments. These soils are associated with coastal strand and sand pine scrub areas, characterized by sand pine, slash pine, and long leaf pine as dominant trees, and saw palmetto, cabbage palm, and inkberry in the understory.

"Poorly drained" soils consist of nearly level soils developed in loamy and unconsolidated marine sands and loamy sediments.

These soils are associated with cabbage palm flatwoods, south Florida flatwoods, and sloughs. Examples of dominant trees include slash pines and longleaf pines, while the understory is typically cabbage palm, sand cordgrass, and saw palmetto. The Conservation Element and the Natural Groundwater Aquifer Recharge Sub-element contain additional soils information.

Floodprone Areas

The occurrence of floods is an important concern for communities with coasts subject to storm events, or for any community with waterbodies, waterways, or flood hazard areas. Generally, a flood hazard is any land area that is susceptible to being inundated by water from any source, while flooding is a temporary condition of partial or complete inundation of normally dry land areas.

Floods can occur throughout the Indian River County area anytime during the year; however, they are most frequent during the summer season from May to October. In Indian River County, streams and canals in the "inter-ridge" area (between the Ten Mile Ridge near I-95 and the Atlantic Coastal Sand Ridge near U.S. Highway #1) as well as those that discharge into the St. Johns River, are subject to flooding from prolonged heavy rainfall. Low, swampy inland areas (i.e. palustrine (freshwater) wetlands) are also subject to periodic flooding during wet periods.

Coastal areas of the county on the ocean are subject to storm surge flooding in the event of hurricane or tropical storm activity. Along the Indian River Lagoon, areas may experience flooding from storm surge caused by a tropical storm or hurricane. A flood insurance study by the Federal Emergency Management Agency (FEMA) references storm surge levels that are reported to have been as high as 4.5 feet above mean sea level (MSL) in the IRL. Storm surge levels in the Atlantic Ocean have been as high as five (5) feet above MSL. Coastal flooding hazards are further discussed in the Coastal Management Element.

Floodplains provide for natural overflow of waterbodies during flood events. Within the County, floodplains are extensive and often overlook scenic waterbodies. Due to the extent of floodplains in the county and the demand for development, building within flood hazard areas is inevitable.

To provide minimum standards for the design and construction of buildings and structures (other than coastal protective structures) and to reduce the harmful effects of hurricanes and other natural disasters occurring along the coastal areas of the county, Indian River County enacted a "Coastal

Construction Code" (Ord. No 86-21, February 26, 1986). The coastal code applies only to the "coastal building zone," which is defined as being the land area from the seasonal high-water line (of the Atlantic Ocean) to a line five thousand (5,000) feet landward from the state coastal construction control line, or the entire barrier island, whichever is less.

Historically, large portions of the county were low and swampy. Although many of these areas have been drained to permit development, several of these areas are presently subject to periodic flooding. These floodprone areas also tend to be areas having soils characterized as being "poorly" or "moderately" drained. Floodprone areas within the IRL watershed include:

- the Barrier Island, south of the City of Vero Beach
- the Barrier Island, north of the City of Indian River Shores
- the mainland, between the IRL and the Atlantic Coastal Sand Ridge (U.S. Highway #1)
- the mainland, east of and adjacent to the Ten Mile Ridge (Interstate 95)
- the mainland, west of the Ten Mile Ridge

Within the St. Johns River watershed portion of the County, the soils are generally characterized as being "poorly" drained. Throughout this portion of the county, the land tends to be low, marshy, and prone to flooding. The floodprone areas within Indian River County are depicted in Figure 3.E.5.

Wetlands

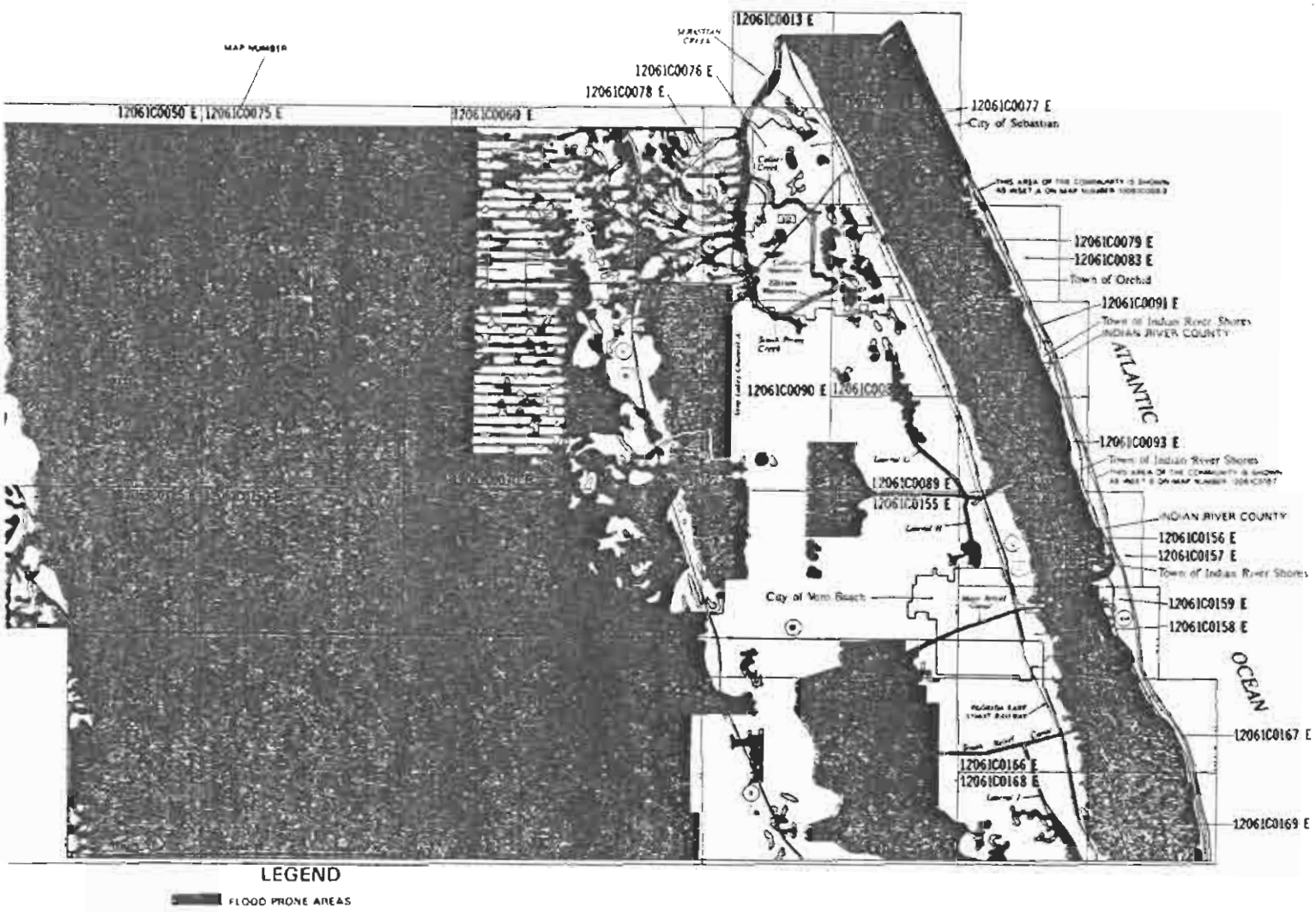
Within the boundaries of Indian River County, there are two (2) large wetland areas. These are the Upper St. Johns River Watershed (USGS Hydrologic Unit #03080101) and the Indian River Lagoon (IRL) Watershed (USGS Hydrologic Unit #03080203).

The Upper St. Johns River Watershed contains over 88,000 acres of palustrine (freshwater) wetlands. The St. Johns Marsh (±68,750 acres) and the Fort Drum Marsh (±20,000 acres) comprise the majority of the watershed. Blue Cypress lake (±6,555 acres) is the largest open water component within the watershed.

The majority of the ±16,300 acre IRL watershed, is composed of open water estuarine wetlands. Approximately 500 acres of riverine wetlands are associated with the South Prong of the St. Sebastian River. Also, over 3,200 acres of mosquito impoundments are present within the IRL watershed. Additional information regarding the locations and types wetlands in Indian River County is contained in the Conservation Element of the Comprehensive Plan.

FIGURE 3.E.5

Flood Prone Areas in Indian River County
(Resource: Flood Insurance Rate Map #12061C0000, dated May 4, 1989)



Indian River Lagoon Watershed

The Indian River Lagoon (IRL) is an estuarine system that extends from Ponce De Leon Inlet in Volusia County to Jupiter Inlet in Palm Beach County. The IRL watershed encompasses the majority of the eastern portion of Indian River County. Within Indian River County, the waters of the IRL receive an influx of saltwater from the Atlantic Ocean that passes through Sebastian Inlet and Ft. Pierce Inlet. The St. Sebastian River, drainage canals and overland sheet flow provide freshwater inflow. Ocean exchange, rainfall, stormwater runoff and evaporation all contribute to the estuarine characteristics of the IRL. Generally, salinity levels in the IRL range from 4.0 to 40.0 parts per thousand (ppt) and average 26.5 ppt. Salinity levels are highest near the inlets and gradually decline to their lowest levels within the City Limits of Vero Beach. Figure 3.E.6 depicts the area encompassed by the Indian River Lagoon (IRL) system. Figure 3.E.7 depicts the drainage basins in Indian River County.

Sebastian River Water Control District Basin

The Sebastian River Water Control District (SRWCD) was created in 1927 as a Chapter F.S. 298 Special Drainage District to facilitate development of agricultural lands.

- Service Area

The SRWCD is located north of Walker Avenue (26th Street), east of 90th Avenue, and south of 85th Street (Wabasso Road). The SRWCD includes the Canal "C" (which runs north/south along 82nd Avenue) and Ditch "D" (which runs north/south along 90th Avenue) sub-basins. Combined, these sub-basins drain approximately 11,017 aeres.

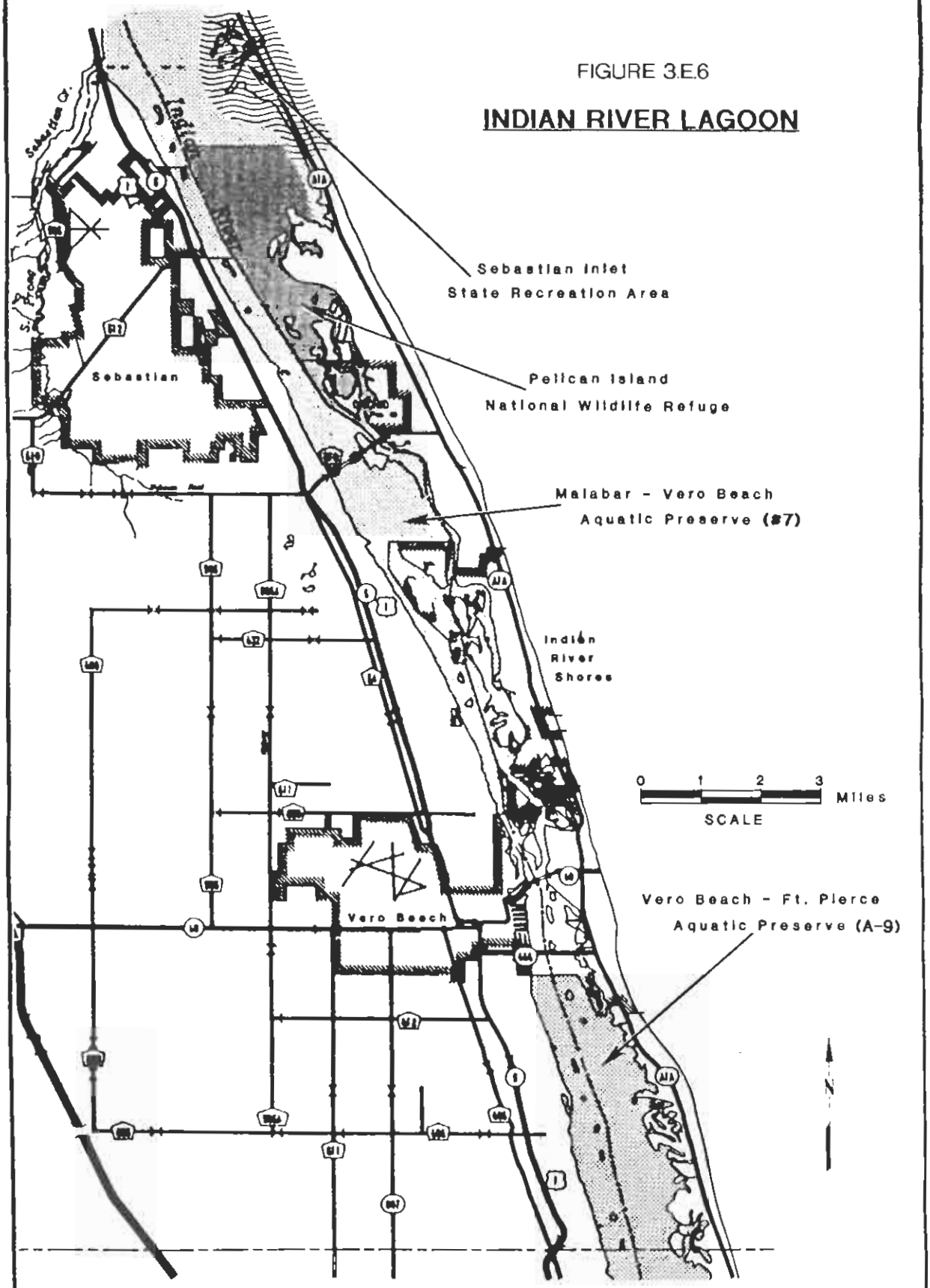
Ditch "D" was originally constructed outside the SRWCD's service area as a borrow ditch for the west levee of the SRWCD. However, this ditch now serves as the principal drainage outlet for all lands west of the SRWCD, including the Vero Lake Estates subdivision. The majority of runoff from Canal "C" flows north before emptying into the South Prong of the St. Sebastian River. Some runoff is diverted to the IRFWCD North Relief Canal.

- Natural Features

This basin is relatively flat with an average elevation of 20 feet. The basin slopes in a northerly direction towards the South Prong of the St. Sebastian River. Soils present within this basin include the Riviera-Pineda-Wabasso series and the Winder-Rivera-Manatee series. Both soil series are classified as "poorly drained." Due to relatively poor draining soil conditions, the watertable elevations are one (1) to two (2) feet below ground during the wet season and approximately four (4) feet below ground during the dry season.

FIGURE 3.E.6

INDIAN RIVER LAGOON



Source: Florida Game and Fresh Water Fish Commission

Sept. 16, 1987

Boyle Engineering Corporation

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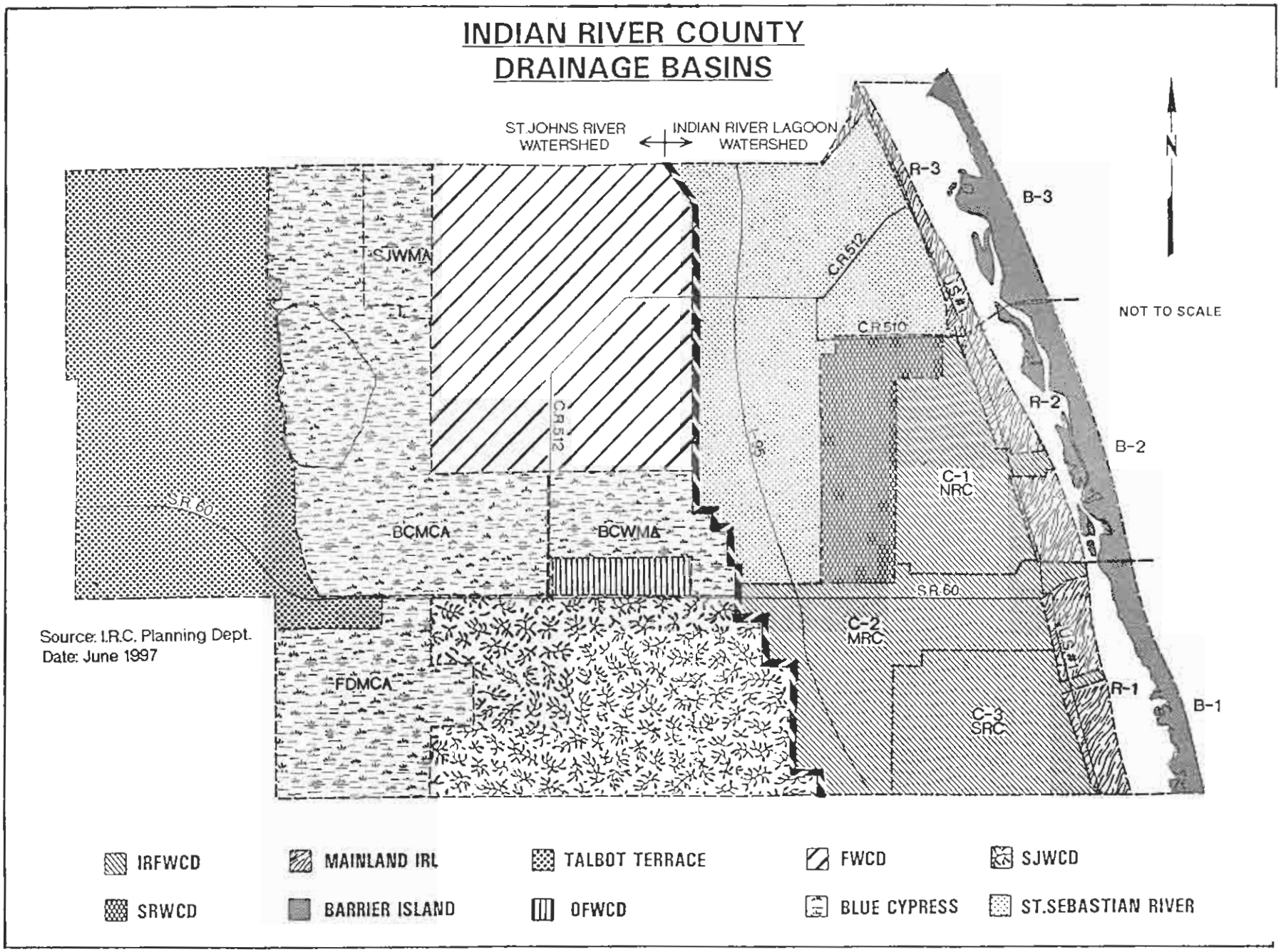
INDIAN RIVER COUNTY
FLORIDA

FIGURE 3.E.7


INDIAN RIVER COUNTY
DRAINAGE BASINS
ST.JOHNS RIVER WATERSHED
INDIAN RIVER LAGOON WATERSHED
N
NOT TO SCALE
SJWMA
BCMCA
BCWMA
FDMCA
C.R.512
C.R.510
S.R.60
I-95
U.S.#1
R-3
R-2
R-1
B-3
B-2
B-1
C-1 NRC
C-2 MRC
C-3 SRC
Source: I.R.C. Planning Dept.
Date: June 1997
IRFWCD
MAINLAND IRL
TALBOT TERRACE
FWCD
SJWCD
SRWCD
BARRIER ISLAND
OFWCD
BLUE CYPRESS
ST.SEBASTIAN RIVER

- Flood Zones

The northern portion of the SRWCD basin is protected from the 100-year flood by a levee located along the west boundary of the SRWCD. However, according to a FEMA study, the levee could be breached by a storm greater than a 100-year storm event. The southwest 900 acres of this sub-basin also lie within a 100-year floodplain. However, base flood elevations have not been determined for this area.

- Land Use

Listed below are the estimated acreages for the types of land use within the SRWCD basin:

Classification	Estimated Acreage
Citrus	9,600
Pasture	713
Open Water/Wetlands	231
Rangeland	210
Residential	176
Other	87

There are 51 agricultural operations located within this basin with an average size of 210 acres.

Source: SJRWMD (1994)

- Operating Entities and Jurisdictional Responsibilities

The SRWCD owns and maintains Canal "C" and its connecting laterals. Indian River County owns and maintains the roadway drainage facilities along 82nd Avenue, 74th Avenue, CR 510, and the other east/west collectors. Also, the County in cooperation with private property owners maintain Ditch "D". Individual grove owners maintain private agricultural drainage systems.

- Capacity Analysis

The SRWCD has not initiated a capacity analysis of either basin under its jurisdiction. The FEMA Flood Insurance Rate Study completed in 1988 analyzed the capacity of the Sebastian River South Prong. During a 10 year rainfall event, the channel at CR 512 has a peak discharge of 1,500 cfs. Since the land use within this sub-basin is predominately agricultural, short term flooding conditions do not threaten residential areas.

- Water Quality

The data for the SRWCD basins are somewhat incomplete. According to available FDEP data, this basin exhibits the following problems: high nutrient loadings; high levels of turbidity and sedimentation; low levels of dissolved oxygen; and, declining fisheries. These problems are largely attributed to stormwater runoff from agricultural operations.

Listed below is an average of the water quality parameters measured at the SRWCD spillway from April 1995 to January 1997:

pH	6.8
Turbidity	3.2 ntus
TSS	10.7 mg/L
BOD	2.9 mg/L
TN	1.3 mg/L
TP	0.2 mg/L
D.O.	6.6 mg/L

Source: SRWCD/Environmetrics (1997)

According to the SJRWMD, agricultural-based loadings are responsible for more than 95 percent of the total loadings for nutrients, TSS, and flow.

St. Sebastian River Basin

Three (3) sub-basins have been identified within this basin. These sub-basins include: the City of Sebastian, which includes the Sebastian Highlands subdivision; the unincorporated Roseland area which is located in the northern portion of the basin; and the St. Sebastian River Buffer Preserve (Fleming Grant area), is located in the northwestern portion of this basin, west of the South Prong of the St. Sebastian River.

- Service Area

This basin is bordered on the east by the FECRR and the eastern boundary of the Fellsmere Farms Water Control District (FFWCD), on the south by Wabasso Road (85th Street/CR 510), along the west by Channel "D", and extends to the north Indian River County line.

This basin is located north of the SRWCD, and receives discharge from Basins 1, 2, 3 and 4 via the tributaries leading to the South Prong of the St. Sebastian River. The Sebastian River, Collier Creek, and Elkcam floodways flow through basin. Stormwater runoff is ultimately discharged to the IRL.

The Roseland sub-basin contains three small sub-areas (less than 300 acres) which include: Frog Leg Creek (west Roseland), 128th Street (Central Roseland), and Gibson Street (130th Street).

The St. Sebastian River Buffer Preserve is located within the northwestern portion of the basin and contains approximately 5,000 acres.

- Natural Features

The topography of the area is relatively flat with elevations in the mid-20's above MSL. The terrain slopes gently towards the tributaries of the South Prong of the St. Sebastian River (Collier Creek, South Prong Creek, Frog Leg Creek, etc.). Discharge ultimately outfalls to the IRL.

Soils in the area are predominately the Eau Gallie-Oldsmar-Wabasso series and the Riviera-Pineda-Wabasso series associations. Due to poor drainage characteristics, the wet season watertable elevation is within one (1) to two (2) feet of the surface throughout the most of the basin.

- Structural Features

Within the unincorporated County, stormwater runoff from the Roseland area is collected from an area that extends approximately 7,000 feet south of Roseland Road and conveyed north via swales and culverts beneath Roseland Road, thence to the South Prong of the St. Sebastian River. The St. Sebastian River Buffer Preserve is drained through perimeter ditches and natural sloughs to the South Prong of the St. Sebastian River.

Major structural features in this basin include: the Collier Creek Dam, the Elkcam Dam, the Schumnan waterway, and Lake Schumann. Other stormwater management facilities maintained by the City of Sebastian watershed are described in the City of Sebastian's Stormwater Master Plan and Stormwater Management Sub-element.

- Flood Zones

Except for small isolated depressions and the floodplain areas bordering the tributaries of the South Prong of the St. Sebastian River, the majority of this basin is not located within the 100-year flood plain.

- Land Use

Urban development occurs in the northeastern portion of this basin, in and around the City of Sebastian and in the Roseland community. The Sebastian Highlands, a rapidly developing single-family residential subdivision of 14,000 platted lots, comprises the majority of the southeastern portion of the Basin. The Sebastian Highlands subdivision is approximately 50 percent built-out and is rapidly developing at the present time.

The unincorporated area of Roseland is a small residential community located along the St. Sebastian River. Within the Roseland area, commercial development is situated along the U.S. Highway# 1 corridor. The Sebastain River Buffer Preserve area consists of flat, undeveloped pine woods and pasture land.

- Operating Entities and Jurisdictional Responsibilities

Stormwater management facilities within the City Limits of Sebastian are under the jurisdiction of the City, with the exception of CR 512 (Fellsmere Road). Small areas of the unincorporated county between CR 512 and the southern limits of the City of drain north to the Elkcam Waterway. Sections of the St. Sebastian River-South Prong are under the jurisdiction of the City, the SRWCD, Indian River County, and State of Florida.

Portions of Roseland fall under the jurisdiction of the City of Sebastian, as well as Indian River County. The majority of the Fleming Grant area is managed by the FDEP. However, the FDOT maintains facilities along Interstate 95 in the Fleming Grant Watershed.

- Capacity Analysis

The City of Sebastian's Comprehensive Plan Stormwater Management Sub-element addresses capacity analysis for the City of Sebastian. At the present time, the City of Sebastian in the process of developing a Stormwater Master Plan.

The downstream culverts within the western portion of the unincorporated Roseland area have a limited capacity for the approximately 300 acre area. This capacity is not sufficient to convey a 2 year/1 hour rainfall event.

- Water Quality

According to FDEP data, this basin exhibits numerous problems. First, elevated nutrient loadings attributed to septic tanks and agricultural runoff have resulted in algal blooms. Second, urban runoff is responsible for high levels of heavy metals and petroleum products. Third, mining operations and new construction projects have contributed to raised turbidity and sedimentation.
The previously discussed factors in conjunction with modification of the natural hydrological characteristics have resulted in habitat alteration and declining fisheries. Listed on the following page are the water quality parameters for the St. Sebastian River Basin:

Turbidity	N/A	pH	7.5	Alkalinity	N/A
SDD	0.6 meters	TN	N/A	Color	N/A
TP	N/A	TSS	N/A	Chlorophyll	N/A
D.O.	5.0 mg/L	FC	N/A	B.O.D.	N/A
Conductivity	N/A	WQI	65 (Poor)		

Source: FDEP 305(b) Report (1996)

Barrier Island Basins

• Sub-basin B-1 (South Beach)

- Service Area

This sub-basin comprises the southern one-third (1/3) of Orchid Island. The County's jurisdiction extends South of Leeward Lane (west of SR A1A) and Shorewinds Lane (east of SR A1A), approximately three (3) miles south to the Indian River-St. Lucie County line. The portion of this sub-basin located north of Leeward Lane and Shorewinds Lane to the southern boundary of the Town of Indian River Shores is under the jurisdiction of the City of Vero Beach. SR A1A serves as a longitudinal (north-south) partition throughout the entire length of Sub-basin B-1. Stormwater management information pertaining to the City of Vero Beach is contained within the City of Vero Beach Comprehensive Land Use Plan, Stormwater Management Sub-Element.

- Natural Features

The topography of this basin is typical of a coastal barrier island. Elevations range from mean sea level (MSL) along the Atlantic Ocean, to between 13 and 17 feet NGVD along the primary dune, approximately 300 feet west of the MSL. Soils east of S.R. A1A are Canaveral- Captiva-Palm Beach. These "excessively drained" soils are naturally capable of percolating stormwater runoff from a 25-year/24 hour storm event. West of S.R. A1A, soil types are McKee-Quartzipsamments-St. Augustine. These soils are level and are classified as "somewhat poorly drained." Due to the high percolation of soils and the narrow width of the island, the groundwater table elevation within this Basin is approximately one (1) foot above mean sea level, except where hydraulic fill within the Moorings Development creates a perched water table within one (1) to two (2) feet of the surface.

- Structural Features

Linear Grassed swales along SR A1A retain stormwater runoff and provide percolation. A 30 inch diameter culvert beneath SR A1A drains the Moorings Unit 1 area and discharges under SR A1A

to the IRL. Most developed areas west of S.R. A1A, are drained by positive drainage systems, including grassed swales which discharge to the IRL.

- Flood Zones

Coastal velocity or "VE" flood zones are located along the Atlantic Ocean Coastline, east of the primary coastal dune. West of the VE zone is a thin zone designated as 100-year Flood Plain (Zone "AO", depth one (1) foot). Proceeding westerly, a section approximately 600 feet wide is designated as Zone "X", with SR A1A bordering on the west. West of SR A1A is an area designated as 100-year flood plain (zone AE, base flood elevations of five (5) to six (6) feet), which is part of the IRL flood plain.

- Land Use

Development along the south 1.5 mile length of Basin B-1 (south of the Moorings to the south county line) is almost exclusively comprised of small subdivisions and scattered single-family residences on individual lots.

- Operating Entities and Jurisdictional Responsibility

Sub-basin B-1 is entirely within the unincorporated area of Indian River County. Within this sub-basin, the County maintains stormwater facilities in the Moorings subdivision, St. Christopher subdivision, and for Round Island Park. The remaining stormwater facilities are within private developments and are not county maintained.

- Capacity Analysis

As previously mentioned, dune type soils have characteristically excessive percolation rates. Thus, throughout most of the sub-basin, both water quality and water quantity provisions are accommodated with no offsite discharge due to the excessively drained soils located east of SR A1A. Coastal flooding would occur only in the event of a major hurricane.

Stormwater management facilities east of SR A1A have been designed to percolate the runoff from the 25 year/24 hour storm event. West of SR A1A, almost all existing development located in the northern 1.5 miles of Sub-basin B-1 has provided for water quality treatment of at least the first one (1) inch of rainfall. Drainage systems have been designed for the 25-year/24 hour rainfall event, and permits from the FDEP or SJRWMD have been obtained. There are no capacity runoff problems within the area.

The Moorings is the only development that experiences minor drainage problems within Sub-basin B-1. The 40 culverts which outfall from the Moorings area into the IRL are capable of conveying stormwater runoff only from a 3-year/1 hour rainfall event.

- Water Quality

Within the Moorings Development, water quality provisions have not been included within the culvert-outfall systems, since the project was constructed prior to state and local stormwater permitting requirements. However, since the predominant land use is single-family, no large pollution sources such as parking lots exist, and only the two-lane residential street system is directly connected to the IRL.

Listed below are the water quality parameters for Sub-basins B-1 and Sub-basin R-1:

Turbidity	5.6 mg/L	pH	7.7	Alkalinity	122 mg/L
SDD	1.1 m	TN	0.73 mg/L	Color	13 pcu
TP	0.08 mg/L*	TSS	23 mg/L	Chlorophyll	5 mg/L
D.O.	6.4 mg/L	FC	1	B.O.D.	1.2 mg/L
Conductivity	43513 ohms	TSI	46 (Good)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

- **Sub-basin B-2 (Town of Indian River Shores)**

- Service Area

Sub-basin B-2 is located immediately north of the City of Vero Beach, and extends to CR 510 (Wabasso Road). This sub-basin comprises the middle one-third (1/3) of Orchid Island.

Indian River County neither owns nor maintains any stormwater management facilities within the Town of Indian River Shores, except for a grass swale along North Winter Beach Road (a county roadway) and the drainage system within Tracking Station Park. Stormwater management information pertaining to the Town of Indian River Shores is contained within the Town of Indian River Shores Comprehensive Plan.

- Natural Features

The topography of this sub-basin is typical of a Coastal Barrier Island. Elevations range from Mean Sea Level (MSL) along the Atlantic Ocean Coastline to the east, rising to elevation 13 to 20 feet NGVD along the primary dune (300 feet west of the coastline), and sloping westerly to MSL at the IRL shoreline. The average width of the area is approximately 3000 feet from east to west.

Excessively drained soils east of SR A1A absorb and percolate all of the entire stormwater runoff from the 25 year/24 hour storm event. "Somewhat poorly drained" soils located west of SR A1A, are drained by natural sheet flow toward the IRL.

Due to good percolation and close proximity to tidal waters, the groundwater table is approximately one (1) foot above MSL through the eastern section of the basin. West of SR A1A, the water table rises to an elevation of approximately three (3) feet.

- Structural Features

At the north end of the basin, the Coralstone (formerly Moon River) and Sea Oaks developments are designed to percolate runoff from a 25 year/24 hour storm event east of SR A1A. West of SR A1A, a series of drainage pipes route stormwater runoff to wet retention/detention ponds prior to discharging via weirs into the IRL. The Island Club subdivision has two large retention ponds that are capable of accommodating runoff from a 25 year/24 hour storm event.

- Flood Zones

This sub-basin contains coastal flood "VE" zones along the Atlantic Ocean. A substantial portion of this sub-basin lying west of SR A1A is located within a 100 year floodplain. However, proper floodplain management criteria was adopted by the county prior to development, resulting in high finish floor elevations above the 100-year flood plain elevation (7 to 9 feet above MSL) and adequate floodplain storage compensation.

- Land Use

Single and multi-family residential land uses are predominant in this sub-basin. Most development has occurred since the adoption of state and local stormwater management regulations, resulting in planned residential developments with properly designed and permitted stormwater management facilities.

- Operating Entities and Jurisdiction Responsibilities

Stormwater management facilities for the Coralstone, Sea Oaks, and the Island Club developments are privately owned and maintained by property owners associations. SR A1A is owned and maintained by the FDOT. Indian River County owns and maintains a small percolation system at Wabasso Beach Park and the Jungle Trail Roadway swale system. Except for the previously mentioned facilities, the County neither owns nor maintains any additional stormwater management facilities within this sub-basin.

- Capacity Analysis

The existing design capacity of the Coralstone, Sea Oaks, and Island Club developments accommodates a 25 year/24 hour storm event. Since small individual basins exist, no large public drainage facilities are present, and the county has no need to increase design capacity or water quality treatment.

- Water Quality

Since the IRL is classified as Class II Outstanding Florida Waters (OFW) west of the sub-basin, retention of more than one (1) inch of runoff is required for developments within this sub-basin.

Listed below are the water quality parameters for Sub-basins B-2 and R-2:

Turbidity	6.5 mg/L	pH	7.7	Alkalinity	129 mg/L
SDD	1.0 m	TN	0.90 mg/L	Color	23 pcu
TP	0.12 mg/L*	TSS	10 mg/L	Chlorophyll	9 mg/L
D.O.	6.1 mg/L	FC	100	B.O.D.	2.2 mg/L
Conductivity	38700 ohms	TSI	52 (Fair)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

- **Sub-basin B-3 (Ambersand Beach Area)**

- Service Area

Sub-basin B-3 encompasses the northern one-third (1/3) of Orchid Island and is situated between CR 510 (Wabasso Road) and the north county line. The Town of Orchid lies within the southern mile of Sub-basin B-3.

- Natural Features

Similar to the other B-series basins, the area contains coastal hammock, citrus groves, and low density residential land use. The relief ranges from MSL at the Atlantic Ocean Coastline, rises to an elevation of 20 feet above sea level, and descends toward the IRL. Four (4) miles north of CR 510, the island becomes narrows to several hundred feet in width and continues to the north county line. The "excessively drained" soils located east of SR A1A percolate the entire stormwater runoff from a 25 year/24 hour storm event. Soils west of SR A1A are classified as "somewhat poorly drained". Due to good percolation and the close proximity to tidal waters, the groundwater table is

approximately one (1) foot above MSL throughout the eastern section of the basin and rises to elevation 2.0 within the central area.

- Structural Features

At the southeast end of the sub-basin, the Summerplace Subdivision drainage sub-basin consists of swale percolation systems, as does SR A1A. The stormwater management facilities for the Orchid Island Beach Club (located within the Town of Orchid) and the Windsor Polo Club are similar in design. West of SR A1A, the developments drain to large retention/detention basins, and controlled weir discharge structures drain the systems to the IRL. The few remaining citrus groves within the basin drain west via overland flow to culverts beneath Jungle Trail, thence to the IRL.

- Flood Zones

The western 3,000 feet of this sub-basin lies within the 100 year flood plain below elevation 8.0. The easternmost 300 feet of the sub-basin lies within the coastal velocity "VE" flood zone along the Atlantic Ocean. A thin band of land, approximately 500 feet wide that extends along SR A1A is located outside the 100 year floodplain ("X" zone). The Summerplace Subdivision in the south portion of the basin is located within this non-flood prone area. Along the northern land mass, the entire area is prone to flooding.

- Land Use

High priced residential developments have been constructed in this sub-basin within the last ten (10) years. These include the Windsor Polo Club and the Seaview subdivision. The Orchid Island Golf and Beach Club is located south of Windsor within this sub-basin. County park land lies east of SR A1A along 12,000 feet of the coastline. Located at the northwest portion of this sub-basin is a large undeveloped tract of land that buffers the Pelican Island National Wildlife Refuge.
Along the north peninsula lies the Sebastian Inlet State Recreation Area.

- Operating Entities and Jurisdictional Responsibility

The southwest 400 acres of the sub-basin are within the municipal limits of the Town of Orchid. Indian River County does not have jurisdiction nor operational responsibility within this area. North of the Town of Orchid, Indian River County has jurisdiction to regulate development within the sub-basin. The State of Florida has jurisdiction and operational responsibility for the 100 foot wide SR A1A right-of-way. Since most developments, including the Windsor Polo Club, Sanderling subdivision, and citrus groves are privately maintained, the county does not have operation responsibility to maintain stormwater management facilities.

- Capacity Analysis

The minimum design capacity of all systems is the 10 year/24 hour storm event. Newer developments provide capacity for a 25 year/24 hour storm event. Proper floodplain management and water quality provisions have also been included within each system's design.

- Water Quality

East of the Intracoastal Waterway, the IRL is classified as Class II (Shellfish Propagation or Harvesting) Outstanding Florida Waters (OFW). Therefore, all new developments within this sub-basin are required to provide retention of more than one (1) inch of stormwater runoff.

Listed below are the water quality parameters for Sub-basins B-3 and R-3:

Turbidity	4.7 mg/L	pH	8.0	Alkalinity	123 mg/L
SDD	1.0 m	TN	0.71 mg/L	Color	23 pcu
TP	0.07 mg/L	TSS	11 mg/L	Chlorophyll	9 mg/L
D.O.	7.1 mg/L	FC	N/A	B.O.D.	0.8 mg/L
Conductivity	41338 ohms	TSI	50 (Fair)		

Source: FDEP 305(b) Report (1996)

Mainland IRL Basins

"R" sub-basins are located along the eastern slope of the one mile coastal ridge. The western limits are generally formed by the fill and ballast of the FECRR which generally follows the contour of the one mile coastal ridge. This area is bounded on the east by the IRL, on the south by the south boundary of Indian River County, and on the north by the St. Sebastian River, the center of which is the northern boundary of Indian River County.

For purposes of identification, study and planning, the eastern slope of the coastal ridge has been separated into three (3) sub-basins. Sub-basin R-1 extends from the northern limits of the City of Vero Beach to the South County line, and comprises the southern one-third (1/3) of the Mainland IRL Basin. Sub-basin R-2 is bounded on the south by the northern boundary of the City of Vero Beach and to the north by CR 510 (Wabasso Road). This sub-basin comprises the middle one-third (1/3) of the Mainland IRL Basin. Sub-basin R-3 extends north of CR 510 to the St. Sebastian River, and is the northern one-third of the Mainland IRL Basin.

The eastern slope of the coastal ridge which makes up the "R" sub-basins begins at an elevation of zero (0) at the IRL and runs gradually to elevations varying from 20 to 30, feet with points up to

nearly 50 feet at the west side of the Basin near the top of the Atlantic Coastal Sand Ridge. This series of basins is penetrated at various points by drainage canals extending from the county's interior and by other scattered outfalls and residential canals. The only significant natural drainage feature in this Basin is the Sebastian River; all other facilities have been constructed since the 1920's.

- **Sub-basin R-1 (South County)**

    - Service Area

The boundary of this sub-basin is formed by the IRL to the east and the one mile coastal ridge (IRFWCD) to the west. This sub-basin is extends from the northern limits of the City of Vero Beach (east of U.S. Highway #1) and extends to the Indian River-St. Lucie County line.

    - Natural Features

The topography of this sub-basin is typical of the east slope of the Atlantic Coastal Sand Ridge. Elevation is zero (0) at the shore of the IRL. The land rises slowly, from the IRL through approximately 1000-2000 feet of coastal marsh and estuarine wetlands before rising to an elevation of five (5) feet approximately one-half (½) to one (1) mile inland. Sheet flow is slowed and treated naturally by these wetlands. From this point the ground rises quickly to the top of the Atlantic Coastal Sand Ridge with average elevations in the 20-30 foot range.

The soil types in this sub-basin classified as being "poorly drained are as follow: St. Augustine, Boca, Eau Gallie, Holopaw, Kesson, McKee, Quartzipsamments, Wabasso, and Riviera. These soils are present in the low lying marsh and wetland areas near the IRL. Soils classified as being "moderate" to "excessively" drained are generally found on or adjacent to the Atlantic Coastal Sand Ridge and include: Astatula, Archbold, St. Lucie, and Paola series. These soils facilitate the percolation of stormwater runoff and have water table depths greater than six (6) feet during the wet season.

Groundwater elevations vary substantially as distance from the IRL increases. Much of the wetlands near the IRL are frequently flooded much of the year to depth up to two (2) feet. When not flooded, the water table is normally found at a depth of zero (0) to one (1) foot according to the SCS soil survey. Much of the higher uplands experience similar shallow water tables, with wet season water depths of one (1) foot or less during the months of June to December.

    - Structural Features

Substantial portions of this sub-basin adjacent to the IRL south of SR 60 have been filled to construct residential canal subdivisions. Stormwater management facilities include outfall culverts sized 18 to 36 inches, outfall ditches constructed by the FDOT, and residential canals. FDOT ditches drain the right-of-way of U.S. Highway 1.

- Flood Zones

The eastern part of the basin is within the 100 year flood plain. According to the FIRM, this AE zone extends inland a distance of approximately 3000-3500 feet to elevations five (5) to six (6) feet above MSL. Flood Zone "X" (within the 500 year floodplain) extends an additional 300-1500 feet inland. The remainder of the basin is generally outside (above) the 500 year flood hazard zone. Significant amounts of residential development exist within these two flood zones. However, the Vista Royale development and Vero Shores Subdivision have finished floor elevations above the 100 year floodplain. Existing preserved 100-year floodplain wetlands protect upland development from storm surge.

- Land Use

Mixed residential use, including some residential canal areas, strip commercial development, and open space (e.g. undeveloped flatwoods, estuarine wetlands) are the predominant land uses. Transportation corridors, including the FECRR, U.S. Highway 1, Old Dixie Highway (CR 605) and Indian River Boulevard (CR 603) transect and divide this sub-basin. Major residential developments within this sub-basin are as follow: Vero Shores subdivision, River Shores subdivision, Vista Gardens, Rockridge subdivision, Vero Isles subdivision, and Vista Harbor.

- Operating Entities and Jurisdictional Responsibility

Within this sub-basin outfalls are maintained by the City of Vero Beach, the FDOT, and Indian River County. Stormwater management facilities that serve the Vista Royale Condominium Development are privately maintained.

- Capacity Analysis

There are a few limited capacity runoff problems in the area, most of which could be alleviated by improved maintenance. The stormwater management facilities of this sub-basin are generally capable of accommodating a 10 year/24 hour storm event. However, the Vista Royale system was designed to mitigate the runoff from the 25 year/24 hour storm event.

Primary Drainage for older developments in the middle portion of this sub-basin is provided by two (2) FDOT drainage ditches (10th Street outfall and 14th Street outfall) which were originally constructed to serve U.S. Highway 1. Secondary drainage is provided by a network of agricultural ditches which flow eastward to mangrove marshes. The "FDOT" ditch system is designed to convey stormwater runoff from a 25 year/24 hour event.

All stormwater management facilities associated with the north extension of Indian River Boulevard (CR 603) are designed to accommodate the impacts of a 100 year/72 hour storm event.

- Water Quality

More recent developments provide on-site retention/detention treatment of stormwater runoff. However, River Shores subdivision and Vero Shores subdivision were developed prior to stormwater management regulations. As a result, these subdivisions have the most significant impact on water quality within this sub-basin.

Listed below are the water quality parameters for Sub-basins R-1 and B-1:

Turbidity	5.6 mg/L	pH	7.7	Alkalinity	122 mg/L
SDD	1.1 m	TN	0.73 mg/L	Color	13 pcu
TP	0.08 mg/L*	TSS	23 mg/L	Chlorophyll	5 ug/L
D.O.	6.4 mg/L	FC	1	B.O.D.	1.2 mg/L
Conductivity	43513 ohms	TSI	46 (Good)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

- **Sub-basin R-2 (Gifford/Wabasso Area)**

- Service Area

Sub-basin R-2 is located between the east boundary of the IRFWCD and the IRL, extending from the north boundary of Sub-basin R-1, northward to CR 510.

- Natural Features

The eastern 1000-2000 feet of this sub-basin is mostly wetlands and tidal marshlands. The topography of Sub-basin R-2 is typical of the eastern slope of the Atlantic Coastal Sand Ridge. Elevations gradually rise from zero (0) at the shore of the IRL, to approximately 20 feet at the top of the ridge near the west boundary of the basin. Some small knolls along the top of the Atlantic Coastal Sand Ridge reach elevations of 45 to 50 feet. This ridge area is largely undeveloped land and consists mostly of pine flatwoods and scattered citrus groves.

Soils of the area include the McKee series near the shore of the IRL. These soils are low, "poorly drained" sandy soils. Myakka soils are located further inland and exhibit characteristics similar to McKee soils. Astatula soils are found on the Atlantic Coastal Sand Ridge. These sandy soils are "excessively drained", and generally slope to a depth of seven (7) feet or more.

Standing water, up to two (2) feet in depth, covers much of the low lying areas throughout the wet season (June-December). As distance from the IRL increases, the water table becomes increasingly deeper. The water table depth is six (6) feet or more throughout the year on the Atlantic Coastal Sand Ridge.

- Structural Features

The western half of the sub-basin is largely undeveloped with no defined drainage ways or systems. The transportation corridor is drained to the IRL through a series of drainage ditches constructed by the FDOT and FECRR. Citrus groves are drained by private agricultural systems which discharge into the major ditches or directly to the IRL and adjacent marshes.

- Flood Zones

According to FIRMs, flood zones cover over half the sub-basin. The 100 year flood zone (AE) encompasses the eastern 3500-4500 feet of the basin as measured from the shore of the IRL. This zone extends to elevations seven (7) feet above MSL. The 500 year flood zone (X) extends an additional 500 to 1000 feet inland. Flood zones cover over half of the basin, excluding most of the western portion.

- Land Use

The western part of the basin includes U.S. Highway 1, Old Dixie Highway, the FECRR, and sections of the Gifford area. The northern extension of Indian River Boulevard (CR 603), a four (4) lane controlled access highway, transects the southern portion of this sub-basin and terminates at 53rd Street. This area includes substantial amounts of development composed of mixed residential, commercial and industrial uses. Grand Harbor, an 860 acre planned residential development, is located within the middle portion of this sub-basin. The undeveloped portion extending to U.S. Highway 1 is used mainly for citrus farming. Most lands on the Atlantic Coastal Sand Ridge remain undeveloped.

- Operating Entities and Jurisdictional Responsibility

Sub-basin R-2 is entirely within the unincorporated area of Indian River County. Within the basin are facilities owned and maintained by Indian River County . The FDOT owns and maintains facilities that serve U.S. Highway 1.

- Capacity Analysis

The entire sub-basin is deemed capable of accommodating a 25 year/24 hour storm event. There are no known capacity problems in this sub-basin. However, the stormwater management facilities that serve this transportation corridor have been inventoried or analyzed in any comprehensive manner.

- Water Quality

Rockridge subdivision and Country Club Pointe subdivision were developed prior to stormwater management regulations and thus provides inadequate treatment of stormwater runoff. Nonpoint source runoff from U.S. Highway 1 and the 14th Street area also impact the water quality of this sub-basin. Listed below are the water quality parameters for Sub-basins R-2 and B-2:

Turbidity	6.5 mg/L	pH	7.7	Alkalinity	129 mg/L
SDD	1.0 m	TN	0.90 mg/L	Color	23 pcu
TP	0.12 mg/L*	TSS	10 mg/L	Chlorophyll	9 mg/L
D.O.	6.1 mg/L	FC	100	B.O.D.	2.2 mg/L
Conductivity	38700 ohms	TSI	52 (Fair)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

- **Sub-basin R-3 (Roseland Area)**

- Service Area

This linear sub-basin is located between the IRL and FECRR. The sub-basin extends north of County Road 510 north to the to the shore of the St. Sebastian River.

- Natural Features

The topography is typical of the coastal ridge, sloping gently from zero (0) at shoreline of the IRL to the top of the ridge, where a low flat plateau exists at an elevation of 20 to 25 feet.

The soils in this basin are mostly Astatula, Archibold and St. Lucie and are "well" to "excessively drained" and sandy to depths of seven (7) feet or more. The high permeability of soils in this area keep groundwater tables relatively low. Wet season elevation will varies from three (3) to five (5) feet in the better drained soils to less than one (1) foot in poorly drained soils near the IRL.

- Structural Features

The northern portion of Sub-basin R-3, is predominately an urban stormwater management system consisting of canals, ditches, storm sewers and culverts. Much of the area consists of older developments with little or no water quality treatment. A large part of the basin is in the City of Sebastian. The drainage system in vicinity of the City of Sebastian is designed, in theory, to handle

a 10 year/24 hour storm without significant property damage. However, problems associated with lack of maintenance, such as obstruction by sediment or debris are not uncommon.

The southern section of Sub-basin R-3 is served by drainage ditches proximate to the FECRR and U.S. Highway 1. These primary ditches are supplemented by secondary ditches constructed by citrus growers. The main ditches were constructed by the FDOT and the FECRR as part of the construction and improvement of their roadways or rail facilities. The main ditches are designed to accommodate the 25 year/24 hour storm event for the sub-areas which they serve.

- Flood Zones

In the northern portion of the sub-basin, 100 year (AE) and 500 year flood zones (X), do not extend very far from the shore of the IRL. However, the 500 year flood zone (X) extends further inland nearly to US Highway 1 throughout the basin and across the highway towards the southern portion of the sub-basin.

- Land Use

Commercial and industrial developments are scattered along the transportation corridor (U.S. Highway 1, Old Dixie Highway, and the FECRR). Several multi-family residential developments are located near the IRL. Single family residences and citrus groves are scattered throughout the basin. Most of the narrow band of estuarine wetlands along the IRL remains undeveloped. Overall, Sub-basin R-3 is nearly 50 percent developed.

- Operating Entities and Jurisdictional Responsibility

Sub-basin R-3 is located within the unincorporated area of Indian River County and partially in the City of Sebastian. Within the basin are facilities owned and maintained by Indian River County, the FECRR, the FDOT. Two private residential areas, Reflections on the River Condominiums and River Run, have privately maintained drainage systems.

- Capacity Analysis

The primary stormwater management facilities proximate to U.S. Highway 1 and the FECRR are designed to accommodate a 25 year/24 hour storm event. The numerous pipes and ditches which discharge into the IRL have not been inventoried, nor has a complete study of the system been conducted. Therefore, the capacity of this sub-basin is not known.

There are no known capacity problems in this sub-basin, and the system should continue to be adequate provided stormwater management regulations are followed. Drainage problems in the sub-basin are maintenance related. Notwithstanding, the effect of tidal surge caused by a tropical storm or hurricane would inundate most of this sub-basin.

- Water Quality

The Durrance subdivision, a residential canal development project, provides inadequate treatment of stormwater runoff. Most of the Roseland area was developed prior to stormwater management regulations and, therefore, adversely impacts water quality. U.S. Highway 1 and Indian River Drive also contribute nonpoint source loadings to this sub-basin.

Listed on the following page are the water quality parameters for Sub-basins R-3 and B-3:

Turbidity	4.7 mg/L	pH	8.0	Alkalinity	123 mg/L
SDD	1.0 m	TN	0.71 mg/L	Color	23 pcu
TP	0.07 mg/L	TSS	11 mg/L	Chlorophyll	9 mg/L
D.O.	7.1 mg/L	FC	N/A	B.O.D	0.8 mg/L
Conductivity	41338 ohms	TSI	50 (Fair)		

Source: FDEP 305(b) Report (1996)

- **Indian River Farms Water Control District Basin**

- Service Area

The Indian River Farms Water Control District (IRFWCD) has the largest service area of any water control district in the county. This district manages stormwater runoff for over two-thirds of the county's urbanized area. With nearly 50,211 acres contained within its service area, IRFWCD exceeds the combined areas of the SRWCD and the FFWCD. The majority of the IRFWCD service area is located west of the Atlantic Coastal Ridge. The IRFWCD contains three (3) separate sub-basins that discharge to the IRL. The North Relief Canal (NRC), the Main Relief Canal (MRC), and the South Relief Canal (SRC) are discussed separately in this section.

- Natural Features

Water table elevations within the IRFWCD are relatively shallow throughout most of the year. Wet season conditions result in water table elevations of one (1) to two (2) feet below the ground surface. With dry season conditions, the groundwater depth averages between four (4) to six (6) feet.

The surface soils are fine sands, ranging in depth from 12 to 60 inches and having a very high permeability. Subsoils are organic hardpans, clays and marls of varying thickness and hardness.

The five (5) main soil types occurring include:

- Astatula-Immokalee-Eau Gallie
- Archibold-Myakka-Oldsmar
- St. Lucie-Satellite-Wabasso
- Riviera-Winder-Pineda; and,
- Riviera-Wabasso-Manatee

The average elevation of the land is 22.0 feet NGVD. The steepest slopes are located along the west side of the Atlantic Coast Ridge, where the elevations change about one (1) foot for every 1,000 feet in horizontal distance. Gentle slopes of 0.3 feet per 1,000 feet exist in the area between 66th Avenue and 90th Avenue. The remaining areas of the district are flat with slopes on the order of 0.1 feet per 1,000 feet.

- Structural Features

The entire district is shielded from outside inflow by a system of levees. Secondary swales, backlot ditches, and small channels discharge stormwater runoff into the canal system. Over 320 miles of sub-lateral and lateral drainage canals provide positive drainage of runoff to the North, Main and South Relief Canals which discharge into the IRL.

Sub-lateral canals are spaced at one-half (½) mile intervals, run east and west, and connect to a lateral canal system. Each sub-lateral canal drains an area approximately one-quarter (¼) of a mile north and south of the sub-lateral canal and then drain specific land uses and then transport the stormwater to a lateral canal. The lateral canals connect the sub-lateral canals and the relief canals. The main function of the lateral canals is to transport the water from the sub-lateral canals to the relief canals. Presently, there are ten (10) lateral canals, labeled "A" through "J".

There are three (3) major water control structures on the relief canal system. The purpose of the flood control structures is to prevent saltwater intrusion into the western portion of the county and to control the water level of the canal for agricultural irrigation purposes. There are two (2) flood control structures on the Main Relief Canal (MRC). One is just east of 43rd Avenue and the second is located near the Vero Beach Country Club. The flood control structure for the South Relief Canal (SRC) is located just east of 27th Avenue. The flood control structure for the North Relief Canal (NRC) is located approximately 200 feet east of 58th Avenue..

- Land Use

Listed below are the acreages of land uses present throughout the entire IRFWCD Basin:

AGRICULTURAL	TOTAL ACREAGE
Citrus	20,800
Rangeland	2,602
Pasture	2,394
Cropland	515
Other	300
SUB-TOTAL	26,611
NON-AGRICULTURAL	TOTAL ACREAGE
Residential	11,563
Commercial	611
Industrial	281
Extractive	380
Open Water/Wetlands	1,814
Forested	7,164
Other	1,787
SUB-TOTAL	23,600
TOTAL	50,211

- Operational Entities and Jurisdictional Responsibilities

IRFWCD: Jurisdiction and maintenance of primary drainage outfall canals are the responsibility of the IRFWCD as authorized by F.S. Section 298. The District has a regular maintenance program to clean the canal system and operate flood control gates.

City: Secondary drainage swales, ditches and culverts within the City of Vero Beach are the responsibility of the city.

County: Secondary drainage swales, ditches, and culverts within the unincorporated area are the responsibility of Indian River County. The county funds maintenance and minor construction activities through ad valorem taxes generated within the unincorporated area.

- Capacity Analysis

Due to water quality concerns, IRFWCD has not substantially increased outfall capacity from to the IRL since 1930. The District's philosophy has been to maintain discharge on a status-quo basis.

A 1988 IRFWCD study analyzed the capacity of the entire basin. The EPA Stormwater Management Computer Model (SWMM 3) was used to evaluate capacity. The modeling effort identified areas within the District where existing flooding occurs for the 10 year, 25 year, and 100 year storm events.

Evaluation of Existing System - Hydrolic Problem Areas - The study determined that large sections of sublaterals in the District are constricted due to extensive culverting. These areas are indicated by low flow and high headlosses. The majority of these areas are, as expected, found in urban areas where significant amounts of impervious surface have been created and where extensive culverting has taken place. Areas with canal constrictions and low ground elevations are subject to frequent flooding. The IRFWCD study also states that:

- Design flows east of the spillway on the main canal are shown to be flooding the salinity control structure, and stage elevations top the outfall canal bank. A redesign of the salinity weir and deepening of the outfall canal should be considered.

- A list of flooding nodes with minimum 0.8 feet of maximum flooding in a ten (10) year storm is included within the report. The probable cause and the conduit associated with the flooding is also listed. Some of the culverts in the problem areas should be replaced with recommended design sizes to eliminate flooding.

The total discharge for the District under various storms is as follows:

Average Peak 24 Hour Discharge	100 Year Storm	25 Year Storm	10 Year Storm
South Relief Canal	3,706.9 CFS	3,133.8 CFS	2,576.2 CFS
Main Relief Canal	3,699.2 CFS	3,079.2 CFS	2,595.5 CFS
North Relief Canal	2,622.1 CFS	2,138.3 CFS	1,806.8 CFS
Total Volume (96 Hours)	33,068 Acre-Feet	26,854 Acre-Feet	22,269 Acre-Feet

Overall, the average peak discharge capacity of the system is:

100 Year	4.8 inches/24 hours	128.4 CSM
25 Year	4.0 inches/24 hours	106.9 CSM
10 Year	3.3 inches/24 hours	89.3 CSM

The above listed flow capacities are achieved with the system experiencing some flooding. Most locations east of the Atlantic Coastal Sand Ridge will not experience flooding because of the District's canals. However, some areas between the Atlantic Coastal Sand Ridge and the Ten Mile Ridge will experience flooding due to general low ground conditions.

- Water Quality

The three sub-basins of the IRFWCD contribute less than nine (9) percent of the total suspended solids (TSS) entering the IRL from agricultural areas. Furthermore, overall loadings of nutrients (TN and TP), and flow from agricultural areas within the IRFWCD are substantially less when compared to the SRWCD and the FWCD. Reductions may be attributed to water management practices, BMPs (irrigation and fertilization techniques), and general farm management philosophy in the IRFWCD. (SJRWMD, 1994)

Between 1988 and 1993, mean Class III standards for water quality were exceeded on a regular basis for specific conductivity. Elevated concentrations of beryllium (Be), mercury (Hg), and Silver (Ag) are the suspected cause. Also, Class III standards for the following heavy metals were exceeded on a periodic basis: Barium (Ba), Cadmium (Cd), Copper (Cu), and Lead (Pb). The above listed heavy metals are attributed to urban runoff. Furthermore, Class III standards for pH, dissolved oxygen (DO), and fecal coliform (FC) were periodically exceeded. Generally, measured concentrations for water quality standards are two (2) to three (3) times greater during the wet season than during the dry season (SJRWMD, 1994). Thus, the pollutant loadings originating from the IRFWCD can be attributed primarily to urban runoff. Refer to the Technical Appendix for a further explanation of water quality parameters.

- **Sub-basin C-1 (North Relief Canal)**

  - Service Area

The drainage area of Sub-basin C-1 is depicted in Figure 3.E.4.

- Land Use

Listed below are acreages of land use classifications within Sub-basin C-1:

AGRICULTURAL	ACREAGE
Citrus	4,095
Rangeland	789
Pasture	750
Cropland	160
Other	110
SUB-TOTAL	5,904
NON-AGRICULTURAL	
Residential	2,314
Forested	2,188
Extractive	346
Commercial	153
Open Water/Wetlands	450
Industrial	116
Other	113
SUB-TOTAL	5,680
TOTAL	11,584

Source: SJRWMD (1994)

- Flood Zones

The second largest area of flooding within the IRFWCD is within Sub-basin C-1. The boundaries are as follows: 65th Street to the north; 66th Avenue to the east; 74th Avenue to the west; and 45th Street to the south. The flood elevations range from 22 to 23 feet. Another flood prone area is located along the Lateral "G" Canal one-quarter (¼) mile wide from 85th Street to 65th Strect. Flood elevations range from 19 to 23, feet south to north, in this area. Furthermore, an area connected to the NRC by the Lateral "H" Canal is subject to flooding. This designated zone is bounded by 45th Street on the north, 28th Avenue on the east, 35th Avenue on the west, and 41st Street on the south. Flood elevations are between 21 and 22 feet.

- Water Quality

Sub-basin C-1 exhibits elevated levels of nutrients, turbidity and sedimentation. These loadings are attributed mainly to agricultural runoff. Septic tanks are responsible for contributing to elevated levels of fecal coliform bacteria and nutrients. Urban runoff contributes high levels of heavy metals and petroleum products. Historical (1980-1989) water quality parameters for the North Relief Canal are listed below:

Turbidity	4.8 ntus	pH	7.5	Alkalinity	165 mg/L
SDD	0.6 m	TN	1.0 mg/L	Color	60 pcu
TP	0.17 mg/L	TSS	8 mg/L	Chlorophyll	3 ug/L
D.O.	6.9 mg/L	FC	N/A	B.O.D.	1.2 ug/L
Conductivity	1,045 ohms	WQI	44 (Good)		

Source: FDEP 305(b) Report (1996)

- **Sub-basin C-2 (Main Relief Canal)**

  - Service Area

The drainage area of Sub-basin C-2 is depicted in Figure 3.E.4.

  - Land Use

Listed below are acreages of land use classifications within Sub-basin C-2:

AGRICULTURAL	ACREAGE
Citrus	10,575
Pasture	1,081
Rangeland	1,198
Cropland	260
Other	60
SUB-TOTAL	13,174
NON-AGRICULTURAL	
Residential	5,498
Commercial	358
Industrial	150

Extractive	34
Open Water/Wetlands	980
Forested	2,823
Other	1,277
SUB-TOTAL	11,120
TOTAL	24,294

Source: SJRWMD (1994)

- Flood Zones

According to the study produced by Williams, Hatfield & Stoner and Carter and Associates, using the EPA Stormwater Management Model SWMM 3, the largest area of flooding within sub-basin C-2 during a 10 year storm event is connected to the IRL by the MRC and by the SRC. The approximate boundaries of this flood prone area are as follows: the MRC to the north; 43rd Avenue to the east; and 74th Avenue to the west.

The other flood prone areas with this sub-basin, located along the MRC from Country Club Drive to the IRL, is a portion of the IRFWCD that extends one (1) mile east to west and one-half (½) mile north to south. The flood elevations range from six (6) feet at the west end to eight (8) feet at the junction of the MRC and the IRL.

- Water Quality

Sub-basin C-2 exhibits elevated levels of nutrients, turbidity and sedimentation. These loadings are attributed to agricultural runoff, septic tanks and new development. Septic tanks are also responsible for contributing to elevated levels of fecal coliform bacteria. Urban runoff contributes high levels of heavy metals and petroleum products. The previously discussed factors are suspected to have impacted on fisheries. Within the IRFWCD basin, the MRC sub-basin contributes approximately 50% of the TN, 47% of the TP, and 68% of the TSS that enters the IRL. Historical (1980-1989) water quality Parameters for the MRC sub-basin are listed below:

Turbidity	2.0 ntus	pH	7.5	Alkalinity	172 mg/L
SDD	0.9 m	TN	1.08 mg/L	Color	48 pcu
TP	0.16 mg/L	TSS	11 mg/L	Chlorophyll	1 ug/L
D.O.	5.9 mg/L	FC	63 per 100 ml	D.O.	1.0 mg/L
Conductivity	1588 ohms	WQI	39 (Good)		

Source: FDEP 305(b) Report (1996)

- **Sub-basin C-3 (South Relief Canal)**

    - Service Area

The drainage area of Sub-basin C-3 is depicted in Figure 3.E.4

    - Land Use

AGRICULTURAL	ACREAGE
Citrus	6,130
Cropland	95
Pasture	563
Rangeland	615
Other	130
SUB-TOTAL	7,533

NON-AGRICULTURAL	ACREAGE
Residential	3,751
Commercial	100
Industrial	15
Extractive	0
Water/Wetlands	384
Forested	2,153
Other	248
SUB-TOTAL	6,759
TOTAL	14,292

Source: SJRWMD (1994)

    - Flood Zones

As previously stated, a portion of the largest flood prone area within the IRFWCD is located in this sub-basin. The approximate boundaries of this flood prone area are as follows: SRC to the north; 43rd Avenue to the east; 74th Avenue to the west; and the St. Lucie County line to the south. The flood elevations in this area range from 21 to 24 feet. This area floods due to the limited discharge capacity of the relief canals and the low elevations. The other flood prone area in this sub-basin is

located along the Lateral "J" Canal; it is a one-quarter (¼) mile wide area that extends from 13th Street SE to the St. Lucie County Line. Flood elevations are from 19 to 21 feet.

- Water Quality

Within the IRFWCD basin, the SRC contributes the least amount of TN, TP and TSS to the IRL. Nevertheless, sub-basin C-3 exhibits elevated levels of nutrients, turbidity and sedimentation. These loadings are attributed to agricultural runoff, septic tanks and new development. Septic tanks are also responsible for contributing to elevated levels of fecal coliform bacteria. Urban runoff contributes high levels of heavy metals and petroleum products. The previously discussed factors are suspected to have impacted on fisheries. Historical (1980-1989) water quality parameters for the South Relief Canal are listed below:

Turbidity	3.5 ntus	pH	7.5	Alkalinity	164 mg/L
SDD	0.6 m	TN	1.08 mg/L	Color	55 pcus
TP	0.26 mg/L*	TSS	9 mg/L	Chlorophyll	4 ug/L
D.O.	5.5 mg/L	FC	83 per 100 ml	B.O.D.	1.1 mg/L
Conductivity	1,313 ohms	WQI	47 (Fair)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

Fellsmere Farms Water Control District Basin

The C-54 (Fellsmere) Canal is located within the Fellsmere Farms Water Control District (FFWCD) and discharges approximately 88 MGD. This canal has an extensive network of "feeder" canals which combine to give the C-54 Canal the single largest average surface water discharge of any natural or anthropogenic drainage feature within the County.

- Service Area

The FFWCD is divided into two (2) sub-basins. The north-south boundary separating the two (2) sub-basins is located one and one-half (1½) miles west of the City of Fellsmere between the Brevard County line to 1½ miles south of the City of Fellsmere. The east-west watershed boundary is located 1½ miles south of the City of Fellsmere and goes from the eastern boundary of the District to 1½ miles west of the City of Fellsmere. The northeast sub-basin covers about one-third (1/3) of the area of the FFWCD. The southwest sub-basin covers the remaining area of the FFWCD.

The FFWCD is an area of approximately 50,000 acres located between I-95 and Blue Cypress Lake. The FFWCD extends from the Brevard County line to four (4) miles north of SR 60. This district is ten (10) miles long east to west along the Brevard County line and eight and one-half (8½) miles

wide north and south along the eastern boundary. The southern half of the eastern boundary abuts the Vero Lakes Estates subdivision. The southwest boundary varies from one-half (½) to two (2) miles east of Blue Cypress Lake.

- Natural Features

The five (5) main soil types occurring within the basin are as follows: Terra Ceia-Gator-Canova; Widner-Riviera-Manatee; Riviera-Pineda-Wabasso; Eau Gallie-Oldsmar-Wabasso; and Immokalee-Myakka-Satellite. These soils are generally "poorly" drained with water table elevations ranging from two (2) feet above to three and one-half (3½) feet below the ground surface. The lower watertable elevations occur along the northeast boundaries of the FFWCD and southwest of the City of Fellsmere. The topography of the area is generally flat with an average elevation of 20 NGVD.

- Structural Features

The FFWCD stormwater management system contains five (5) north-south lateral canals spaced two (2) miles apart. Connected to these lateral canals are approximately 30 east-west ditches spaced every one-quarter (¼) mile. The Fellsmere Canal along the Brevard County line discharges east into the C-54 Canal which then discharges into the North Prong of the Sebastian River at a point one-half (½) mile north of the Indian River County line. A silt trap and salinity weir are in place at the downstream intersection of the Fellsmere canal and the C-54 canal. The salinity weir prevents backflow of brine from the C-54 canal to the Fellsmere canal. Pumping water from the watershed west and south of the City of Fellsmere into the Fellsmere Canal was discontinued in 1987.

The northeastern watershed drains north by gravity into the Fellsmere Canal. The remaining two-thirds (2/3) of the FFWCD is pumped into the St. Johns Water Management Area (SJWMA) and the Blue Cypress Water Management Area (BCWMA).

- Flood Zones

The City of Fellsmere has been a participant in the Federal Flood Insurance Program since October of 1993.

Within the banks of the C-54 Canal, which traverses the northern boundary of the FFWCD, the FIRM indicates a base flood elevation of 25 feet for the 100 year storm event. A north-south levee extends the entire width of the FFWCD, one and one-half (1½) miles west of the City of Fellsmere. A base flood elevation of 23 feet has been established throughout the entire FFWCD west of the levee. For three (3) miles beginning at the south boundary of the District, CR 512 runs adjacent to this levee.

The 100 year floodplain continues east of the levee up to the west limits of the City of Fellsmere. There are no base flood elevations determined here. Of the remaining areas within the District, about

30 percent are within the 100 year floodplain with no base flood elevations established. This area is approximately two (2) miles wide from the west limits of the City of Fellsmere to the eastern boundary of the District. The areas which are outside of the 100-year floodplain occur between the east-west canals which are spaced one-quarter (¼) mile apart.

- Land Use

There are 15 agricultural operations located within this basin with an average size of 1,400 acres. The City of Fellsmere is located at the junction of CR 507 and CR 512. Following are 1994 estimated acreages of land uses within this basin:

LAND USE	ESTIMATED ACREAGE
Citrus	7,046
Pasture	4,858
Rangeland	7,149
Residential	656
Open Water/Wetlands	858
Other	321
TOTAL	20,888

Source: SJRWMD (1994)

- Operating Entities and Jurisdictional Responsibilities

Indian River County maintains 23 miles of unimproved roadways under an intergovernmental agreement with FFWCD. The county also maintains swales along CR 507 and CR 512 throughout the FFWCD. In addition, the County maintains the drainage improvements associated with Tropical Village Estates Subdivision, located on the south side of CR 512, just east of the Fellsmere City Limits. The City of Fellsmere maintains all other streets within the city limits. The remaining roadways within the FFWCD are owned and maintained by individual private property owners.

The SJRWMD maintains reservoirs located in the 6,280 acre St. Johns Water Management Area (SJWMA). All of the remaining drainage facilities are maintained by the FFWCD.

- Capacity Analysis

The stormwater management facilities operated by the FFWCD have a design capacity of one-quarter (¼) inch of runoff in 24 hours.

- Water Quality

Agricultural-based pollutant loadings contribute more than 95 percent of the total for nutrients (TN and TP), TSS, and flow. Within the FFWCD, the Lateral "U" contributes the highest loadings of TSS, followed by the Fellsmere canal. The Fellsmere canal is the primary contributor of flow and TN loadings. The Fellsmere canal is also the largest overall contributor of flow and TN to the IRL watershed.

Listed below are the water quality parameters for the Fellsmere Canal:

Turbidity	4.1 ntus	pH	7.3	Alkalinity	N/A
SDD	0.9 m	TN	2.55 mg/L*	Color	100 pcu
TP	0.10 mg/L	TSS	8 mg/L	Chlorophyll	4 ug/L
D.O.	5.7 mg/L	FC	N/A	B.O.D.	N/A
Conductivity	815 ohms	WQI	55 (Fair)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

Listed below are the water quality parameters for the C-54 Canal:

Turbidity	3.4 ntus	pH	7.3	Alkalinity	N/A
SDD	0.7 m	TN	2.26 mg/L	Color	70 pcu
TP	1.37 mg/L*	TSS	44 mg/L	Chlorophyll	6 ug/L
D.O.	5.1 mg/L	FC	N/A	B.O.D.	N/A
Conductivity	15,400 ohms	WQI	59 (Fair)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

St. Johns River Watershed

Delta Farms Basin

- Service Area

The Delta Farms basin borders SR 60 on the south, 122nd Avenue on the east, CR 512 on the west and the Blue Cypress Water Management area on the north. The DFWCD is one and one-half (1½)

miles long north to south and three (3) miles wide east to west, and encompasses an area of 2,830 acres.

- Natural Features

According to the Soil Survey of Indian River County, there are two (2) main soil types located in the Basin. The western 10 percent is Terra-Ceia-Gator-Canoa. The remaining 90 percent is Rivera-Pineda-Wabasso. The Soil Survey indicates that there are high water table elevations ranging from the ground surface to one (1) foot below in the Riviera-Pinenda-Wabasso soils and from the ground surface to two (2) feet above in the Terra-Ceia-Gator-Conoa series.

- Structural Features

The area was historically a part of the St. Johns Marsh, however, a perimeter dike now surrounds the entire basin. This basin is drained across the north perimeter dike to the Blue Cypress Water Management Area (BCWMA) by four (4) mechanical pumps. Water management practices maintain the water levels one (1) foot below the ground surface for agricultural purposes.

- Flood Zones

According to FIRMs, the entire district is located within the 100 year floodplain. No base flood elevations have been determined for this basin.

- Land Use

The eastern two-thirds (2/3) of this sub-basin consist of shallow ponds surrounded by pasture. There are 600 acres of citrus in the middle of the district. The western one-third (1/3) of this sub-basin is used as pasture.

- Operating Entities and Jurisdictional Responsibilities

The district operates under the permitting authority of the SJRWMD. There are no county rights-of-ways or county drainage facilities within the boundaries of the district.

- Capacity Analysis

The 150,000 GPM pumping capacity is capable of removing 2.75 inches of runoff in 24 hours.

- Water Quality

No water quality data is available for this basin.

Blue Cypress Marsh Basins

- Service Area

The St. Johns Marsh extends from the St. Lucie County line to the Brevard County line. North of SR 60, the west boundary of the marsh is approximately five (5) miles east of the Osceola County line. Two (2) one-half (½) mile wide prongs of the marsh extend about three (3) miles farther west along Blue Cypress Creek and Padgett Branch Creek. South of SR 60, the west boundary varies from two and one-half (2½) to four (4) miles east of the Okeechobee County line. North of SR 60, the FFWCD borders the marsh to the east. South of SR 60, the SJWCD borders the marsh on the east. Within the marsh halfway between SR 60 and the Brevard County line, Blue Cypress Lake is two and one-half (2½) miles wide east to west and four (4) miles long north to south.

Following are the four (4) marsh areas associated with the Upper St. Johns River Basin in Indian River County:

- Fort Drum Marsh Conservation Area (FDMCA) Sub-basin

This sub-basin is 19,670 acres lying between the Florida Turnpike on the south and SR 60 on the north. The east boundary of FDMCA is just west of the existing C-52 floodway.

- Blue Cypress Marsh Conservation Area (BCMCA) Sub-basin

This sub-basin is approximately 29,500 acres between SR 60 and Fellsmere Grade. The area includes Blue Cypress Lake and the surrounding marsh.

- Blue Cypress Water Management Area (BCWMA) Sub-basin

The BCWMA sub-basin contains approximately 9,735 acres, and is located north of SR 60 and east of BCMCA. Almost half of the area is east of SR 512.

- St. Johns Water Management Area (SJWMA) Sub-basin

SJWMA is 6,280 acres located just south of Fellsmere Grade and east of BCMCA and includes the Stick Marsh and areas formerly in agricultural production.

- Natural Features

Blue Cypress Lake is the only sizeable fresh-water lake in Indian River County. The lake has an area of 6,555 acres, is 24 feet above sea level, and is about eight (8) feet deep over much of its area.

The Terra Ceiva-Gator-Canova soil series occurs over approximately 80 percent of the marsh. This organic soil is classified as being "very poorly" drained. The Florindana-Delray-Holopawsecond soil series is found along Blue Cypress Creek and Padgett Creek. This soil is classified as "poorly" to "very poorly" drained. According to the Soil Survey, the water table elevations for both types of soils range from two (2) feet above the ground surface to one (1) foot below the surface.

The depth of water has not been determined for most of the marsh. From a study of topographic maps of the area, the elevation of the drained marshland that adjoins the present marsh is estimated at about 22 feet above MSL, or less. Presumably, the bottom of a large part of the present marsh is at about the same elevation. When the water surface is at an elevation of 24 feet above MSL, water is probably at least two (2) feet deep over much of the marsh.

- Structural Features

Figure 4 depicts the locations of the Blue Cypress Marsh basins and their associated water control structures is contained in Figure 4.

- FDMCA Sub-basin

Forth Drum Creek drains an area of Okeechobee County into the marsh from the southwest. The C-52 floodway is located just east of the FDMCA boundary. Drainage facilities of the Florida Turnpike are within this sub-basin.

- BCMCA Sub-basin

Blue Cypress Creek and Padgett Branch Creek drain the area of Indian River County west of the BCMCA into Blue Cypress Lake. Levees exist along the west and south boundaries of the FFWCD where that district borders the BCMCA. Another levee beginning north of Blue Cypress Creek reaches to the Brevard County line on the west side of the BCMCA. A privately constructed drainage structure is located at the northeast corner of the BCMCA on the Brevard County line.

- BCWMA Sub-basin

East of CR 512, a levee exists along the north, east, and south boundaries of the BCMCA.

- SJWMA Sub-basin

On the east boundary of the SJWMA is canal C-65, located between two (2) levees L-75 and L-76. On the north boundary along the Brevard County line is levee L-74E. A gated spillway (S-96) is located in the northeast corner of the SJWMA and allows discharges into the C-54 canal during high flood stages.

- Flood Zones

According to FIRMs, all of the marsh is within the 100-Year floodplain. South of SR 60 to the St. Lucie County line, no base flood elevation has been determined. From SR 60 to the south shore of Blue Cypress Lake, the base flood elevation varies from 28-29 feet NGVD. From the south shore to the north shore of Blue Cypress Lake, the base flood elevation ranges from 28 feet to 27 feet. From the north shore of Blue Cypress Lake to 2½ miles south of the Brevard County line, the base flood elevation ranges from 27 feet to 26 feet. Then from 2½ miles north of Blue Cypress lake to Brevard County line, the base flood elevations ranges from 26 feet to 25 feet. No base flood elevations have been determined for the marsh areas along Blue Cypress Creek and Padgett Branch Creek.

- Land Use

This Basin was purchased by the SJRWMD for flood control and water conservation purposes under the Upper St. Johns River Basin Project. A fishing camp and county park are located on the west shore of Blue Cypress Lake. SR 60 passes through the marsh five 5½ miles north of the St. Lucie County line, while the Florida Turnpike passes through the marsh along the St. Lucie County line just within Indian River County. A five (5) mile unimproved county road connects the Blue Cypress Park to SR 60, but only a small portion of this road passes through the marsh.

- Operating Entities and Jurisdictional Responsibilities

Operation of the water management areas and marsh conservation areas is the responsibility of the SJRWMD. The facilities along the Florida Turnpike and SR 60 are maintained by FDOT. C.R. 512, Blue Cypress Lake Park, and Blue Cypress Road are maintained by Indian River County.

- Capacity Analysis

The drainage capacity of the Upper St. Johns River Basin Project has been designed to reduce the 100-year flood stage in the SJWMA to 25.3 feet NGVD and to 28.7 feet NGVD in the BCWMA. The project's flood protection levees are designed to provide flood protection for the Standard Project Flood which has a return period in excess of 200 years. The project is forecasted to result in reductions of discharge into the C-54 canal by 100 percent during a 10 year/24 hour storm event and by over 60 percent during a 100 year storm event.

- Water Quality

Following are the water quality parameters for Ft. Drum Creek:

Turbidity	2.0 ntus	pH	6.1	Alkalinity	33 mg/L
SDD	0.3 m	TN	1.14 mg/L	Color	250 pcu
TP	0.18 mg/L	TSS	2 mg/L	Chlorophyll	1 ug/L
D.O.	4.0 mg/L*	FC	220 per 100 ml*	B.O.D.	N/A
Conductivity	190 ohms	WQI	56 (Fair)		

Following are the water quality parameters for the Ft. Drum Marsh:

Turbidity	1.6 ntus	pH	6.2	Alkalinity	20 mg/L
SDD	0.6 m	TN	1.61 mg/L*	Color	259 pcu
TP	0.05 mg/L	TSS	3.0 mg/L	Chlorophyll	4 ug/L
D.O.	2.5 mg/L*	FC	N/A	B.O.D.	1.6 mg/L
Conductivity	325 ohms	WQI	56 (Fair)		

Following are the water quality parameters for Blue Cypress Lake:

Turbidity	2.8 ntus	pH	7.3	Alkalinity	39 mg/L
SDD	0.8 m	TN	1.20 mg/L	Color	200 pcu
TP	0.08 mg/L	TSS	2.0 mg/L	Chlorophyll	3 ug/L
D.O.	7.4 mg/L	FC	1 per 100 ml	B.O.D	1.1 mg/L
Conductivity	289 ohms	TSI	46 (Good)		

Source: FDEP 305(b) Report (1996) * exceeds screening criteria

St. Johns Water Control District Basin

- Service Area

The St. Johns Water Control District (SJWCD) includes 27,840 acres located between SR 60 and the St. Lucie County line and between the west boundary of the IRFWCD and the Range 38 East/Range 37 East line. This area is 5½ miles north to south and varies from 7 to 8½ miles east to west. The St. Johns Marsh borders the IRFWCD's west boundary.

- Natural Features

According to the Soil Survey of Indian River County, the two main soil types that occur in this Basin are Widner-Riviera-Manatee and Riviera-Pineda-Wabasso. The water table within this Basin ranges from two (2) feet above to one (1) foot below the ground surface.

- Structural Features

The SJWCD is divided by north-south lateral canals spaced every mile which connect to an east-west main floodway located along 9th Street SW (Oslo Road). Discharges are pumped into the Fort Drum Marsh Conservation Area (FDMCA) and the Blue Cypress Water Management Area (BCWMA) to the west and north, respectively.

The SJWCD is surrounded on all four (4) sides by a perimeter dike elevated to 31 feet MSL. The main floodway levees are at 34 feet MSL on the east end and 31 feet MSL on the west end. A large reservoir covering an area of 2 3/4 square miles is located at the west end of the main floodway. North-south lateral canals with a minimum depth of eight (8) feet are spaced approximately every one (1) mile apart along the main floodway. Water levels in these laterals are controlled by pumping and gated culverts. The two (2) sources of irrigation water include rainfall impounded in the reservoir to the west of the main floodway which is regulated by gates and gravity flow from the FDMCA and the BCWMA.

- Flood Zones

The entire district is located in the FIRM 100-year zone with no base flood elevations determined.

- Land Use

The district has been developed exclusively for citrus groves. There are no significant residential developments in this district.

- Operating Entities and Jurisdictional Responsibilities

Within the district, the SJRWMD has jurisdiction and permitting authority over uses involving the FDMCA and BCWMA. The St. Johns Water Control District (SJWCD) maintains the reservoir, the north-south lateral canals, the main floodway and two (2) bridges across the main floodway, and the graded marl roads within 60 foot roadway easements. The 60 foot roadway easements are located around the perimeter of each square mile block. Indian River County has no rights-of-way nor facilities in the district.

- Capacity Analysis

The main floodway, the north-south lateral canals, and the pumping stations all have a design capacity capable of removing four (4) inches of runoff in 24 hours.

- Water Quality

Listed below is an average of the water quality parameters measured at the SJWCD spillway from January 1996 to January 1997:

pH	6.1
Turbidity	3.0 ntus
TSS	4.5 mg/L
B.O.D.	4.1 mg/L
TN	1.7 mg/L
TP	0.2 mg/L
D.O.	5.5 mg/L

Source: SJWCD/Envirometrics (1997)

Talbot Terrace Basin

- Service Area

This Basin is 4½ to 5½ miles wide and extends from the Brevard County line on the north to the Okeechobee County line on the South.

- Natural Features

Between the Osceola County line and the western edge of the St. Johns Marsh, the surface elevations are about 40 feet NGVD. Blue Cypress Creek and Padgett Branch Creek drain into Blue Cypress Lake.

"Poorly" drained soil series occurring within this Basin include Myakka-Immokalee and Myakka-Holopaw-Pompano. The Florindana-Delray-Holopaw series also occurs within this Basin and is classified as being "very poorly" drained. All of the basin drains east into the St. Johns Marsh. High water table elevations according to SCS Soil Survey range from one (1) foot below the ground surface to two (2) feet above the ground surface.

- Structural Features

Other than SR 60, the Florida Turnpike, and private ranches, no significant stormwater management facilities have been constructed in this Basin.

- Flood Zones

The 100 year floodplain covers approximately 25 percent of the area in localized low areas spread throughout the basin.

- Land Use

The Talbot Terrace is primarily utilized for pasture land. There are no significant residential areas within this Basin. The Florida Turnpike, SR 60, and Blue Cypress Lake Road pass through this Basin.

- Operating Entities and Jurisdictional Responsibilities

This Basin lies within the jurisdictional boundaries of the SJRWMD. The FDOT is responsible for maintaining drainage facilities located along the Florida Turnpike and SR 60. Indian River County is responsible for maintaining drainage facilities located along Blue Cypress Lake Road.

- Capacity Analysis

Capacity for the Florida Turnpike and SR 60 drainage systems are designed to meet FDOT criteria.

- Water Quality

Following are the water quality parameters for Padgett Branch Creek:

Turbidity	1.1 ntus	pH	5.6	Alkalinity	9 mg/L
SDD	0.3 m	TN	1.21 mg/L	Color	500 pcu
TP	0.07 mg/L	TSS	2.0 mg/L	Chlorophyll	3 ug/L
D.O.	2.7 mg/L	FC	320 per 100 ml *	B.O.D.	1.1 mg/L
Conductivity	130 ohms	WQI	36 (Good)		

* exceeds screening criteria

Following are the water quality parameters for Blue Cypress Creek:

Turbidity	1.3 ntus	pH	6.8	Alkalinity	26 mg/L
SDD	N/A	TN	1.34 mg/L	Color	250 pcu
TP	0.06 mg/L	TSS	2.0 mg/L	Chlorophyll	5 ug/L
D.O.	2.2 mg/L*	FC	N/A	B.O.D.	N/A
Conductivity	134 ohms	WQI	56 (Fair)		

* exceeds screening criteria

Source: FDEP 305(b) Report (1996)

The water quality parameters for Blue Cypress Lake are listed under the Blue Cypress Marsh Basin section.

ANALYSIS

Drainage Network

The Indian River Farms Water Control District (IRFWCD) is the largest F.S. 298 Special Drainage District in the County and currently manages over two-thirds of the county's urban canal system. The Main Relief Canal discharges approximately 51 MGD of surface water per day into the IRL. Discharges from the North and South Relief Canals into the IRL average 20 MGD and 26 MGD, respectively. Combined, surface water discharges from its three (3) relief canals average nearly 100 MGD. Notwithstanding, the amount of water discharged from the three canals varies by month and day, depending on such factors as agricultural use schedules and storm events.

Water quality of discharges varies greatly according to several factors, including drainage area size and land use, duration and intensity of precipitation, and whether the drainage network is rural or urban. A rural drainage network usually consists of a semi-pervious surface, graded to direct runoff into unimproved (open, permeable) canals or swales. Urban drainage systems often consist of impermeable, enclosed structures, such as pipes and culverts, which collect substantial amounts of runoff from impervious, "urbanized" areas. Water quality from urban runoff is often of poor quality, since little, if any, natural filtration or percolation occurs.

During periods of reduced precipitation, canal systems generally carry large volumes of irrigation water, much of which is withdrawn from the Floridan aquifer. However, during periods of increased rainfall, these canals convey more stormwater runoff, which results in a "flushing" of contaminants to the IRL.

An Engineering Drainage Study (EDS Phase III, Final Report) of 1982 described the IRFWCD canal system, which was designed and implemented in the 1920's for rural agricultural use, as insufficient to accommodate the increased stormwater runoff created by expanding urbanized areas.

Figure 3.E.8 displays the drainage canal network of Indian River County.

Existing Needs

Sebastian River Water Control District Basin

Improve stormwater management facilities in Whitfield's subdivision.

St. Sebastian River Basin

Throughout this basin, there is need for improved maintenance of existing stormwater management facilities.

Within the Roseland area, improvement of existing swales is required along 128th Street and Gibson Street. Also, utilization of retention/detention facilities will be emphasized to regulate discharge so that the capacity of the existing culverts under Roseland Road are not exceeded.

Barrier Island Basins

- Sub-basin B-1 (South Beach area)

Stormwater management facilities west of SR A1A will upgraded to provide retention and treatment to improve the quality of stormwater runoff outfalling to the IRL.

- Sub-basin B-2 (Town of Indian River Shores)

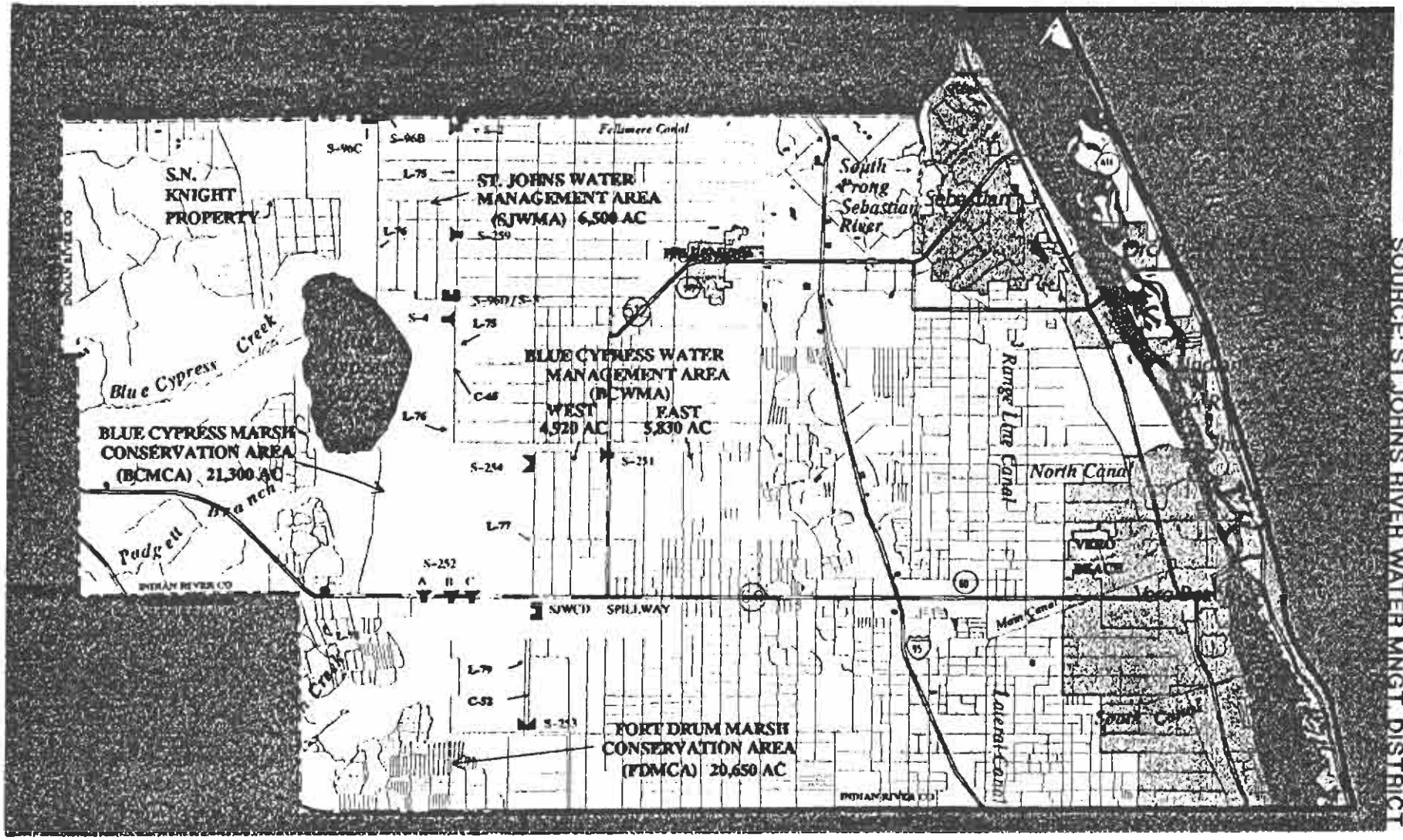
Ongoing maintenance of private retention facilities is needed to ensure stormwater runoff outfalling to the IRL is adequately treated.

- Sub-basin B-3 (Ambersand Beach area)

No existing needs have been identified for this sub-basin.

St. Johns River
Water Management District

Water Control Structures



County boundary

Road

District boundary

Water

1990 Census-based urbanized area

Weir

Culvert

Spillway

Mainland IRL Basins

- Sub-basin R-1 (South County)

Along the Old Dixie Highway (CR 605) corridor, west of the FEC Railroad, drainage improvements will be made to provide for storage and positive drainage for a 25 year/24 hour storm event. This project will be included within the road improvement project for Old Dixie Highway. Also, drainage improvements are needed in the vicinity of 19th Avenue, north of 37th Street.

Stormwater management facilities need to be upgraded in the following subdivisions: Midway Estates Mobile Home Park, Vero Shores, River Shores, Rockridge, and Country Club Pointe.

- Sub-basin R-2 (Gifford/Wabasso)

Improvements to stormwater management facilities in the Gifford area (41st, 45th, and 53rd Streets) and along Indian River Boulevard are currently in the process of being upgraded.

- Sub-basin R-3 (Roseland area)

Outfall culverts beneath Indian River Drive will be replaced. Since additional discharge to the Indian River is not proposed, culvert sizes will not be increased.

Indian River Farms Water Control District Basins

For any culvert proposed to be installed in the District's sub-lateral canals, the District requires the following:

- RCP of 84 inches for all sub-lateral canals located within one-half (½) mile of a lateral canal (within (one) 1 mile of the Lateral "D" canal for sub-lateral canals D-4 and D-5);
- RCP of 72 inches for all sub-lateral canals located between ½ mile to one (1) mile of a lateral canal (between one (1) and two (2) miles of the Lateral "D" canal for sub-lateral canals D-4 and D-5);
- RCP of 60 inches for all sub-lateral canals located beyond one (1) mile of a lateral canal (beyond 2 miles of the Lateral "D" canal for sub-lateral canals D-4 and D-5).

These sizes would give the sub-laterals near their original design flow capacity.

- Sub-basin C-1 (North Relief Canal)

Stormwater improvements are need in the following single-family subdivisions: Ponderosa Estates, King's Lakes Estates, and King's Musicland. Drainage problems will be corrected for the following arterials and collectors: 19th Avenue (North of 37th Street); 45th Street to MRC (West of the FECRR); and, the Intersection of U.S. Highway 1 and 42nd Place

- Sub-basin C-2 (Main Relief Canal)

Drainage improvements are needed for the following subdivisions:

- Laurelwood
- Pinetree Park
- Sixty Oaks
- Indian River Estates
- Kenilworth Estates

- Sub-basin C-3 (South Relief Canal)

Drainage improvements are needed for the following subdivisions:

- Oslo Park (south of Oslo Road)
- Grovenor Estates
- Indian River Heights
- Steven's Park
- Vero Beach Highlands

Additionally, drainage at the intersection of Old Dixie Highway and 5th Street SW needs to be improved.

Fellsmere Water Control District

Most of the City of Fellsmere and the adjacent unincorporated areas experience drainage problems. The worst problem areas include: Massachusetts Avenue, South Oleander Street, and 89th Street.

Listed on the following page in Table 3.E.1 is the seven year schedule of improvements for stormwater facilities.

Table 3.E.1
Stormwater Management Facilities
Seven Year Schedule of Improvements

Project/Revenue Source	FY 1997/98	FY 1998/99	FY 1999/00	FY 2000/01	FY 2001/02	FY 2002/03	FY 2003/04	Revenue Source
Roseland Watershed Improvements - Swale betterment		$200,000						A
Vero Lake Estates drainage improvements	$110,000	$110,000	$60,000	$60,000	$60,000	$60,000	$60,000	A
Upgrade to recommended sizes all bridges & culverts within the IRFWCD Canal system as existing culverts deteriorate	$25,000	$25,000	$25,000	$25,000				A=50% L=50%
Secondary drainage improvements - 15" to 36" drainage pipes to serve existing development	$25,000	$25,000	$25,000	$25,000	$50,000	$50,000	$50,000	T=25% RB=25% U=50%
41st Street drainage improvements	$100,000							T
45th Street drainage improvements	$100,000							I
37th Street drainage improvements	$300,000							I
CR 512 drainage improvements	$100,000							T
56th Avenue (north of S.R. 60) drainage improvements	$10,000							I
Gifford area drainage improvements	$200,000	$35,000						T
12th Street sublateral culvert enlargement	$75,000							T
Sebastian River flood plain					$100,000			A
58th Avenue drainage improvements	$200,000	$500,000	$250,000					T=50% I=50%
4th Street drainage improvements	$100,000							I
43rd Avenue drainage improvements		$250,000	$250,000					I

Project/Revenue Source	FY 1997/98	FY 1998/99	FY 1999/00	FY 2000/01	FY 2001/02	FY 2002/03	FY 2003/04	Revenue Source
U.S. Highway #1 drainage improvements		$150,000						I
Highland Drive drainage improvements		$200,000						I
Oslo Road (9 ' Street SW) drainage improvements		$100,000						T
Pinecrest Subdivision		$30,000						A
TOTAL	$1,345,000	$1,625,000	$610,000	$110,000	$210,000	$110,000	$110,000	

Revenue Sources:
A - Special Assessment
I - Impact Fees
T - Transportation Improvement
L- One (1) percent Local Option Sales Tax
RB - Revenue Bond
U - Stormwater Utility

Projected Needs

Sebastian River Water Control District Basin

The SRWCD must conduct an inventory of its basin and adopt level of service standards to reduce non-point source loadings.

St. Sebastian River Basin

Indian River County will complete drainage improvements along the CR 512 (Fellsmere Road) corridor within the City of Sebastian to provide for roadway improvements. Major drainage structures passing runoff perpendicular to the roadway will be designed to convey 100-year storms to major floodways such as Collier Creek, and secondary drainage facilities will be designed for the 10 year/24 hour rainfall event. For the 20-year planning period, this is the only drainage improvement planned by Indian River County within the City of Sebastian Watershed. No improvements are scheduled within 20 year planning horizon by Indian River County for the St. Sebastian River Buffer Preserve.

Barrier Island Basins

- Sub-basin B-1 (South Beach area)

Since future development will consist of low density single-family residents, no long-range needs have been identified for this sub-basin.

- Sub-basin B-2 (Town of Indian River Shores)

No long-range needs have been identified for this sub-basin.

- Sub-basin B-3 (Ambersand Beach area)

No long-range needs have been identified for this sub-basin.

Mainland IRL Basins

- Sub-basin R-1 (South County)

The Channel "H" improvement project will drain the middle western portion of the sub-basin. Intergovernmental coordination will be necessary since both projects will require a connection to the IRFWCD South Relief Canal (SRC).

Mainland IRL Basins

- Sub-basin R-1 (South County)

The Channel "H" improvement project will drain the middle western portion of the sub-basin. Intergovernmental coordination will be necessary since both projects will require a connection to the IRFWCD South Relief Canal (SRC).

The area between the FECRR and the west boundary of this sub-basin is currently not served by an adequate stormwater management system. Major improvements will be made along 8th Street and 12th Street. These improvements will be designed to mitigate the stormwater runoff from a 25 year/24 hour rainfall event, and provide retention/detention for treatment of stormwater runoff.

A significant opportunity exists to improve stormwater quality discharge to the IRL from FDOT outfalls along U.S. Highway 1 by routing stormwater runoff to mosquito control impoundments for retention and filtration.

- Sub-basin R-2 (Gifford/Wabasso)

Stormwater management will be improved at the intersection of U.S. Highway 1 and 42nd Place. Limiting future land use densities combined with proper floodplain management techniques, including preservation of wetlands, and high finished floor elevations, will protect existing and future developments.

- Sub-basin R-3 (Roseland area)

Generally, stormwater management facilities in the vicinity of Roseland need to be improved and maintained. The City of Sebastian is currently in the process of planning the design of a regional stormwater management facility to serve the entire City. The main component of this facility, as proposed, will be a ±200 acre lake.

Indian River Farms Water Control District Basin

The following recommendations were presented in the IRFWCD report.

- The District needs to be cautious of over sizing sublaterals which would increase flow to the laterals and cause additional flooding of the laterals as well as additional runoff for the District.

- The inverts of proposed culverts in the sub-laterals should be near their original design elevation. The invert of proposed culverts to be installed in the ridge area, i.e. areas between Lateral "A" and (Lateral "G" and Lateral "H") and between Lateral "B" and (Lateral "E" and Lateral "J") should have invert elevations of at least one (1) foot above the control gate's high elevation. This minimum high invert elevation of 17.5 feet needs to be maintained to prevent flow bypassing the radial gates.

- Because of road construction by Indian River County and others, on right-of-way adjacent to canals, the existing canal side slopes are too steep from a safety, as well as aesthetic, standpoint. Many of the sub-laterals will be culverted to eliminating side slope problems.

- The District should seek additional storage area to improve water quality treatment in the canals and to provide storage for quantity abatement. By setting aside approximately four (4) percent of all new development for Water Management downstream of site discharge, the IRFWCD could improve water quality treatment, provide storage for quantity abatement, and provide additional irrigation water.

- Floodplain encroachment below elevations shown on the 100 year stage/contour map will be prohibited. Any fill added under this elevation should be cut at a different location to provide the same storage for flood protection.

- County maintained culverts are to be replaced by new culverts sized in accordance with the 1988 study. Secondary drainage systems must be improved to convey site runoff to the IRFWCD system. Also, storage within the critical flood prone areas will be provided so that future development does not adversely impact the ability of the system to store flood waters. Finally, the IRFWCD must reduce flow and nonpoint source discharge from the North, Main and South Relief Canals.

Fellsmere Water Control District

The City of Fellsmere plans to develop a stormwater master plan.

Water Quality

A number of studies have been conducted by various government agencies. In assessing water quality of Indian River County, these agencies have made the following generalizations: 1) the presence of the "Narrows", located in the vicinity of Vero Beach, results in a decrease in water quality by increasing the residence time of various pollutants; 2) Extensive communities of submerged aquatic vegetation in the IRL function as a sediment stabilizing force to maintain water clarity and also to assimilate nutrients; and, 3) unpaved roads contribute heavy sediment loading to the IRL. Refer to the Coastal Management Element and the Conservation Element

for additional information regarding seagrass beds.

Urban Stormwater Runoff

Throughout the County, urbanized areas (particularly areas developed prior to regulations) contribute the highest pollutant loadings to the IRL. The City of Vero Beach and the City of Sebastian are (on a per acre basis) developed at higher densities and have more impervious surface area. Older developments in the unincorporated County, such as the Moorings development, Vero Beach Highlands subdivision, and Vero Shores subdivision, do not provide adequate treatment of stormwater runoff. Figure 3.E.9 graphically displays the runoff characteristics of impervious surface areas.

According to a SJRWMD report, there is a positive correlation between flow and the following water quality parameters: total nitrogen (TN), total phosphorous (TP), turbidity, total suspended solids (TSS), and fecal coliform (FC). In other words, an increase in flow results in an increase in mobilization and transport. There is a negative correlation for dissolved oxygen (DO) and alkalinity. A negative correlation attributes reduced flow to a decrease in dissolved oxygen and alkalinity. No correlation between increased flow and heavy metals was found. Therefore, reducing the overall amount of flow entering the IRL appears to have a positive effect on water quality.

Agricultural Stormwater Runoff

Generally, pollutant loading rates for pasture are two (2) to five (5) times higher than citrus or row crops. Also, a significant reduction in TP loadings could be achieved through improved nutrient management in the water control districts (SJRMWD, 1994).

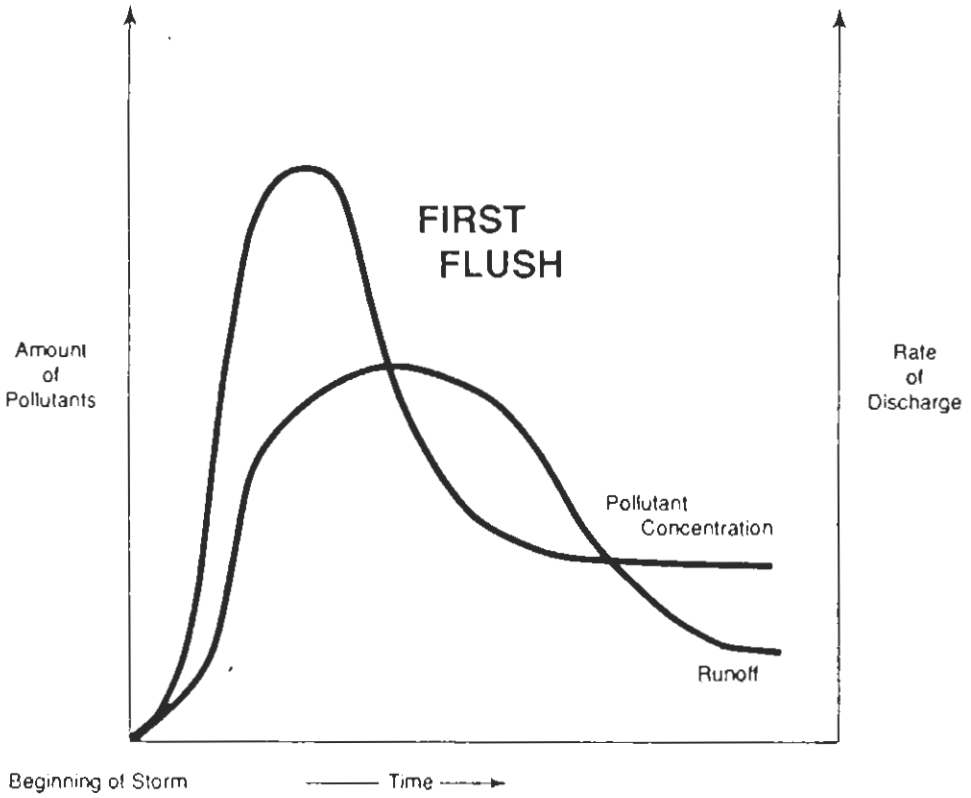
Best Management Practices

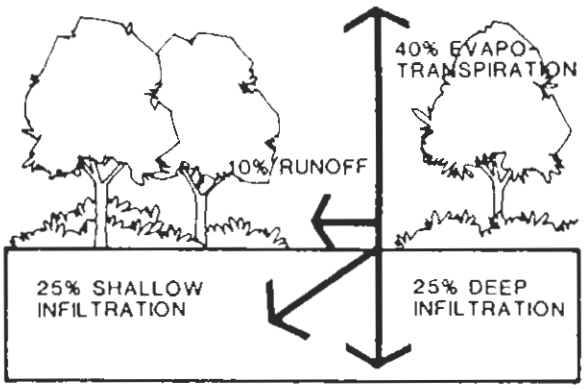
Non-structural best management practices (BMPs) are cost effective prevention-oriented measures, such as land use planning, preservation of wetlands and floodplains, education, and erosion control. Non-structural BMPs for agriculture include controlling the application of herbicides, pesticides, and fertilizers and implementing conservation plans, as recommended by the Natural Resource Conservation Service (NRCS).

According to a SJRWMD report, the following reductions were attributed to the two most common structural BMPs, a vegetated conveyance system (grassed swale) and a wet pond.

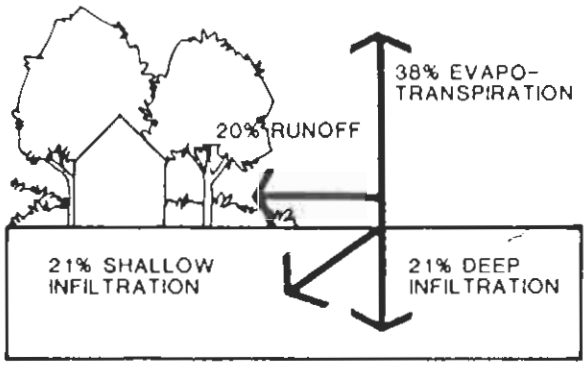
FIGURE 3.E.9

EFFECTS OF URBANIZATION ON STORMWATER QUANTITY

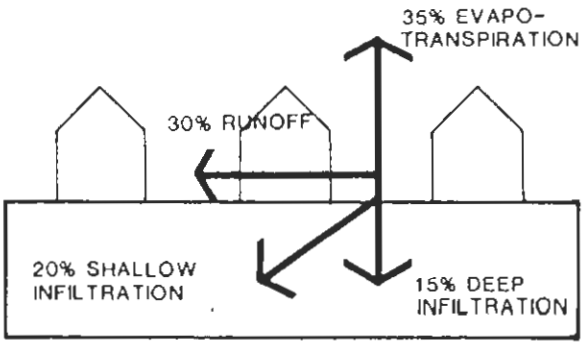




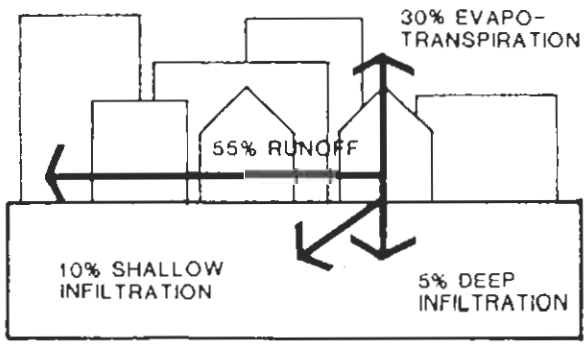
NATURAL GROUND COVER



10% - 20% IMPERVIOUS SURFACE



35% - 50% IMPERVIOUS SURFACE



75% - 100% IMPERVIOUS SURFACE

SOURCE: FDEP

Water Quality Parameter	Grassed Swale	Wet Retention Pond
Total Nitrogen	15 %	30 %
Total Phosphorous	30 %	50 %
Biological Oxygen Demand	45 %	60 %
Total Suspended Solids	80 %	80 %
Flow	20 %	25% (evaporation)

The above listed reductions were attributed individually to each BMP. When combined, the use of several BMPs results in more efficient removal of pollutants. According to the SJRWMD, each farm and water control district should develop its own BMP plan.

Estimated and Projected Annual Pollutant Loadings

Listed below are the current total annual non-point source pollutant loadings to the IRL for Indian River County:

Water Quality Parameter	Total Annual Loading (kg/yr)
Total Nitrogen	363,589
Total Phosphorous	46,679
Total Suspended Solids	7,937,393
Biological Oxygen Demand	1,022,391
Zinc	7,939
Lead	10,806

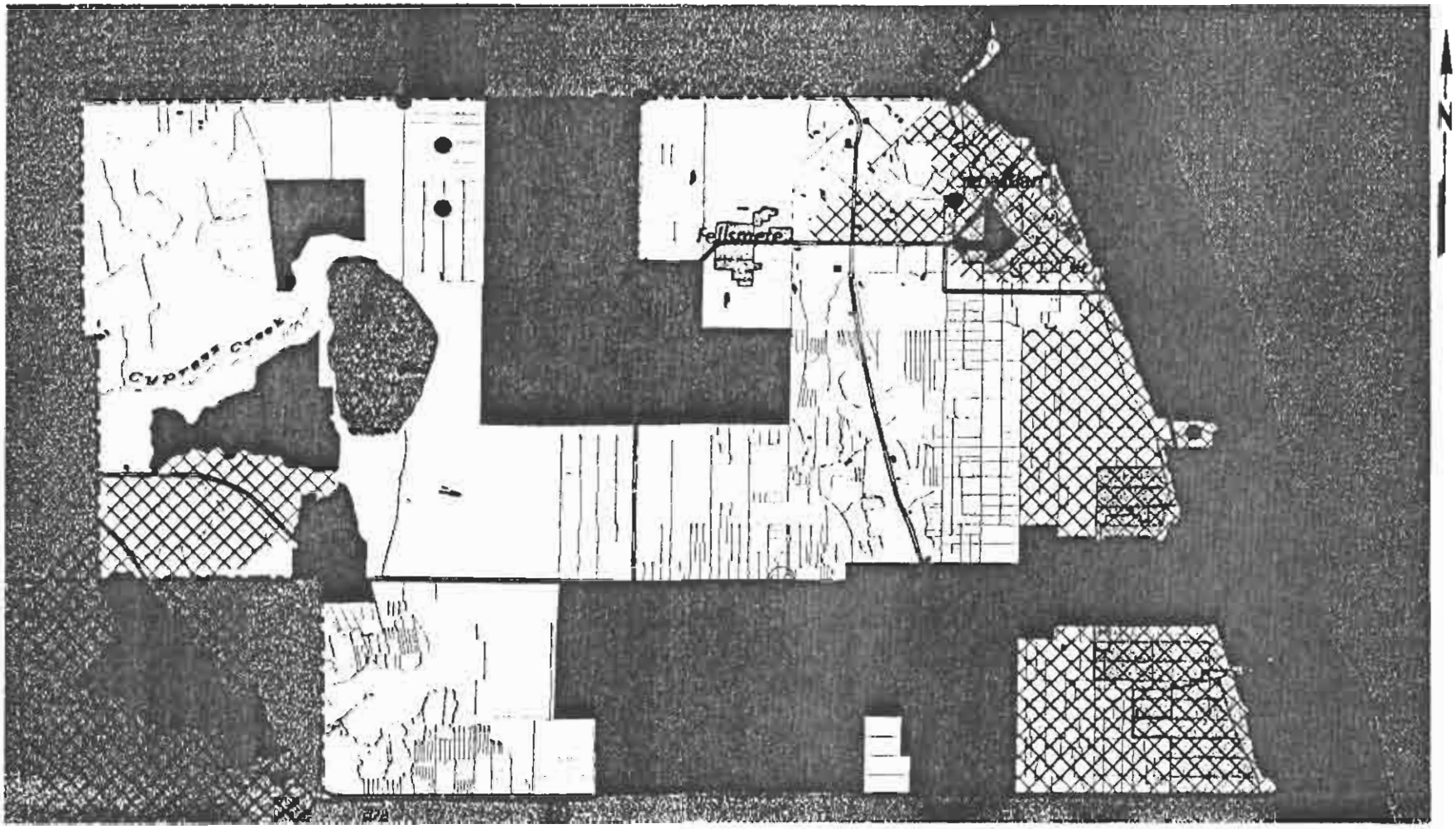
Source: IRLNEP Final Technical Report (1994)

Data from a 1994 IRLNEP study rate the non-point source discharges from Indian River County (Segment 3) as a significant impact to water quality of the Indian River Lagoon (IRL). A generalized map of the existing and future non-point source loading areas of Indian River County is depicted in Figure 3.E.10.

The IRLNEP Final Technical Report also contains area based pollutant loadings based on existing and future land use (2010) for sub-basins. These data are contained in the Technical Appendix section of this sub-element.

FIGURE 3.E.10

Existing and Potential Future Nonpoint Source Pollutant Loading Indian River County



SJRWMD Stormwater Modeling Results

High estimated existing nonpoint source pollutant loads compared to the rest of the District

Areas with projected future loads equal to or greater than existing areas with high estimated loads

SJRWMD Water Quality Analysis Results

STORET water quality stations with elevated pollution levels

County boundary

Road

District boundary

Water

1990 Census-based urbanized area

SOURCE: ST. JOHNS RIVER WATER MNGT. DISTRICT

NOTE:
This map does not show confirmed surface water quality problem areas. Instead it displays areas with high relative nonpoint source loading. The results were generated by a computer model.

This map can be used as a screening tool for further stormwater analysis. Furthermore surface water quality problems may occur outside these areas since other factors may contribute to water quality conditions.

Existing and potential future nonpoint source pollutant loading areas were not identified for each county. Instead, watersheds with the highest estimated loads were identified for the District. Shaded areas on the map indicate possible contributions to Districtwide problems.

Water quality analysis results are based on nutrient-related data (nitrogen, phosphorus, and chlorophyll a) for which there are no numerical state standards.

Surface Water Use Classifications

All surface waters within the Aquatic Preserves in Indian River County have been designated by the FDEP as being either Class II - Shellfish Propagation or Harvesting, or Class III - Recreation/ Propagation and Management of Fish and Wildlife. Management standards for Class II waters are much more restrictive than standards for Class III waters. Class II water standards place more stringent limitations on bacteriological and chemical pollution. Class III water quality standards are intended to maintain suitability for sports and recreation, and production of diverse fish and wildlife communities.

The portion of the IRL extending from approximately Grand Harbor south to the county line, and west of the Intracoastal Waterway (ICW) channel north of Wabasso Causeway is rated Class III by the FDEP. "Class II" waters (of better quality than Class III) are located north of Grand Harbor to the Wabasso Causeway, and east of the ICW north of the Wabasso Causeway (within the Pelican Island National Wildlife Refuge). The Class II waters within the refuge are conditionally approved for shellfish harvesting. Furthermore, the waters of the IRL within the unincorporated County, excluding artificial canals, have an FDEP-designated status of "Outstanding Florida Waters" (OFW). Figure 3.E.11 depicts the location of the areas of the IRL with a Class II and Class III designation.

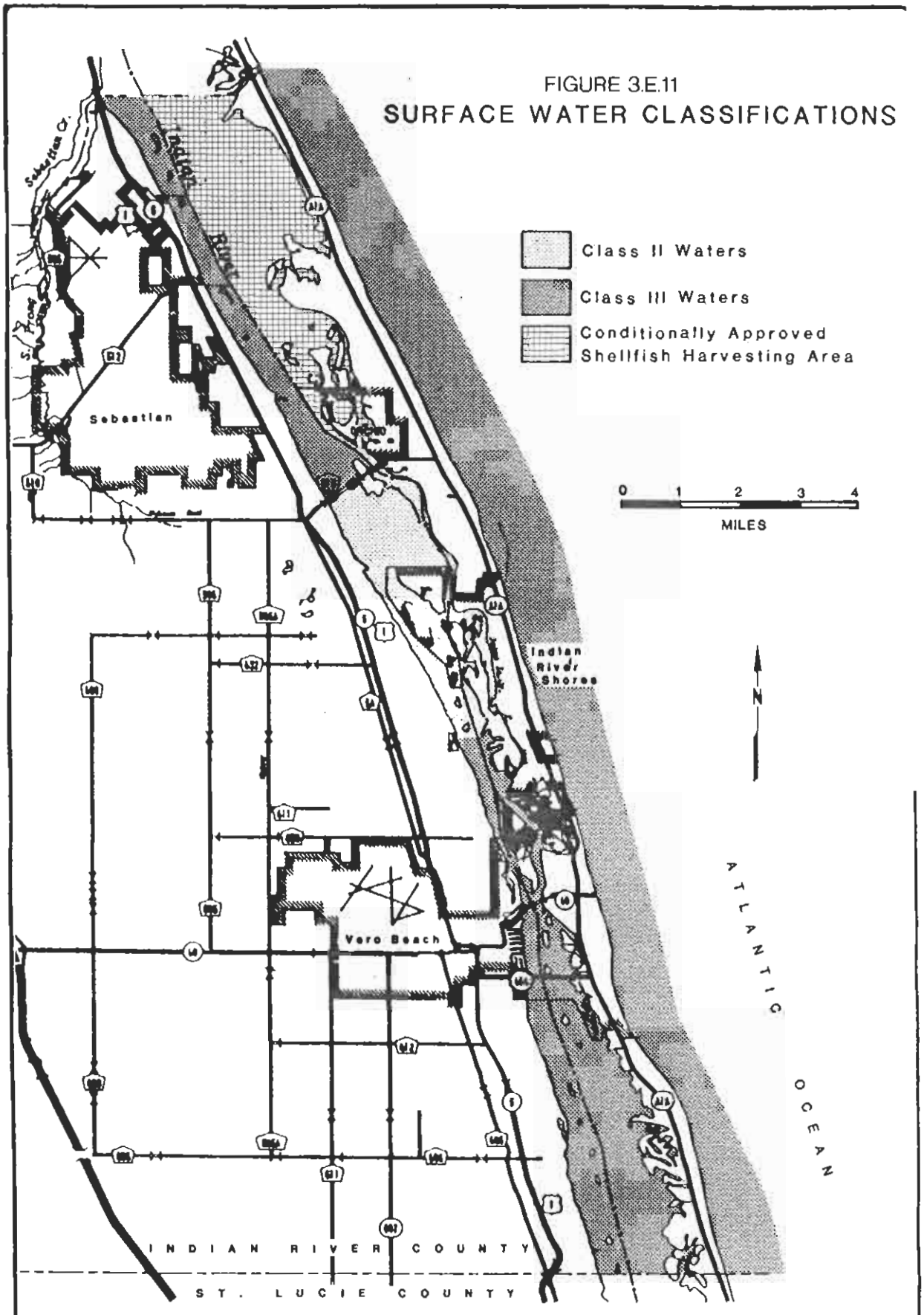
The water quality of Indian River County was documented in the 1994 Water Quality Assessment for the State of Florida (Section 305(b) Report) (FDEP, 1994). The status of waters within a basin or sub-basin was based on whether or not the particular receiving waterbody supports its designated use. The following categories were used by the FDEP to rate waterbodies:

- "GOOD" (meets designated use). All surface waters in the basin are supporting their use classification with no evidence of non-point source problems.
- "THREATENED" (meets designated use). All surface waters in the basin currently meeting their use classification. However, at least some of the surface waters within the watershed are not expected to support their designated use classification within five (5) years without future management activities.
- "FAIR" (partially meets designated use). Some, but not all, surface waters are supporting their designated use.
- "POOR" (does not meet designated use). All surface waters in the watershed are not supporting their designated use.

The Section 305(b) Report classifies the overall water quality of the IRL within the County as being "fair". An explanation of the water quality parameters used to derive the overall water quality rating is contained in the Technical Appendix.

FIGURE 3.E.11

SURFACE WATER CLASSIFICATIONS



Source: Florida Game and Fresh Water Fish Commission

Sept. 15, 1987

Boyle Engineering Corporation

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INDIAN RIVER COUNTY
FLORIDA

Stormwater Management Regulations

Federal, state, regional and local regulations address two primary issues: (1) flood protection (quantity) and (2) environmental (quality) issues. Issues relating to coastal flooding hazards are discussed in the Coastal Management Element. The following section discusses and analyzes existing and proposed stormwater management regulations:

Federal

- Federal Emergency Management Agency (FEMA)

The National Flood Insurance Program (NFIP) regulations address water quantity impacts of stormwater management. NFIP regulations require participating local government to adopt a flood protection ordinance. An adopted flood protection ordinance delegates authority to the local governments to regulate floodway encroachments, provide adequate flood protection for new development, and to eliminate the adverse flooding effects of the 100 year storm event. Coastal High Hazard Areas (CHHAs) are further regulated so that storm surge damage is minimized. In return for the local government's participation in the NFIP, property owners can obtain flood insurance at reduced rates.

In 1988, backwater analysis, computer modeling and storm surge analysis were performed by Gee and Jensen Engineers, Inc. to inventory, measure and analyze all of the major floodways throughout the County. This analysis amended the boundaries of the 100 year floodplain on the County's Flood Insurance Rate Maps (FIRMs). As a result, the County amended its Stormwater Management and Floodplain Protection ordinance in 1990 to ensure proper local regulatory control.

The principal weakness of the FEMA program is that it subsidizes development, excepting COBRA zones, in flood prone areas. By providing flood insurance that would not be available (at reasonable rates) from the private sector, the program encourages construction areas prone to flooding. However, the program is beneficial from the perspective that it ensures that construction and public facility improvements in flood hazard areas are adequately floodproofed. Also, the NFIP provides technical data, applicable to all stormwater activities in the county.

- U.S. Army Corps of Engineers (ACOE)

The ACOE serves as the lead agency for regulating filling and dredging activities in wetland areas under the National Wetlands Protection Act (volume 40 of the Code of Federal Regulation).

- Environmental Protection Agency (EPA)

The U.S. EPA may, at its discretion, review and comment on dredge and fill permit applications. The EPA also administers the provisions of the Federal Water Pollution Control Act of 1972,

commonly referred to as the Clean Water Act (CWA). The CWA established water pollution control programs with the objective to "restore and maintain the chemical, physical and biological integrity of the Nation's waters." Also, the CWA provided individual citizens the opportunity to initiate lawsuits to demand cleaner watersheds.

The CWA granted the EPA authority to delegate enforcement responsibility to individual states. In 1987, Congress amended the CWA under Section 402(p) to regulate stormwater runoff under the National Pollutant Discharge Elimination System (NPDES) permitting program. In November 1990, the EPA issued Phase II NPDES regulations which required medium-sized municipalities (population 100,000 to 250,000) to obtain a permit for the discharge of municipal stormwater. Although the EPA originally intended to complete Phase II NPDES permitting by 1992, the EPA, in 1994, extended the deadline until 2001. In the interim, the EPA is to finalize Phase II rules, which outline the responsibilities of medium-sized municipalities, by March 1999. Notwithstanding, the U.S. Congress may, at its discretion, amend the CWA before that time.

State of Florida

- Florida Department of Environmental Protection (FDEP)

Under Chapter 62-3, of the Florida Administrative Code, the FDEP regulates stormwater runoff for water quality standards compliance. In Indian River County, the formal permitting program has been delegated to the St. Johns River Water Management District (SJRWMD) for implementation. The existing state regulations require the retention or detention of the first inch of rainfall to remove a minimum of 80 percent of the annual average pollutant load. Stormwater discharges to a waterbody designated as Outstanding Florida Waters (OFW) must remove 95 percent of annual average pollutant load.

- St. Johns River Water Management District (SJRWMD)

The existing regulations of the SJRWMD require that no new major development can occur unless the project complies with the following regulations:

- Chapter 40C-4 F.A.C.
- Chapter 40C-40 F.A.C.
- Chapter 40C-42 F.A.C.

An individual or general permit must be obtained for any dam, impoundment, reservoir, appurtenant work or works which exceed the thresholds identified in "SJRWMD Applicant's Handbook - Management and Storage of Surface Waters". If offsite discharges are not altered, no permits are required.

The SJRWMD regulations are comprehensive in nature and are intended to manage the St. Johns River basin, an area encompassing portions of 18 counties. The major criticism regarding SJRWMD regulations are the exemptions and the lack of regulations for projects below certain thresholds; however, these weaknesses are not significant and do not warrant concern.

- Florida Department of Transportation (FDOT)

District 4 of the FDOT regulates connections to all FDOT stormwater facilities. Whereas the connection permit program is intended to regulate the quantity of stormwater runoff, it also requires that the quality of the stormwater runoff be in accordance with state FDEP stormwater treatment criteria.

The FDOT requires that an applicant calculate the critical duration of different rainfall events. However, many existing connections to FDOT outfall systems were allowed prior to permitting requirements, and retrofitting is not required. Therefore, some FDOT-managed roads such as U.S. Highway #1 lack facilities to adequately address the quantity and quality of stormwater runoff.

Local

- Indian River County

Indian River County revised its Stormwater Management and Flood Protection Ordinance (LDR Chapter 930) in 1990. The purpose of those revisions was to ensure protection of the County's development and natural resources through stormwater and floodplain management ,and to reduce stormwater pollutant loadings to the IRL. The County's Level-of-Service (LOS) standards established, in 1990, afford an adequate measure of flood protection for life and property.

LDR Chapter 930 requires all new development, including single-family dwellings, to have an onsite drainage plan capable of mitigating the impact of a 25 year/24 hour storm event. The county also has a requirement that, as redevelopment or expansions of existing buildings occur, stormwater deficiencies in terms of quality and quantity must be corrected. Following are local road protection LOS standards:

- 3 year storm/24 hour duration - no flood encroachment outside existing easement and right-of-way (ROW) limits;
- 10 year storm/24 hour duration - limited encroachment of stormwater in front and rear yards;
- 25 year storm/24 hour duration - greater encroachment of stormwater in front and rear yards with no minor street flooding (2 inch maximum); and

- 100 year storm/3 day duration - some street flooding, but no flooding of existing or proposed residences

The current LOS standard for drainage basins is the 2 year/24 hour storm event. LOS standards, however, have not yet been implemented for all of the drainage sub-basins within the county.

Additional provisions in the Land Development Regulations (LDRs) relating to stormwater management include:

- All zoning districts have provisions regulating the minimum amount of open space and the maximum amount of impervious surface area for all parcels.

- All new developments are required to provide on-site stormwater retention/detention. Retention/detention and filtration must be provided for the first one (1) inch of rainfall. Furthermore, all stormwater ponds greater than one-half (½) acre in size are required to provide a minimum 30 percent littoral zone coverage.

- The county has an adopted Wetlands and Deepwater Habitat Protection Ordinance. The purpose of this ordinance is to preserve the functional aspects of wetlands located throughout the county.

- The county has buffer setback requirements for properties adjacent to the Indian River Lagoon and the St. Sebastian River.

- The Environmental Planning section requires an erosion control plan, incorporating Best Management Practices (BMPs), to be submitted prior to the issuance of a land clearing permit.

The County Public Works Department has a full-time Registered Professional Drainage Engineer to review all drainage plans for code compliance. The county also has stormwater computer software to check each design when warranted.

In response to new Rule 9J-5.011(2)(c)(5), Objective 6 has been revised to address the establishment of Water Quality Level-of-Service standards (WQLOS. WQLOS will be based on the Pollutant Load Reduction Goals (PLRGs) currently under development by the SJRWMD.

- F.S. Chapter 298 Special Drainage Districts

The IRFWCD, SRWCD, FWCD and SJWCD have regulations for permitting connections to district canals. To date, the IRFWCD is the only water control district in the County that has adopted level-of-service standards for pipe and culvert sizing.

- Incorporated Municipalities

The cities of Vero Beach, Sebastian, and Indian River Shores have stormwater regulations that contain stormwater quantity and quality performance criteria requirements. Currently, the City of Vero Beach has a well equipped and well qualified staff to conduct the city program. The remaining municipalities have limited staff and resources to regulate stormwater. As previously mentioned, the City of Sebastian is in the process of developing a stormwater master plan and implementing a user-fee based stormwater utility. The City of Fellsmere became a participant in the NFIP in October 1993. Recently, the City expressed an interest in upgrading its stormwater management facilities.

- Private Property Owners Associations

Many private developments have established property owner associations which enforce deed restrictions associated with private stormwater systems. These regulations pertain to maintenance and special assessments for drainage improvements.

Comprehensive Watershed Management

Ultimately, any and all land use within a watershed will have an effect on the water resources of that watershed. A comprehensive watershed management approach recognizes the importance of integrating land use, infrastructure and stormwater management throughout an entire watershed. The primary components of a comprehensive watershed management program include: developing a stormwater master plan, establishing a dedicated funding source, such as a stormwater utility, and actively managing stormwater facilities. When combined, these components can be effectively used to mitigate existing flooding, erosion and pollution problems; to anticipate future problems and needs; and, to take advantage of opportunities to improve flood control and enhance environmental quality using economies of scale. (Debo and Reese, 1995)

Stormwater Master Planning

In order to develop a stormwater master plan, a comprehensive inventory which documents the location, capacity and condition of all stormwater facilities within the County must first be conducted. This inventory is then used to evaluate the effectiveness (quantitative and qualitative) of existing stormwater management facilities and to identify existing and potential problems, needs, opportunities and constraints.

Once completed, a comprehensive inventory could be used to form the basis for establishing a 20 year drainage improvement program, as mentioned in Objective 3. Also, an inventory could be stored in a Geographic Information System (G.I.S.) format to enhance stormwater modeling capabilities by providing the ability to conduct "what-if" analysis. Furthermore, a G.I.S. would allow the County to improve storage of maintenance records, and offer additional intangible benefits.

The final step moves from inventory to development of goals and objectives. The Local Government Comprehensive Planning and Land Development Regulation Act and Chapter 9J-5, F.A.C. require the County to adopt Level-of-Service (LOS) standards for stormwater management facilities. These stormwater LOS standards must address both stormwater quality and quantity and should be expressed as an attribute of a watershed, rather than an attribute of a facility.

Most of the objectives regarding Flood Protection Level-of-Service are already contained in Chapter 930 of the County's Land Development Regulations (LDRs) as well as the Goal, Objectives and Policies section of this sub-element. These FPLOS standards will be utilized to identify deficiencies in capacity, and to approve or deny new development projects. Furthermore, FPLOS standards will be used to target specific capital improvements, and to plan for future development.

Although the County has adopted FPLOS standards, the County does not have adopted Water Quality Level-of-Service (WQLOS) standards for stormwater. Rather than developing its own WQLOS standards, the County will develop WQLOS standards based upon the Pollutant Load Reduction Goals (PLRGs) currently being developed by the SJRWMD. Once established, the WQLOS will be used to target needed retrofits to existing stormwater management facilities, and to ensure that future developments remain in compliance with St. John's River Water Management District (SJRWMD) and Florida Department of Environmental Protection (FDEP) regulations.

Once goals and objectives have been finalized, actions are prioritized and implemented. Planning solutions are long-range prevention-based measures, such as floodplain preservation, zoning regulations, or regional detention facilities. Engineering solutions usually focus on existing needs and remedial actions, such as improvement of secondary drainage facilities. (Debo and Reese, 1995).

According to Policy 2.5 of the 1990 Drainage Sub-Element, the County was supposed to have developed a comprehensive stormwater plan by 1994. Furthermore, Policy 2.5 stated that implementation of the stormwater master plan should have begun by June 1995. Due to resource constraints, the County was unable to develop a stormwater master plan within the original time frame. However, Indian River County will begin developing a stormwater master plan by the year 2000.

Funding

To effectively implement a stormwater management program, the County must establish a source of funding dedicated exclusively to stormwater management. Furthermore, the County will explore the feasibility of phasing out the present practice of funding stormwater management through the MSTU fund. General revenue should be replaced with dedicated funding sources including: bonds, impact fees for new developments and a stormwater utility.

A stormwater utility assess a user fee based the stormwater runoff characteristics (i.e. size and amount of impervious surface area) of a particular parcel. Credits can be given for the use of Best

Management Practices (BMPs). (Livingston and McCarron) A stormwater utility would be sufficient to fund minor projects and ongoing maintenance. However, large-scale projects, such as building a regional stormwater facility, would be funded by bonds development impact fees, and cost-share grants.

Furthermore, by having an adopted stormwater master plan, the County would be more successful in securing dedicated funding sources, such as EPA Section 319 Grants and Surface Water Improvement Management (SWIM) funds from the SJRWMD. Otherwise, the ability to obtain funding sources from state and federal agencies will be reduced. State and federal cost-share funds would be applied towards to improving water quality by retrofitting existing stormwater facilities.

Maintenance

Maintenance of stormwater management facilities is the responsibility of an entity operating within a particular sub-basin. As a result, some public and private stormwater facilities are not being maintained to their design capacity at the present time. Additional stormwater facilities will more than likely experience a similar situation as they continue to age.

The stormwater management facilities under the County's jurisdiction are maintained by the Road & Bridge Department. According to the Public Works Department, many of the drainage-related problems throughout the County can be attributed to a lack of maintenance of secondary drainage facilities, such as secondary swales and culverts. However, most of these problems remain unidentified until the occurrence of a storm event. Once a storm event has occurred, the County's Road & Bridge Department reacts to complaints submitted by the public.

A pro-active approach would be the most beneficial and cost-effective method of improving short-term problems throughout the County. To ensure stormwater facilities continue to function properly, the County will establish defined levels of maintenance and conduct inspections of private as well as public facilities on a routine basis. County-operated maintenance, including abandonment of facilities associated with residential developments, will be initiated when private maintenance fails.

GOAL, OBJECTIVES, AND POLICIES

GOAL

Provide a drainage system for Indian River County which reduces the risk of property damage and inconvenience from long term flooding, promotes stormwater recharge of the shallow aquifer, reduces stormwater pollutant loading of the Indian River Lagoon and receiving waters and provides proper floodplain management.

OBJECTIVE 1 Flood Protection

By 2020, all existing and new development in the unincorporated section of Indian River County will be protected from flooding from a 25 year/24 hour storm event.

Policy 1.1: The county hereby adopts the following level-of-service standard for all new drainage systems within the unincorporated county: New development requiring major site plan approval or subdivision platting shall construct a drainage system capable of mitigating the impacts of a 25 year/24 hour design rainfall event using the Natural Resource Conservation Service (NRCS) Type 2 modified rainfall curves. Post development runoff shall not exceed pre-development runoff unless a maximum discharge rate has been adopted for the applicable drainage basin and the discharge does not exceed that rate. If a maximum discharge rate has not been adopted for the applicable basin, post development discharge may not exceed pre-development discharge.

Policy 1.2: The finished floor elevation of any new buildings constructed within a flood zone, as designated in the 1989 Federal Emergency Management Agency (FEMA) Flood Insurance Study - Indian River County and Incorporated Areas, shall be subject to the following requirements:

- "AE" zone - structures must be elevated a minimum of six (6) inches above the base flood level;
- "A" zone - structures must be elevated a minimum of 18 inches above the crown of the road or at the elevation required by the DHRS, whichever is higher; if no base flood data are available, the structure must be elevated at least three (3) feet above the highest natural elevation or the ground surface prior to construction next to the proposed walls of the structure;
- "VE" zone - structures must be elevated so that the bottom of the lowest horizontal structural member of the lowest floor is elevated one-half (1/2) foot or more above the base flood level.

Policy 1.3: The county shall ensure that adequate stormwater management facilities are constructed and maintained to prevent major flooding of the road network of Indian River County during storm events.

Policy 1.4: All new storm sewers discharging into any canal or receiving water body shall be designed to convey the permitted discharge after tailwater conditions are considered.

Policy 1.5: All major bridges shall be designed to withstand a 100 year/3 day storm event.

Policy 1.6: Prior to the issuance of a Land Development Permit, the county shall require all culverts within all F.S. Section 298 Drainage Districts' rights-of-way or easements be sized and approved by the appropriate district.

Policy 1.7: Within all new subdivisions, wide backlot and front yard drainage easements, as well as side lot swales to provide for localized runoff routing will be required where centralized retention/detention facilities are not provided.

Policy 1.8: The county shall require all new stormwater management facilities that outfall to a F.S. Section 298 Drainage District canal be completed prior to the issuance of a certificate of completion.

OBJECTIVE 2 Stormwater Management Facilities

By 2010, all drainage basins in Indian River County shall, at a minimum, meet the Flood Protection Level of Service (FPLOS) for a 10 year/24 hour storm event.

Policy 2.1: In existing developments, the county will reconstruct existing drainage systems and restore design capacity when road paving is programmed under the county's Petition Paving Program.

Policy 2.2: By 2010, all existing roadways in the county shall be improved to meet the following level-of-service standard:

1. Minimum road crown elevation for existing roads shall be raised during resurfacing/rebuilding to the flood elevation resulting from the 2 year/24 hour storm event on local streets.

2. The center two lanes of rebuilt roads must be at or above flood levels resulting from a 10 year/24 hour storm event on Arterial and Collector roads.

Policy 2.3: All drainage basins will meet the following level-of-service standards:

- By 2000 - 2 year/24 hour storm event;
- By 2005 - 5 year/24 hour storm event;
- By 2010 - 10 year/24 hour storm event

Policy 2.4: The county shall require all new development sites to be designed with retention systems capable of accommodating 1.25 times the impervious surface area, or 0.5 inches times the project area.

Policy 2.5: By 2002, the county will adopt a Stormwater Master Plan. In developing the Stormwater Master Plan, the county will analyze each basin in the unincorporated county, identify existing conditions and problems in each basin, and identify projected growth in each basin. As a result of that analysis, the county will identify a design storm parameter, discharge rate, land use allowance, and structural improvement plan for each basin. The county will coordinate with the City of Sebastian, and will prioritize analysis of the areas within and adjacent to the St. Sebastian River basin.

Policy 2.6: To ensure stormwater management facilities function properly, the county will establish defined levels of maintenance for public and private stormwater management facilities, and will conduct inspections on a routine basis.

Policy 2.7: The county will, through its land development regulations, require existing uses undergoing redevelopment to meet the new development requirements for stormwater management.

Policy 2.8: The county will continue its activities to retrofit the Vero Lakes Estates drainage system.

Policy 2.9: By 2002, the county will conduct a comprehensive inventory of all stormwater management facilities in all of the drainage sub-basins under the county's jurisdiction.

Policy 2.10: By 2002, the county shall establish a Geographic Information System (G.I.S.) - based inventory of all stormwater management facilities under the county's jurisdiction.

OBJECTIVE 3 Capital Improvements

By 2002, Indian River County will have an adopted Stormwater Master Plan, which will guide all improvements to stormwater management facilities in Indian River County over a 20 year time frame.

Policy 3.1: Stormwater Management Facility Improvements shall be included within the Indian River County Infrastructure CIP, as outlined in Table 3.E.1 of the Stormwater Management Sub-Element and Table 6.22 of the Capital Improvements Element. A 20 Year Improvement Program for stormwater management facilities will be included as part of the Indian River County Stormwater Master Plan, once adopted.

Policy 3.2: In all major transportation improvement projects, the county shall include stormwater management facilities to serve the discharge needs of developments existing at the time of the improvement project within the upstream watershed area. Funding shall be included in the Transportation CIP.

Policy 3.3: Proposed capital improvement projects shall be evaluated and ranked according to the following priority level guidelines:

- Level One- whether the project is needed to protect public health and safety, to fulfill the county's legal commitment to provide drainage facilities and services, or to preserve or achieve full use of existing facilities.

- Level Two - whether the project increases efficiency of use of existing facilities, prevents or reduces future improvement costs, provides service to developed areas lacking full service or promotes in-fill development.

- Level Three - whether the project represents a logical extension of facilities within a designated drainage basin.

Policy 3.4: By 2002, the county shall consider establishing a stormwater utility to fund maintenance and improvements of existing stormwater management facilities.

OBJECTIVE 4 Intergovernmental Coordination

By 2000, Indian River County will have established formal cooperative relationships with the incorporated municipalities and F.S. 298 Special Drainage Districts having jurisdiction in Indian River County.

Policy 4.1: County staff will attend meetings of federal, state, regional, and local agencies which have stormwater jurisdiction within the county.

Policy 4.2: By 1999, the county, in cooperation with the SJRWMD, shall request a formal meeting with representatives from all of the F.S. 298 Special Drainage Districts in the county to discuss the following issues: conducting comprehensive basin inventories, adopting maximum discharge limitations, and setting level-of-service standards for water quality and flood protection.

Policy 4.3: The county will continue to include representatives from F.S. 298 Drainage Districts on its Technical Review Committee.

Policy 4.4: The county will coordinate with applicable local governments and F.S. 298 Drainage Districts to provide notification to appropriate entities of development having potential impacts on another jurisdiction.

Policy 4.5: The county shall coordinate with the SJRWMD, and encourage the municipalities within the county to adopt stormwater master plans.

OBJECTIVE 5 Preservation of Floodplains and Floodways

By 2002, the county will have adopted a comprehensive floodplain management plan approved by the Federal Emergency Management Agency (FEMA).

Policy 5.1: The county shall prohibit encroachments, including fill, new construction, substantial improvements, and other development, within a county adopted regulatory floodway, as identified in the data section of this sub-element, that would result in any increase in flood levels during the occurrence of a flood discharge, unless specifically approved by the Administrator of the Federal Insurance Administration under the provisions of 44 CFR 65.12, as amended.

Policy 5.2: By 2003, the county shall preserve a minimum of 1,000 acres located within the 100 year floodplain.

Policy 5.3: For any structures or fill placed within the 100 year floodplain, an equal volume of storage capacity must be created for any volume of the base flood that would be displaced by fill or structures, except for the following instances as more specifically described in LDR Chapter 930:

- development projects within the floodplain along the Indian River Lagoon granted a waiver by the county upon showing the development will not create material adverse impact on flood protection;
- subdivided lots less than one (1) acre in size existing prior to July 1, 1990;
- development projects located in the St. Johns Marsh, when granted a cut and fill waiver by the county based on lack of material adverse impact; or
- development within the Vero Lake Estates Municipal Services Taxing Unit (MSTU) for which a cut and fill waiver has been granted by the county.

Policy 5.4: The county will preserve the natural functions and values of wetlands by implementing the policies listed under Objective 5 of the Conservation Element.

OBJECTIVE 6 Recharge of the Surficial Aquifer

Consistent with Objective 2 of the Natural Groundwater Aquifer Recharge Sub-element, there will be no reduetion in the availability of groundwater from the surficial aquifer through 2020.

Policy 6.1: The county will continue to require on-site retention/detention in accordance with SJRWMD and FDEP performance standards, as outlined in the Stormwater Management and Flood Protection ordinance.

Policy 6.2: The county will continue to require reuse of stormwater runoff for irrigation of golf courses and other developments with wet detention/retention ponds with a surface area greater than one (1) acre.

OBJECTIVE 7 Stormwater Quality

Consistent with DCA Rule 9J-5.011(2)(c)(5), the county will adopt Water Quality Level of Service (WQLOS) standards by 2000. WQLOS standards will be based on Pollutant Load Reduction Goals (PLRGs) currently being developed by the SJRWMD.

Policy 7.1: The county shall cooperate with the IRLNEP, SJRWMD, FDEP, DHRS, Marine Resources Council (MRC), and other organizations in conducting an inventory pollutant loadings to the Indian River Lagoon (IRL).

Policy 7.2: The county will reduce the loading of suspended solids within stormwater runoff by paving unpaved county roads within developed areas where the roads' drainage systems discharge into the IRL.

Policy 7.3: The county will continue to require applicants to submit an erosion control plan prior to issuance of a land clearing permit.

Policy 7.4: The County will continue to operate a street sweeping program for county roads.

Policy 7.5: Indian River County will continue to require sodding or grassing of steep slopes constructed in conjunction with all Transportation Improvement Projects.

Policy 7.6: In accordance with Program Goal I of the Indian River Lagoon Comprehensive Conservation and Management Plan (1996) and Goal I of the Surface Water Improvement Management (SWIM) Plan (1991), the county shall reduce the amount of non-point source pollution entering the Indian River Lagoon by applying for SWIM funds and Section 319 Grants to improve the pollutant removal of efficiency of existing stormwater management facilities and, where feasible, to construct new regional stormwater management facilities.

Policy 7.7: The county shall eliminate all point sources of pollution from private sewer plants and septic tanks contributing to water quality problems and nutrient enrichment of the Indian River Lagoon and the Upper St. Johns River Basin (as indicated in the Sanitary Sewer Sub-Element policies) by:

- Continuing to expand sanitary sewer service within the Urban Service Area;
- Requiring annual evaluation of private sewer plants;
- Requiring monitoring of septic tanks;
- Reusing irrigation quality wastewater for spray irrigation;
- Requiring new developments to connect to a regional wastewater treatment facility; and
- Other policies contained the Sanitary Sewer Sub-Element.

Policy 7.8: In compliance with the Indian River Lagoon Act of 1990, the county shall continue to prohibit the discharge of effluent from domestic wastewater treatment plants into the Indian River Lagoon.

Policy 7.9: The county, in cooperation with the Indian River Soil and Water Conservation District (IRSWCD), shall require all new groves and replanted groves to implement conservation plans, and non-structural best management practices (BMPs). Non-structural BMPs, as defined by the Natural Resource Conservation Service (NRCS), include land use planning, preservation of wetlands and floodplains, education, and erosion control.

Policy 7.10: Until WQLOS standards are adopted, the county will continue to require as a minimum, retention of the first one (1) inch of rainfall prior to off-site discharge. Consistent with Chapter 17-25.025(9), F.A.C., an additional 50 percent treatment (1.5 inches) is required for all direct discharge into the Indian River Lagoon due to its designation as an Outstanding Florida Water (OFW).

Policy 7.11: All existing uses shall meet the adopted WQLOS at time of redevelopment.

Policy 7.12: The county will require all new surface water bodies to include littoral zones for created surface waterbodies greater than one-half (1/2) acre.

OBJECTIVE 8 Land Use

Through 2020, all land uses and land use densities within Indian River County will be in compliance with the Future Land Use Plan map.

Policy 8.1: The county will allow only low density land uses in areas designated as flood prone (within the 100 year floodplain) as depicted on the Future Land Use Map. The only exception is where platted subdivisions were developed prior to existing regulations.

Policy 8.2: The county will assess the drainage capability of all lands proposed for a change in land use designation and not approve land use changes where drainage service levels will not be met.

Policy 8.3: The county shall promote infill development by improving and maintaining the existing drainage facilities in the developed areas of the county.

PLAN IMPLEMENTATION

An important part of any plan is its implementation. Implementation involves execution of the plan's policies by taking actions and achieving results.

For the Stormwater Management Sub-Element, implementation involves various activities. While some of these actions will be ongoing, others are activities that will be taken by certain points in time. For each policy in this element, Table 3.E.2 identifies the type of action required, the entity or entities responsible for taking the action, the timing, and whether or not the policy necessitates a capital expenditure.

To implement the Stormwater Management Sub-Element, several types of actions must be taken. These include, but are not limited to: development of new stormwater facilities, upgrading/retrofitting existing stormwater facilities, revising land development regulations and ordinances, adopting pollutant load reduction goals (PLRGs), intergovernmental coordination and execution of interlocal agreements, establishing a stormwater utility, and development and adoption of a stormwater master plan.

Overall plan implementation responsibility will rest with the Public Works department. Besides its responsibilities as identified in 3.E.2, the Community Development Department has the additional responsibility of ensuring that other entities discharge their responsibilities. This will entail notifying other applicable departments of capital expenditures to be included in their budgets, notifying other departments and groups of actions that must be taken, and assisting other departments and agencies in their plan implementation responsibilities.

EVALUATION & MONITORING PROCEDURES

To be effective, a plan must not only provide a means for implementation; it must also provide a mechanism for assessing the plan's effectiveness. Generally, a plan's effectiveness can be evaluated by the degree to which the plan's objectives have been achieved. Since objectives are structured, to be measurable and to have specific time frames, the plan's objectives are the benchmarks used as a basis to evaluate the plan.

Table 3.E.3 identifies each of the objectives of the Stormwater Management Sub-Element and the measures used to evaluate progress in achieving these objectives. Most of these measures are

quantitative, such as adopted pollutant load reduction goals, improvements to existing stormwater management facilities, and adopted intergovernmental coordination mechanisms. Table 3.E.3 also identifies an anticipated time frame associated with meeting the objectives.

The Community Development Department staff will be responsible for the overall monitoring and evaluating the Stormwater Management Sub-Element. The Community Development Department will coordinate with the Public Works Department to obtain information regarding facility capacity, capital improvement projects, and flood protection level-of-service. Also, the Community Development Department will assist the Public Works Department in developing a Stormwater Master Plan.

While monitoring will occur on a continual basis, formal evaluation of the Stormwater Management Sub-Element will occur every five (5) years in conjunction with the Evaluation and Appraisal of the Comprehensive Plan. Besides assessing progress, the Evaluation and Appraisal Report (EAR) will also be used to determine if the Stormwater Management Sub-Element's objectives and policies should be maintained, revised or deleted. In this way, the monitoring and evaluation of the Stormwater Management Sub-Element will provide a means of determining the degree of success of the plan's implementation, as well as, providing a mechanism for evaluating needed changes to this Sub-Element.

TABLE 3.E.2
Stormwater Management Sub-Element Implementation Matrix

Policy	Type of Action	Responsibility	Timing	Capital Expenditure
1.1	Adopt 25 year/24 hour storm event of LOS standard for all new drainage systems	Public Works	Ongoing	NO
1.2	Regulate construction in FEMA flood zones	Public Works/Community Development Department	Ongoing	NO
1.3	Ensure adequate SWM facilities are constructed and maintained to prevent street flooding	Public Works	Ongoing	YES
1.4	Design storm sewers to convey discharge after tailwater conditions are considered	Public Works	Ongoing	NO
1.5	Design bridges to withstand 100 year/3 day storm	Public Works	Ongoing	NO
1.6	Coordinate sizing of culverts with FS 298 Districts	Public Works/FS 298 Special Districts	Ongoing	NO
1.7	Require wide drainage easements in subdivisions without retention/detention facilities	Public Works/Planning	Ongoing	NO
1.8	Require all SWM facilities outfalling to FS 298 District canals be completed prior to C.O. issuance	Public Works/Planning	Ongoing	NO

Policy	Type of Action	Responsibility	Timing	Capital Expenditure
2.1	Reconstruct existing drainage systems and restore design capacity of roads under Petition Paving program	Public Works	Ongoing	YES
2.2	Improve LOS standards for roads	Public Works	2010	YES
2.3	LOS standards for all drainage basins	Public Works	2010	YES
2.4	Require new development sites to accommodate 1.25 times the impervious surface area or 0.5 inches times the project area.	Public Works	Ongoing	NO
2.5	Adopt Stormwater Master Plan	Public Works/Planning	2002	NO
2.6	Establish defined levels of maintenance and conduct routine inspections of SWM facilities	Public Works	Ongoing	NO
2.7	Require existing developments undergoing redevelopment to meet requirements for new development	Public Works/Planning	Ongoing	NO
2.8	Retrofit Vero Lake Estates drainage system	Public Works	Ongoing	YES
2.9	Conduct inventory of SWM facilities under county jurisdiction	Public Works	2002	NO
2.10	Establish a G.I.S.-based inventory of SWM facilities under county jurisdiction	Public Works	2002	NO
3.1	Include SWM facility improvement program in the Infrastructure capital improvements plan	Public Works/Planning	1998	NO
3.2	Include drainage facilities to serve upstream watershed area for all major transportation improvement projects	Public Works	Ongoing	YES
3.3	Establish priorities for capital improvements projects	Public Works	Ongoing	YES
3.4	Consider establishing a stormwater utility fund	Public Works/Planning	2002	NO
4.1	Attend meetings of state, federal, regional, and local government agencies	Public Works	Ongoing	NO
4.2	Request formal meeting with SJRWMD and FS 298 District representatives	SJRWMD/Public Works/ FS 298 Districts	1999	NO
4.3	Include representative from drainage districts on Technical Review Committee	Planning	Ongoing	NO
4.4	Coordinate with local governments and FS 298 Districts	Public Works	Ongoing	NO
4.5	Encourage municipalities to adopt stormwater master plans	SJRWMD/Public Works	Ongoing	NO
5.1	Prohibit encroachment in floodplains	Planning/Public Works	Ongoing	NO
5.2	Preserve a minimum of 1,000 acres in the 100 year floodplain	Planning	2003	YES

Policy	Type of Action	Responsibility	Timing	Capital Expenditure
5.3	Enforce cut and fill balance regulations in the 100 year floodplain	Public Works	Ongoing	NO
5.4	Preserve natural functions of wetlands	Planning	Ongoing	NO
6.1	Require on-site retention in accordance with SJRWMD and FDEP requirements	Public Works	Ongoing	NO
6.2	Continue to require reuse of stormwater for irrigation with wet ponds greater than one acre	Planning	Ongoing	NO
7.1	Cooperate with government agencies to conduct an inventory of pollutant loadings to the IRL	Planning	Ongoing	NO
7.2	Reduce suspended solids by paving roads with drainage systems that discharge to the IRL	Public Works	Ongoing	YES
7.3	Require erosion control plans	Planning	Ongoing	NO
7.4	Operate street sweeping program	Public Works	Ongoing	NO
7.5	Require sodding/mulching of slopes	Public Works	Ongoing	NO
7.6	Reduce pollutant loadings to IRL; solicit state and federal grants to construct SWM facilities	SJRMWD/Public Works/ Planning	Ongoing	NO
7.7	Eliminate point source pollution and OSDS pollution from the IRL and the USJRB	DHRS/FDEP/SJRWMD/ Utilities	Ongoing	NO
7.8	Prohibit WWTP discharges from entering the IRL	SJRWMD/FDEP/DHRS/ Planning	Ongoing	NO
7.9	Require new groves and replanted groves to implement conservation plans and use BMPs	IRSWCD/Planning	Ongoing	NO
7.10	Require retention/detention in accordance with state requirements until WQLOS is adopted	Public Works	Ongoing	NO
7.11	Require existing uses to meet WQLOS at time of redevelopment	Public Works	Ongoing	NO
7.12	Require surface waterbodies over ½ acre to include littoral zone plantings	Planning	Ongoing	NO
8.1	Allow only low-density zoning in 100 year floodplain	Planning	Ongoing	NO
8.2	Assess drainage capability of lands proposed for change in land use designation; prohibit land use changes if drainage service levels are not met	Planning	Ongoing	NO
8.3	Promote infill development by improving existing drainage facilities	Public Works/Planning	Ongoing	YES

TABLE 3.E.3
STORMWATER MANAGEMENT SUB-ELEMENT
EVALUATION MATRIX

OBJECTIVE	MEASURE	TIME FRAME
1	Protect development from 25 year/24 hour storm	2020
2	Flood Protection Level of Service (FPLOS) for all drainage basins	2010
3	Adopted Stormwater Master Plan	2002
4	Establish formal cooperative inter-governmental relationships	2000
5	Adopted Comprehensive Floodplain Management Plan	2002
6	Availability of groundwater in the surficial aquifer	2020
7	Adopt Water Quality Level-of-Service (WQLOS) standards	2000
8	Land uses and densities in compliance with the Future Land Use Plan map	2020

TECHNICAL APPENDIX A

Metric Conversion Table

SI (metric) unit	Abbreviation	Approximate U.S. Equivalent
Kilogram	kg	2.20 pounds
Hectare	ha	2.47 acres
Liter	L	1.06 quarts
Meter	m	39.4 inches
Milligram	mg	0.015 grains

Measurements

Measurement	Units	Abbreviation
ratio	milligrams-per-liter	mg/L
ratio	micrograms-per-liter	ug/L
ratio	parts-per-thousand	ppt
ratio	parts-per-million	ppm
volume per unit time flow	million gallons per day	MGD
volume	acre-feet	ac-ft
volume per unit time flow	cubic feet per second	cfs

Water Quality Parameters

An increase in the presence of the following water quality parameters indicates reduced water quality:

Alkalinity measures of the hardness of water.

Units: mg/L of calcium carbonate ($CaCO_3$)
FDEP standard: minimum concentration of 20.0 mg/L of $CaCO_3$
Median Value: 75

Turbidity Elevated levels of turbidity are detrimental to an ecosystem for several reasons. First, aquatic life is harmed as photosynthesis is reduced which, in turn, decreases the productivity of the food web. Second, the aesthetic qualities of water are diminished. Third, other water quality parameters may be negatively affected, such as reduced dissolved oxygen and nutrient enrichment. Turbidity is the aggregate of dissolved and suspended solids present in a water column.

Units:	ntus
FDEP standard:	≤ 29 ntus above background levels
Median Value:	5

Total Suspended Solids (TSS) is closely related to turbidity. However, TSS expresses the amount of suspended solids contained in water which are not in solution. The long-term effects of elevated levels of TSS can result in sedimentation and reduced habitat.

Units:	mg/L
FDEP standard:	not established
Median Value:	7

Biological Oxygen Demand (BOD) is a measure of the amount of dissolved oxygen that is depleted from waterbody through the introduction of organic pollutants. BOD loading is of particular concern in a relatively stagnant body of water such as the Indian River Lagoon (IRL).

Units:	mg/L over 5 days
FDEP standard:	BOD must not cause the level of dissolved oxygen (DO) to fall below 5.0 mg/L
Median Value:	1.5

Total Nitrogen (TN) and Total Phosphorous (TP) express the total amount of each nutrient present in the system. Although TN and TP include organically-bound elements (i.e. not readily available for plant growth), they are used to indicate the overall health of an ecosystem and are commonly referenced in scientific data. Total Kjeldahl Nitrogen (TKN) is a measure of dissolved and particulate organic nitrogen which must be converted to an inorganic form before it can be assimilated by plants. TKN represents nitrogen held in reserve. A TP level above 0.02 mg/L has the potential to induce an algal bloom. A waterbody with a TP level above 0.1 mg/L is considered excessively enriched.

Units TP/TN:	mg/L	
FDEP standard:	level must not cause an imbalance to the ecosystem	
Median Values:	Stream	0.09 (TP), 1.2 (TN)
	Lake	0.05 (TP), 1.1 (TN)
	Estuary	007 (TP), 0.8 (TN)

Eutrophication is the enrichment of a waterbody by nutrients through natural and/or anthropogenic means. Nitrogen and phosphorous are the two elements most responsible for enhancing the eutrophication process. Natural sources of nutrient loadings into receiving waters are caused by the deposition of detrital matter and growth of organisms. Anthropogenic sources of nutrient input include: drainage from agricultural lands, animal waste, fertilizers, untreated sewage discharge and septic tanks. Also, dredging of waterways releases nutrients stored within the submerged land. Reducing the sources of nutrient input into receiving waters is the most effective method of controlling eutrophication.

Heavy metals such as mercury, copper, zinc, and lead are conveyed by stormwater runoff from urbanized areas to receiving waters. Heavy metals are toxic to aquatic organisms. Secondary impacts to the food web, including implications to human health, may be substantial. Measurements of zinc (Zn) and lead (Pb) are used to indicate the presence of heavy metals. Notwithstanding, a low level of Zn and/or Pb does not guarantee that other heavy metals are absent from an ecosystem. The FDEP has established maximum contaminant levels (MCLs) for various heavy metals.

Fecal contamination is the result and human and animal waste. Fecal coliform (FC) is a measure used to indicate the presence of bacterial and/or viral contamination of a waterbody. Concerns relating to FC include on-water recreational contact and contamination of shellfish. Some sources consider a FC count greater than 200/100 mL to be excessive for recreational purposes.

Units:	#FC/100 mL
FDEP standard:	1,000/100 mL
Median Value:	600/100 mL

A decrease in the following water quality parameters indicates reduced water quality:

Dissolved Oxygen (DO) is a measure of the amount of oxygen in a waterbody that can be readily metabolized by an organism. Generally, the critical level of DO for fish is between 3 to 6 mg/L. Certain species of game fish require a minimum DO concentration above 5.0 mg/L. Absence of DO creates an anaerobic condition with odor and aesthetic problems.

Units:	mg/L
FDEP standard:	minimum 5.0 mg/L
Median Value:	5.8

Secchi Disk Depth (SDD) is a relative indicator of water clarity in certain portion of a waterbody. A simple test is performed by submerging a disk and measuring the maximum depth at which it can be observed prior to fading from vision.

Units:	meters
FDEP standard:	90 percent of the natural background level

Median Value:	Stream	0.8 m
	Lake	0.9 m
	Estuary	1.1 m

Salinity The significance of salinity depends upon the natural characteristics of a particular waterbody. Nevertheless, salinity is a critical factor in the health of an estuarine system such as the IRL. An increase of decrease over background levels results in a decline in fishery resources and/or changes in species composition.

Units:	ppt
FDEP standard:	not established
Median Value:	varies

Other water quality parameters include:

pH is a general measure of water quality. A high pH reflects an alkaline condition, whereas a low pH reflects an acidic condition. A neutral solution has a pH equal to 7, however, a neutral condition is rarely observed in a natural waterbody. Most species of fish can tolerate a pH between 5.0 and 9.0. A change in pH above or below this range is hazardous to aquatic life since toxicity increases due to the solubility or precipitation of heavy metals. A pH between 6.0 and 8.5 is the minimum FDEP criterion for a Class III designation.

Units:	N/A (exponential scale)
FDEP standard:	6.0 - 8.5
Median Value:	7.1

Chlorophyll is a substance that allows photosynthesis to occur in plants. The amount of chlorophyll present in a waterbody is used to assess the potential of an algal bloom.

Units:	ug/L
FDEP standard:	not established
Median Value:	6

Color is a variable and somewhat arbitrary measure of water quality.

Units:	platinum-color units (pcu)
FDEP standard:	"no nuisance conditions"
Median Value:	71

Specific Conductance (Conductivity) is a measure of water's ability to conduct an electrical current due to dissolved chemicals. The test may be used to substitute for salinity readings.

Units:	micro-ohms (ie electrical resistance)
FDEP standard:	1275 micro-ohms or less than 50 percent above the background level
Median Value:	335

Rate of discharge (velocity) and flow (quantity) of stormwater runoff increase when natural conditions are disrupted. An increased flow transports more non-point source pollution to a receiving body of water. In conjunction with the increased flow, the overall amount of non-point source pollution will be increased. Also, since pollutants have less time to settle, additional pollutant loadings are transported to receiving waters thereby further reducing stormwater runoff quality. In this way, natural and anthropogenic factors influence the quality of stormwater runoff.

Listed below are the natural factors which affect the rate and quantity of stormwater runoff:

- duration and intensity of storm events;
- natural relief and slope;
- natural vegetation/land cover; and
- soil characteristics

Anthropogenic activities that negatively influence the rate and quantity of stormwater runoff include the following:

- alteration of natural topography;
- increased groundwater withdrawal and discharge;
- removal of natural vegetation;
- mining;
- agricultural/sivilcultural operations;
- flood control structures/conveyance facilities;
- alteration/destruction of wetlands;
- increased impervious surface area; and
- channeling stormwater runoff

When combined, the above listed natural and artificial factors create a negative synergism which can further reduce stormwater runoff quality.

Water Quality Index (WQI) summarizes from one (1) or more of the above listed water quality parameters to determine the overall health of a stream, river or canal. Categories which comprise a WQI include the following: water clarity (turbidity,TSS); D.O.; oxygen demanding substances (BOD,COD); nutrients (TN,TP); bacteria (FC,total coliform); and, the macroinvetebrate diversity index based on substrate samples, artificial substrate samples and Beck's Biotic Index. The WQI is an average of the category index values and can be calculated from one (1) index category; however, reliability increases when categories are used. (FDEP, 1994). WQI values are as follows:

- "GOOD" water quality = zero (0) to less than 45
- "FAIR" water quality = 45 to less than 60
- "POOR" water quality = 60 to 99

Trophic State Index (TSI) is a measure of the growth potential of algae and aquatic weed growth used to evaluate lakes and estuaries. Components of the TSI include: TN, TP, chlorophyll(a), and secchi depth (FDEP, 1994). TSI values for lakes are as follow:

- "GOOD" water quality = zero (0) to 59
- "FAIR" water quality = 60 to 69
- "POOR" water quality = above 69

The TSI values for estuaries are as follow:

- "GOOD" water quality = zero (0) to 49
- "FAIR" water quality = 50 to 59
- "POOR" water quality = above 59

TSI	Chlorophyll	Secchi Depth	Total Phosphorous	Total Nitrogen
0	0.3	7.4	0.003	0.06
10	0.6	5.3	0.005	0.10
20	1.3	3.8	0.009	0.16
30	2.5	2.7	0.01	0.27
40	5	2.0	0.02	0.45
50	10	1.4	0.04	0.70
60	20	1.0	0.07	1.2
70+	>40	≤0.7	≥0.12	≥2.0

Source: 1994 Water Quality Assessment for the State of Florida Technical Appendix, FDEP (1994)

TECHNICAL APPENDIX B

The estimated annual pollutant loadings for existing and future land use (2010) conditions for the major basins draining to the Indian River Lagoon (IRL) are contained in this Appendix. Future pollutant loadings are based on future land use conditions from 1990 Indian River County Comprehensive Plan.

St. Sebastian River Basin

EXISTING LAND USE

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg-ha)
Total Nitrogen	93,793	3.70
Total Phosphorous	11,067	0.44
Total Suspended Solids	1,779,246	70.15
Biological Oxygen Demand	253,417	10.00
Zinc	1,935	0.08
Lead	2,809	0.11

FUTURE LAND USE (2010)

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg/ha)	Percent Change
Total Nitrogen	165,761	6.53	+76.7
Total Phosphorous	17,623	0.70	+59.2
Total Suspended Solids	2,354,467	92.82	+32.3
Biological Oxygen Demand	616,527	24.30	+143.3
Zinc	2,210	0.90	+14.2
Lead	3,176	0.13	+13.1

Source: IRLNEP Technical Report (1994)

Sebastian River Water Control District Basin

EXISTING LAND USE

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg-ha)
Total Nitrogen	26,090	3.70
Total Phosphorous	3,752	0.44
Total Suspended Solids	599,424	70.15
Biological Oxygen Demand	45,174	10.00
Zinc	314	0.08
Lead	301	0.11

FUTURE LAND USE (2010)

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg/ha)	Percent Change
Total Nitrogen	19,387	4.62	- 34.6
Total Phosphorous	1,459	0.35	- 61.1
Total Suspended Solids	148,811	35.45	- 302.8
Biological Oxygen Demand	60,224	14.35	+33.3
Zinc	120	0.30	- 61.8
Lead	209	0.05	- 30.6

Source: IRLNEP Technical Report (1994)

Barrier Island ("B") and Mainland IRL ("R") Basins

EXISTING LAND USE

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg-ha)
Total Nitrogen	52,094	7.23
Total Phosphorous	7,312	1.01
Total Suspended Solids	1,306,829	181.27
Biological Oxygen Demand	216,851	30.08
Zinc	1,770	0.25
Lead	2,485	0.35

FUTURE LAND USE (2010)

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg/ha)	Percent Change
Total Nitrogen	96,777	14.42	+ 85.8
Total Phosphorous	12,768	1.77	+ 42.7
Total Suspended Solids	2,054,091	284.92	+ 57.2
Biological Oxygen Demand	552,727	76.67	+ 154.9
Zinc	2,044	0.28	+ 15.5
Lead	2,818	0.39	+ 13.4

Source: IRLNEP Technical Report (1994)

Indian River Farms Water Control District Basin

EXISTING LAND USE

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg-ha)
Total Nitrogen	132,550	6.37
Total Phosphorous	18,131	0.87
Total Suspended Solids	3,036,953	145.94
Biological Oxygen Demand	393,796	18.92
Zinc	3,116	0.15
Lead	4,188	0.20

FUTURE LAND USE (2010)

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg/ha)	Percent Change
Total Nitrogen	171,709	8.25	+ 29.5
Total Phosphorous	21,374	1.03	+ 17.9
Total Suspended Solids	3,172,363	152.45	+ 4.4
Biological Oxygen Demand	882,969	42.43	+ 124.2
Zinc	2,384	0.12	- 23.5
Lead	3,543	0.17	- 15.4

Source: IRLNEP Technical Report (1994)

Fellsmere Water Control District Basin

EXISTING LAND USE

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg-ha)
Total Nitrogen	23,952	4.01
Total Phosphorous	2,862	0.48
Total Suspended Solids	443,784	74.33
Biological Oxygen Demand	49,674	8.32
Zinc	349	0.06
Lead	496	0.08

FUTURE LAND USE (2010)

Water Quality Parameter	Total Loading (kilograms)	Area-Based Load (kg/ha)	Percent Change
Total Nitrogen	30,756	5.15	+ 28.8
Total Phosphorous	2,601	0.46	- 10.0
Total Suspended Solids	305,018	51.08	- 45.5
Biological Oxygen Demand	106,186	17.78	+ 113.8
Zinc	295	0.05	- 18.3
Lead	481	0.08	- 3.0

Source: IRLNEP Technical Report (1994)