*Title Page

THE STATE OF CHARLOTTE HARBOR, FLORIDA

Its Adjacent Inland Waters and Watershed

A Characterization Report
for the
Charlotte Harbor National Estuary Program

by

MOTE MARINE LABORATORY

DRAFT

January 22, 1997

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*Estuaries

An estuary is defined as a semi-enclosed water body with a free connected to the ocean and where salt water is mixed with and diluted by freshwater from rivers and streams. Estuaries are unique ecosystems that combine nutrient-rich brackish water, tidal mixing, and circulation and protection from the disruptive forces of the open sea. Biologists consider estuaries to be among the most productive environments on earth.

The Charlotte Harbor area is a series of distinct, but related bays and estuaries including Lemon Bay, Charlotte Harbor, Pine Island Sound, Matlacha Pass, San Carlos Bay and Estero Bay. Together they form the one of the largest estuarine systems in the state and, according to the State Department of Environmental Protection, "the most productive estuarine area on the west coast of Florida and perhaps anywhere in Florida."

*Introduction

The Charlotte Harbor region of southwestern Florida is a singular place. Surrounded by such unique state resources as Tampa Bay, the Kissimmee Valley and Lake Okeechobee, the Big Cypress Swamp and the Gulf of Mexico, the harbor region is itself a landscape and seascape worthy of national attention and pride.

The Harbor, America's 17th largest estuary and Florida's second largest open-water estuary, produces sea shells, tarpon, and bird life of international fame. Vast stretches of the harbor shoreline and adjacent uplands have been preserved, forever securing the wilderness scenery first described by early explorers and settlers.

The harbor's watershed is a Florida heartland. Covering parts of 10 counties, the watershed spreads inland into ancient scrub habitats that survived Florida's nearly-total submergence by high sea level. Today, fossil remains of sea creatures are mined as phosphate, making the watershed a source of fertilizer and food for a growing world population.

Three large rivers and numerous smaller streams flow like veins from the heartland to the harbor. These are working rivers, each in its own way providing goods and services for natural ecosystems and human economies. Our rivers connect the lives of inland and coastal communities, making us all neighbors in a landscape of unparalleled beauty.

What was this region before modern settlement, and how has it changed as a result of human endeavor? What will it become if we act thoughtlessly, and what could it be with reasoned thought and a commitment to the seventh generation of our decedents? Now the time has come to ask such questions, before the crush of human population growth eliminates our options to decide. Now the time has come to meld our separate agendas into a vision of the future where humans live sustainably with nature.

In this little report, the Charlotte Harbor National Estuary Program presents a brief overview of the region's past, present, and future. This report is a prelude and introduction to the work of many government and citizen groups that will unfold as the 20th century comes to a close-- and a new century of progress for the harbor opens.

*One and Only

The nation's coastal communities are rightly proud of their local bays and estuaries. Each seeks to distinguish their waters as nationally significant-- having the most fish species, producing the most oysters, or even being the most polluted. What distinguishes Charlotte Harbor? It is relatively large by national standards, falling between 15th and 20th depending on how the comparison is made, so it is not America's largest estuary. Or even Florida's, although it is the state's second largest open-water estuary. Charlotte Harbor is famous for sea shells, tarpon fishing, and other ecological and recreational resources, but even more importantly, it possesses another, more subtle quality, one less prone to slogans. The harbor is still, despite developments and changes during the past century, a functional and whole ecosystem. Though comparative data are lacking, probably more of the Harbors natural shoreline has been preserved and protected, than most U.S. estuaries. Freshwater inflows, though measurably changed, still occur in natural locations and schedules. Nutrient and contaminant loads, while higher than previously, do not cause ecological problems across most of the region's waters. And living resources are abundant. In many ways, the distinction Charlotte Harbor has is an ironic one: it is much the way it used to be. The Harbor attracts scientists and the public because it is perceptibly "natural." It is clean enough to support new efforts at mariculture, when other estuaries are being closed to shell-fishing. It is even being used as a standard for the rehabilitation of other estuaries. In a word, the Charlotte Harbor region is entering the 21st century in far better condition than most estuaries, and it is distinctive because future management will work harder to preserve the harbor, than restore it. An idea too complex for a bumper sticker, but tangible to every wader, boater, diver, and student whose lives are touched by this great estuary.

*Special Attributes

At the landscape level, the national significance of the Charlotte Harbor NEP area can be illustrated by noting:

- It connects ecosystems already recognized as nationally important and worthy of federal/state management initiatives;
- It contains the most barrier islands, tidal inlets, and publicly owned tidal wetlands of any existing NEP;
- It supports the nation's largest sustainable tarpon tournament and recreational fishery;
- Five national wildlife refuges occur in the study area;
- The Sanibel Island sea-shelling grounds are internationally famous;
- The study area contains the largest number of tidally influenced oxbow lakes; and,
- The Harbor is the nation's only subtropical estuary where density stratification is an annual occurrence, and hypoxia occurs naturally.

At the state level, estuarine areas have been recognized and protected as several conterminous aquatic preserves. Upland areas recognized as ecologically significant include Florida's largest state park, a state preserve, and a state wildlife management area. All of the Harbor within SWFWMD is a SWIM priority water body, including the Peace and Myakka rivers. The Myakka is also a state wild and scenic river because of its pristine habitats and aquatic communities.

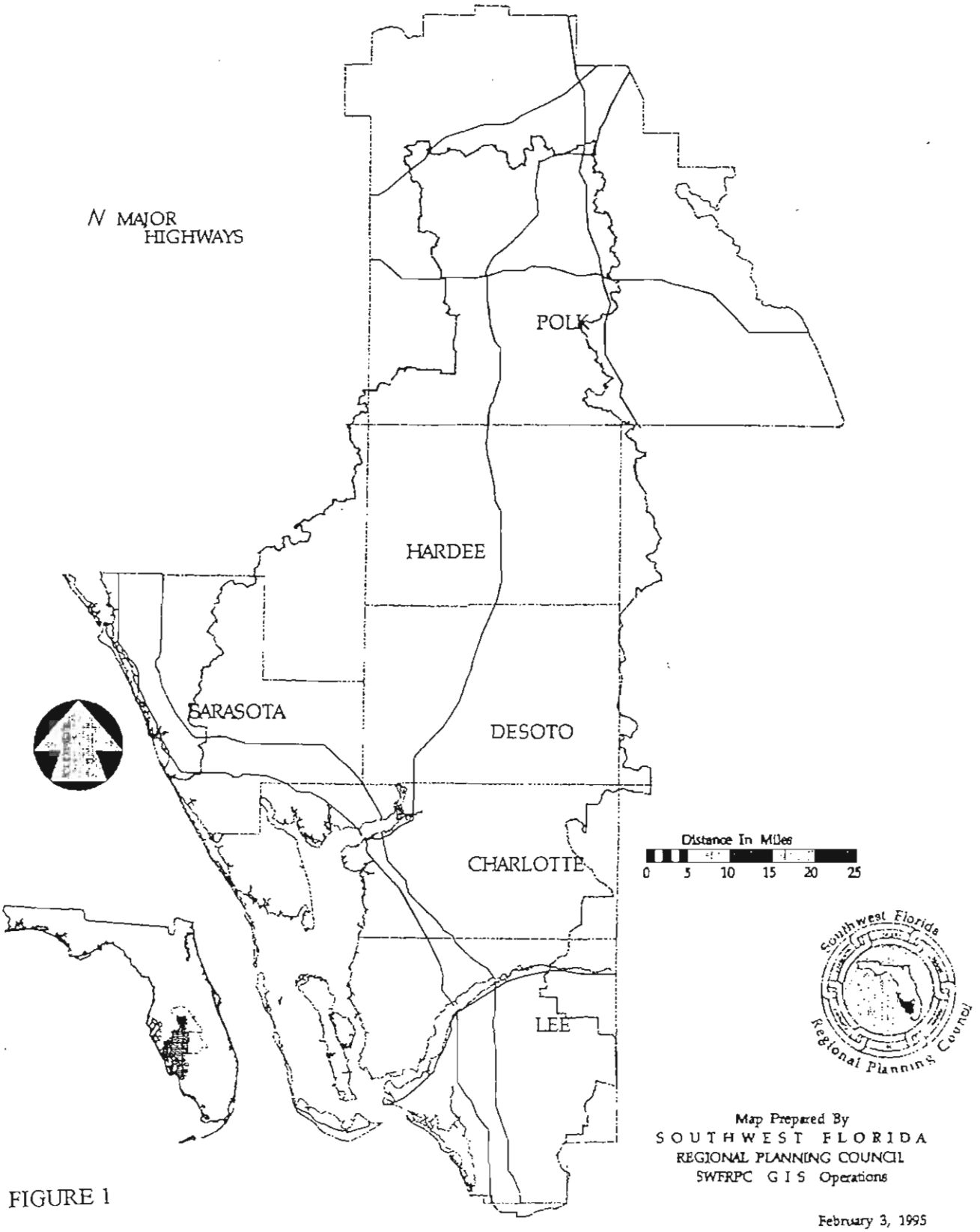
*Geography

Charlotte Harbor and its adjoining lands and waters constitute a large and valuable ecosystem complex in southwest Florida. The Harbor is estuarine in nature, meaning that:

- It is a semi-enclosed body of water, open to the Gulf of Mexico through several tidal inlets;
- Freshwater inflows of three major rivers and several smaller streams intermix with marine waters of the Gulf, within the Harbor;
- Dilution of sea water ranges from 0 to 100% depending on season, location, and depth in the Harbor; and
- The Harbor is inhabited by plants and animals characteristic of estuarine environments.

Charlotte Harbor proper is a strongly positive estuary with seasonal density stratification. Adjoining protected inland waters are neutral to weakly positive estuaries and are well-mixed most of the time. Charlotte Harbor is, by itself, the nation's 18th largest estuary and the 9th largest estuary along the Gulf of Mexico. Together with neighboring Tampa and Sarasota Bay NEPs, the combined land and water area covered by the 3 conference agreements is the Gulf's 4th largest. The Harbor's NEP boundaries follow natural watershed lines. Because of the Harbor's strategic location, the Harbor NEP also connects other major resource management programs. The Charlotte Harbor NEP links the Tampa and Sarasota Bay NEPs as a single landscape unit. These are linked, in turn, to intensive ecosystem management initiatives in South Florida (Lake Okeechobee, Everglades biome, Ten Thousand Islands, Florida Bay, Florida Keys). Geographically, the Charlotte Harbor NEP area stretches from the headwaters of the Peace River, in Polk County, to the southern end of Estero Bay, in Lee County; a distance of more than one hundred miles. The Charlotte Harbor estuary has a water surface area of approximately 270 square miles. The estuary's watershed, or inflow area, is approximately 4,360 square miles and covers all or part of 6 counties. The area can be divided into seven sub-areas on the basis of hydrological, ecological, and management distinctions. These sub-areas are also distinct in terms of their economic, cultural, and demographic features.

Charlotte Harbor NEP Study Area



Map Prepared By
SOUTHWEST FLORIDA
REGIONAL PLANNING COUNCIL
SWFRPC GIS Operations

February 3, 1995

FIGURE 1

*Our Place

The place we call Charlotte Harbor and watershed can be understood using geographer's tools: realm and region, relative location, scale, and human-environmental interactions. Our realm is the coastal plain of the southeastern United States-- low, level lands dominated by marine influences. Our region is the Florida peninsula, a geologically young land mass with mostly continental affinities but with distinct tropical influences. Our relative location is southwest, signifying an intimate relationship with the warm Gulf of Mexico. Our relative location distinguishes us from the metropolis of Tampa Bay and the wilderness of the Florida Everglades. Scale allows us to see more detail. Though the coastal fringe is decidedly urban, most of our land is rural. From north to south, our rivers have undergone progressively more intense alterations. From east to west, our region is large enough that fishermen in Matlacha may rarely think of rodeos in Arcadia, even though the two are almost neighbors in a hydrological sense. Matlacha and other coastal residents adapt to their micro-environment by building to anticipate hurricanes. Farmers in Hardee County adapt to prospects of killing freezes by timing their crops and using irrigation to advantage. The same afternoon lightning storm that starts a wildfire in DeSoto County may endanger the tarpon fisherman in Boca Grande, later in the same day. Our sense of place is set by what and where we are, and what and where we are not. Water creates the sense of community we perceive in southwest Florida, the place we call home.

*Geologic Past

The mounds, middens, and earthworks surrounding the Harbor stand as silent testimony of the estuary's importance in the lives of early humans. Yet, the human species has occupied the harbor for only a short period of geologic time. Long before the first people lived in Florida, the peninsula was an archipelago of islands, atolls, and shallow seas. Over hundreds of thousands of years, sediments from the Appalachian Mountains filled in the channel separating the Florida banks from the continent, and covering most of the region with quartz sands. With successive glacial and interglacial periods, sea level rose and fell over Florida, carving terraces and plains, escarpments, and valleys. When the last glaciation was at its maximum sea level was 300 feet below its present level. Florida extended west to the continental slope. The place we call Sanibel Island today was as far east of the shoreline, then, as it is west of the Atlantic Ocean, today. Forests and prairies grew across the broad shelf. Rivers and valleys rolled from Highlands County for 150 miles to the west. When our ancestors first arrived in Florida, sea level was perhaps 50 feet below its present stage.

There were no barrier islands, no coastal bays and sounds, no broad rivers. The Myakka, Peace, and Caloosahatchee Rivers were little more than the headwater tributaries of very long rivers flowing west to the sea. As the glaciers melted and freed water returned to the atmosphere and oceans, sea level rose--rapidly at first, and then more slowly. The broad Florida shelf drowned. All of the plants, animals, landforms, and carbon of this vast ecosystem eventually were covered by the sea and transformed to barren sea floor. Rivers drowned, melding into shallow Gulf embayments.

As sea level rise slowed, about 6,000 years ago, the first barrier islands began to form. When the first Europeans saw Charlotte Harbor, the sea was about 4 feet lower than today. The Harbor and its rivers looked more or less as they do today.

*Beaches and Barrier Islands

The bays and estuaries of the Charlotte Harbor area are bounded on their seaward side by a string of sand beaches and barrier islands stretching seventy miles along the Gulf coast. Manasota Peninsula, the islands of Don Pedro, Gasparilla, Cayo Costa, Captiva, Sanibel and Estero and Bonita Beach are natural resources of exceptional aesthetic and recreational value. They rank among the most important assets of the area's tourist- based economy and protect the estuaries and coastal mainland by buffering storm winds and tides.

These beaches and barrier islands typify a low energy coastline with their relatively shallow, sloping bottoms. This configuration prevents the buildup of large waves and, combined with predominately offshore winds, inhibits the onshore buildup of sand deposits. As a result, most of these islands do not have high, well developed dune systems like those found along the Atlantic coast. Low relief is typical of these barrier islands. Many have maximum elevations of only seven or eight feet above mean sea level. Consequently, they are highly susceptible to being breached and flooded during hurricanes.

Barrier islands are unstable land masses, constantly changing their shape in response to the forces of wave action, wind and rising sea levels. Waves striking the beach at oblique angles generate a current parallel to the shoreline. Sand suspended by the breaking waves moves with this current and is deposited at the other end of the island-- even across a pass or channel to a different island. This process, known as littoral drift, is the most pervasive force affecting the beaches. The volumes of sand transported in this manner can be astounding. The U.S. Corps of Engineers has estimated the southerly rate of littoral drift at Boca Grande Pass to be 100,00 cubic yards of sand annually.

*Climate

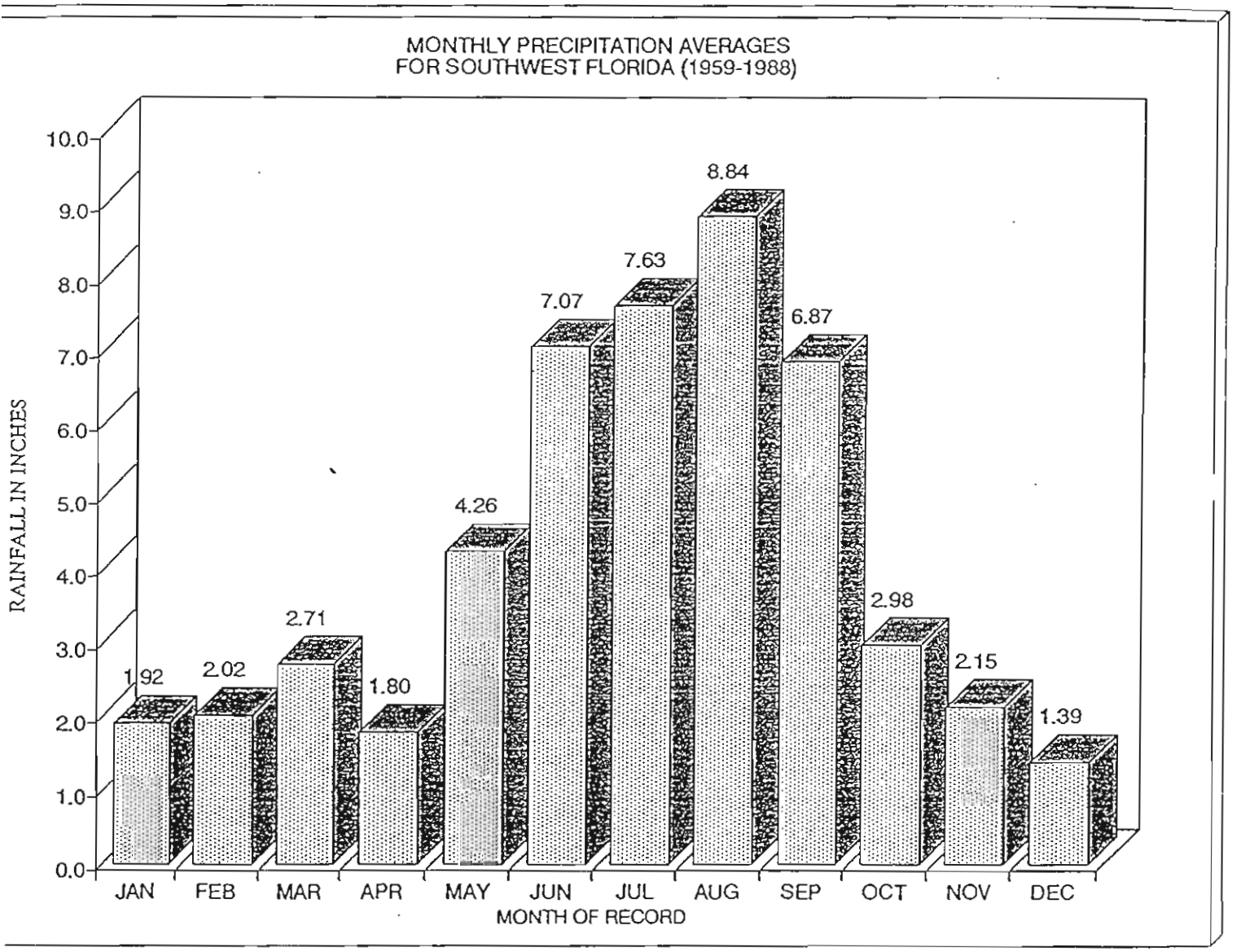
The Charlotte Harbor area has a humid subtropical climate, annually averaging 73 degrees F at Punta Gorda. Its warm winter temperatures attract tourists from northern states, many of whom return to live and work or retire. The subtropical climate is largely responsible for the evolution of the area's natural vegetation, soils and wildlife and makes possible year-round agricultural industries which produce vegetables, flowers and citrus.

Temperatures range from about 62 to 83 degrees F, with coastal areas having less variation than inland areas. About 15 hard freezes have affected coastal areas since 1900, compared to almost 30 inland and north of the Harbor. Freezes there prompted a southward relocation of citrus groves during the past 20 years.

Perhaps the most important characteristics of the area's climate is the annual rainfall cycle. The Charlotte Harbor area averages 50 to 55 inches of rainfall annually, but this varies greatly from year to year and has a pronounced seasonal pattern. Typically, as much as 70 percent of the annual rainfall occurs during the summer months from June to September. Consequently, the area has a dry spring season with little or no rain. Even rainy seasons produce less useful water than popularly believed, because as much as two-thirds of all rainfall returns to the atmosphere by evaporation, or through vegetation.

Tropical storms and hurricanes are a fact of life in southwest Florida, though several years have passed without recent residents experiencing the force of a big storm. Since 1900 our region has known about 40 tropical disturbances to pass within 50 miles. None has been so great as the 1926 storm that pushed 12 feet of water above sea level at Punta Gorda. This region's yearly chance of a hurricane strike is one in twenty, leading local governments to prepare emergency plans for evacuation, shelter, and public aid.

FIGURE I-1


MONTHLY PRECIPITATION AVERAGES
FOR SOUTHWEST FLORIDA (1959-1988)
RAINFALL IN INCHES
10.0
9.0
8.0
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JAN
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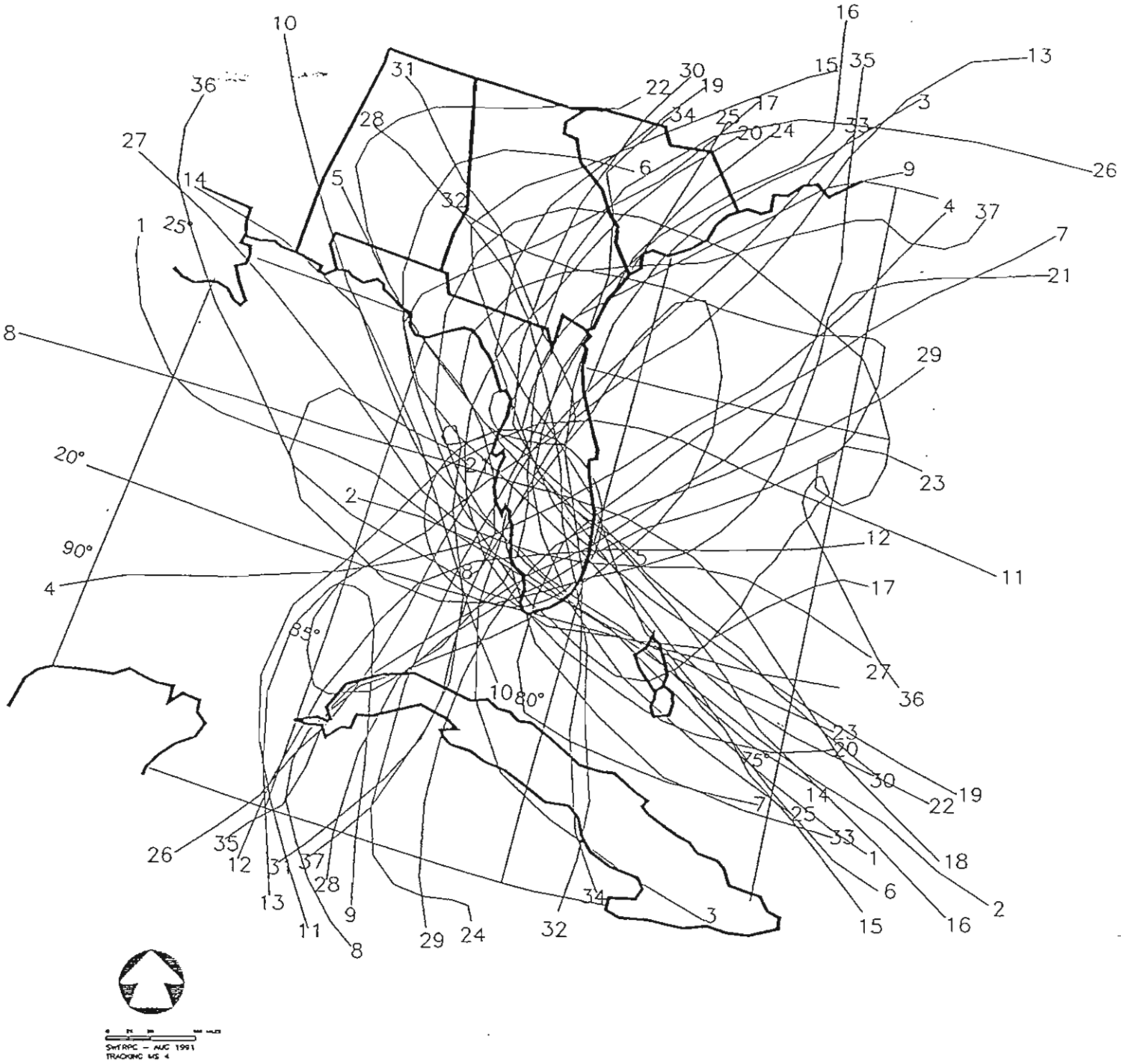


MAP I-4
HURRICANES PASSING WITHIN 100 MILES OF 26.6N 81.9W
1888 - 1990 FORT MYERS, FLORIDA

*Watersheds

The Myakka River heads in Manatee County, close by the Manatee River. Emerging from flat pastures and low hillocks, the river drops through Flatford Swamp to Myakka City, follows a narrow floodplain forest corridor to Tatum Sawgrass, and enters Myakka River State Park. The majority of lands above the park are pasture, rural lands, or agriculture. The park is a large tract of pine flatwoods, seasonal wetlands, and river hammocks, managed to maintain pre-settlement conditions. The park adjoins large tracts of similar land owned by Sarasota County, and managed for landfills, wellfields, recreation, and conservation. The river in the park widens into two large lakes and grassy wetlands. A large sinkhole in the river bed, "Deep Hole" is near the southern park boundary. From there the river falls through limestone and sand formations, surrounded by public lands or ranches, eventually reaching tidal influence below Rocky Ford. The tidal river extends through Sarasota and Charlotte Counties, losing water to the Blackburn Canal but gaining water from Deer Prairie Creek, Warm Mineral Springs, and Big Slough. Land use changes from low to high density residential along the downstream river, with some encroachments of trailer parks or canal communities between US 41 and El Jobean. Undeveloped lands along the lowermost river area are developing at a rapid pace.

The Caloosahatchee River originated as overflow from Lake Okeechobee, through marshlands and swamp forest. Improvements during the past century have converted the upper river to a canal into the Lake, controlled by discharge structures and locks. Taking Moore Haven as the head of the river, flows to the west now move through a straightened channel, some 50 miles to San Carlos Bay. Uplands east of Franklin Lock, the downstream-most control structure, are largely converted for agricultural purposes. Drainage and irrigation canals are numerous, and river water flows at time into or out of peripheral canals according to demand. Citrus has expanded considerably during the past decade. The river between Fort Myers and Cape Coral is highly urbanized. Most of the river area in Fort Myers already is urbanized, whereas the Cape Coral peninsula is infilling with residential and commercial growth.

The Peace heads in Polk County, from ambiguous hydrological connections south of the Green Swamp. Ground and overland flows follow natural and altered gradients through and around lakes, connector canals, flood control structures, reclaimed phosphate lands, and drained wetlands. Lake Hancock, in Lakeland, discharges surface water through a control structure to the nominal head of the Peace River, and discharges are joined by the flow of the Peace Creek canal system. In its drop through Polk County the river flows through a narrow river corridor. Historic headwater tributaries to the river in Polk County have largely been eliminated from past mining practices. Land use is a mixture of cities, expanding suburban development, agriculture, and phosphate lands. Phosphate lands include old mined areas and old reclaimed lands, new mines and new reclaimed lands, fertilizer plants with clay settling areas and gypsum stacks, and supporting service industries. Below Polk County, stream network density increases. The floodplain forest varies in width and the channel falls from Zolfo Springs in Hardee County to Arcadia in DeSoto County. The river reaches tidal influence above Fort Ogden, by which time 4 major

tributaries have contributed runoff from rural lands, ranches, and increasing acreages of citrus nd tomatoes. The tidal river corridor is largely undeveloped, and receives additional inflows from Shell Creek. The tidal river emerges from a braided channel system into the wide open waters of upper Charlotte Harbor, at Punta Gorda. Punta Gorda and Port Charlotte flank the mouth of the river, each largely developed into commercial and canal-front residential areas.

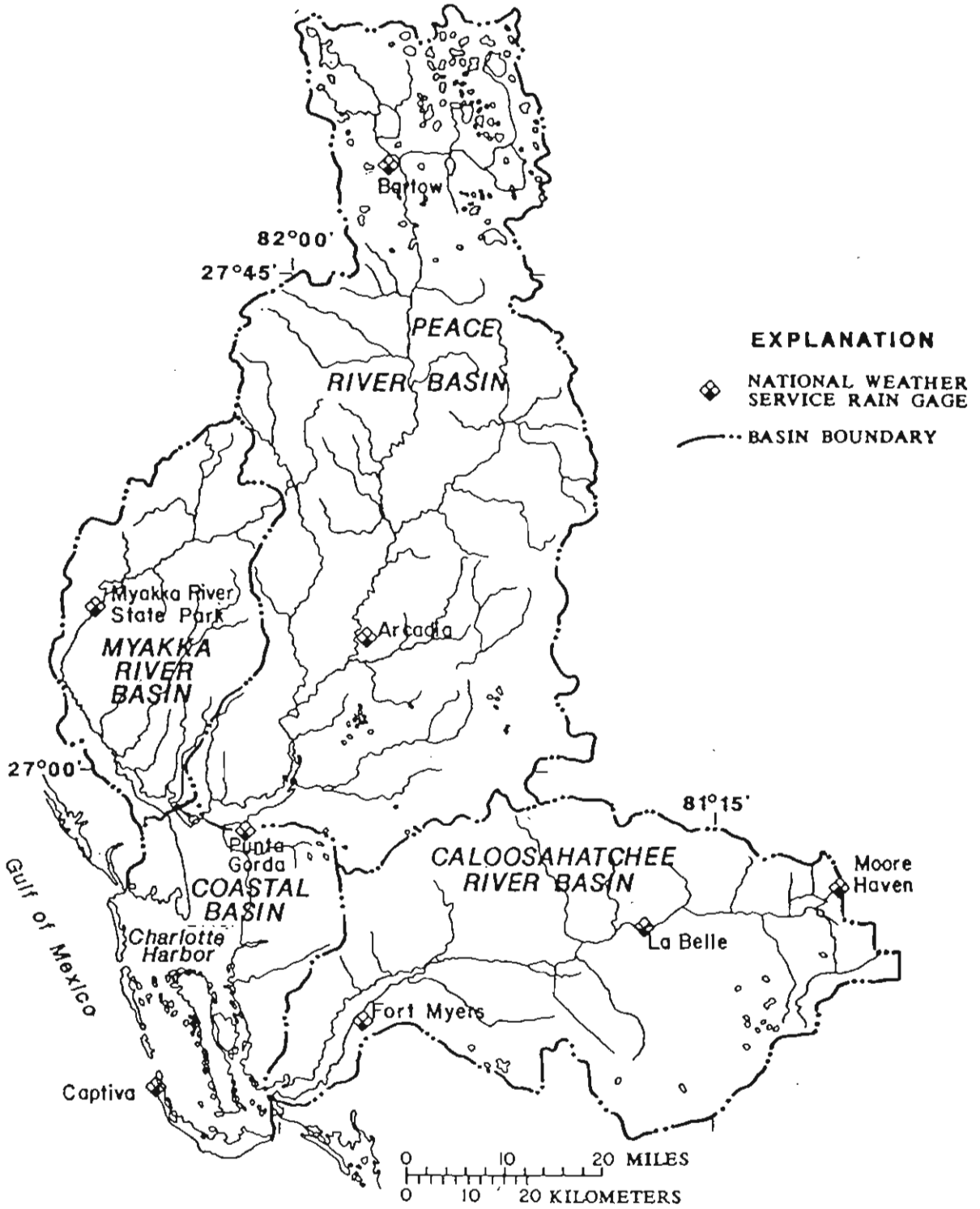


Figure 2.--Charlotte Harbor inflow area.

*Sixteen to One

For every acre or square mile of tidal water in Charlotte Harbor and adjoining estuaries there are close to 16 equal units of land within the region, drained to tide.

*Cow-Calf Ranching

Ranches occupy vast areas of the Harbor watershed. Cattle graze on unimproved or improved pastures which, prior to the 1950s, were unfenced. Then, cattle ranged freely across watersheds, prairies, and Cape Haze. Today, cattle roam over lands fenced with barbed wire. These are "cow and calf" ranches rather than dairies. Calves born throughout the basin are shipped to midwestern and plains states, where they can be fed abundant and inexpensive corn.

Ranches are relatively benign land uses. Fences interfere little with movements of native wildlife. Natural landscapes are opened up without completely removing wetlands or forested areas. Much of the Peace and Myakka's natural shoreline beauty results from ranchers' decisions to keep cattle from wetter areas. Ranchers also used prescribed burns to manage grasslands and native habitats. Runoff from ranchland tends to have few contaminants other than coliform bacteria and nitrogen from wastes. Earlier practices of unchecked pesticide use at "dipping stations" are avoided.

Economic pressures endanger future ranching. Development potential has raised the tax base of some ranches to critical levels. Some ranch families may be forced to divide land in order to pay estate taxes. Others will lease ranchland to citrus or tomato producers, which generally degrades land, soils, and water. The rural quality of the region depends on the maintenance of our ranching heritage.

*Myakka River and Watershed.

KEY WORDS AND CONCEPTS: Preservation, stable flow history, wild and scenic river, largest state park, instream lakes, natural sink holes and springs, existing management plans, protected uplands, large public support, future phosphate mining.

The Myakka River and watershed abut the Tampa Bay NEP to the north, and Sarasota Bay NEP to the west. The sub-area covers 3 counties in 2 regional planning councils and 1 water management district. The river has more freshwater wetlands than any other Harbor sub-area, and extensive tidal wetlands. Land uses are primarily rural in nature although urban uses are gradually increasing. The main agricultural activity in the watershed is cow-calf cattle ranching. To facilitate the need for range and pasture land much of the watershed has historically been drained or diverted. This has led to the use of some of the drained area for row crops, field crops and citrus groves. Increasing urbanization along the west bank of the river, and particularly in the North Port and Port Charlotte areas, is gradually forcing agricultural uses to the east and north. Much of the northern and central portions of the Myakka River Watershed, and portions of the river mouth, are under public protection. Myakka State Park is the largest of Florida's state parks, with an area of 45 square miles. Sarasota County has recently acquired the Carlton Reserve, a large land area located south and east of the park. The State of Florida owns portions of the tidal portion of the river (part of the Charlotte Harbor State Reserve). Other public entities owning or managing land within the Myakka River Watershed include the Southwest Florida Water Management District and the City of North Port. Within Sarasota County, the entire length of the Myakka River has been designated as a State Wild and Scenic River. A management plan is in place and the Florida Department of Environmental Protection enforces the plan's goals and policies through a permitting program for docking facilities and other types of land uses. The Department is advised by the Myakka River Management Coordinating Council, consisting of one member each state, regional, and local governments, plus citizen groups and private individuals. Recently. a private non-profit group, the Myakka Conservancy, adopted its own stewardship plan for the entire basin. The plan seeks to establish a greenways system, co-locate infrastructure, and protect existing land uses without additional regulation.

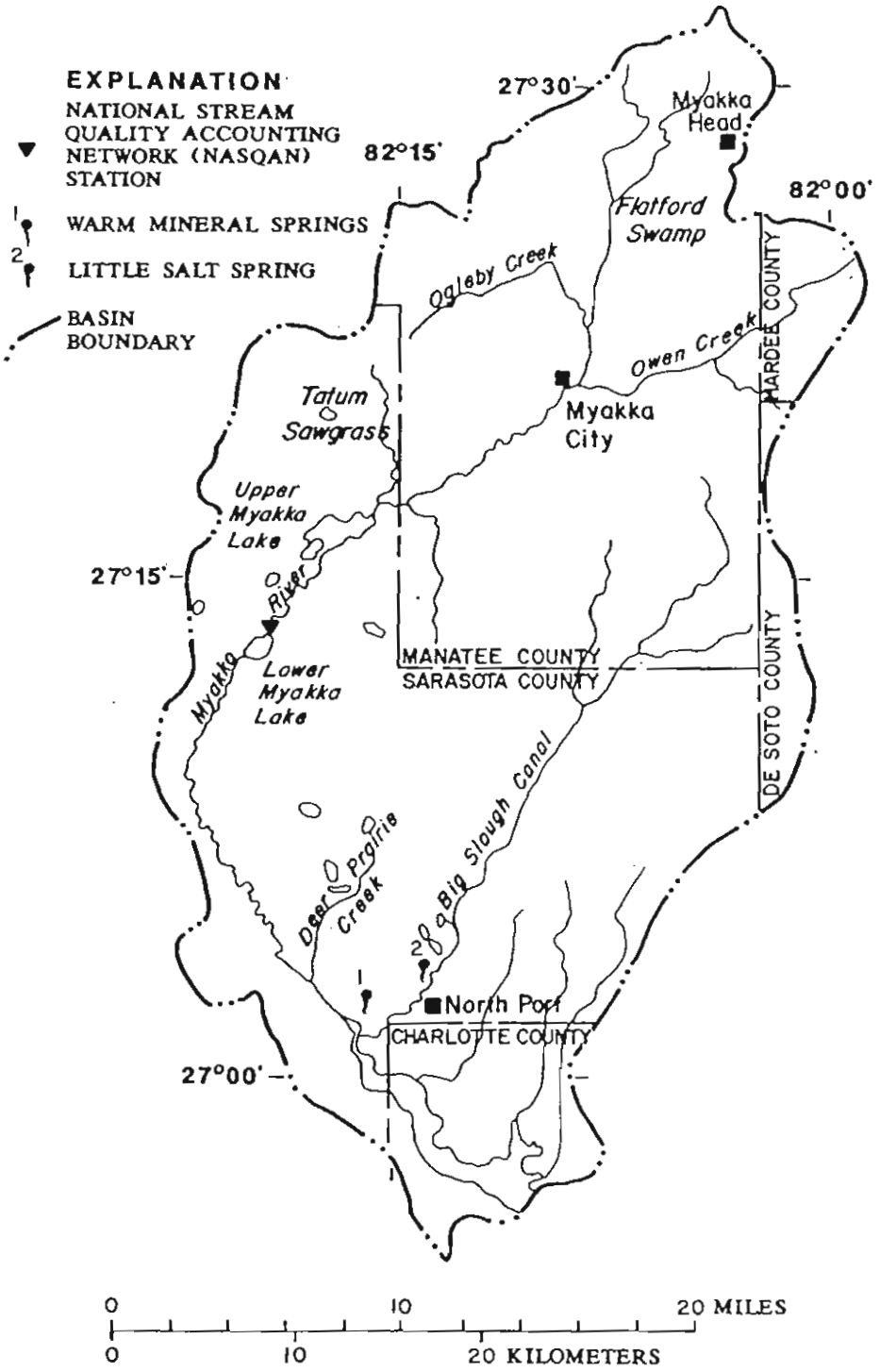


Figure 4.--Myakka River basin.

*Peace River Watershed.

KEY WORDS AND CONCEPTS: Declining stream flow, restoration, phosphate mines, reclaimed lands, ground water losses, regional habitat planning, Lake Hancock eutrophication, water supply diversions, Joint RPC Committee.

The Peace River and watershed abuts the Tampa Bay NEP, to the west; the Green Swamp Area of Critical State Concern, to the north; and the Kissimmee River Restoration Project, to the east. The Peace rises in part from the Green Swamp and numerous partially connected lakes and streams in central Polk County. These water bodies coalesce into a defined stream channel near the City of Bartow and flow southwest for approximately 105 miles to Charlotte Harbor. At 2,300 square miles, the watershed is the State's largest.

The watershed includes portions of Polk, Hardee, DeSoto, Charlotte, Hillsborough, Manatee, Sarasota and Highlands Counties, and adjoins the Myakka Watershed on its western boundary. Lakes and poorly drained swamps in the upper portion of the Peace River watershed act as important recharge areas for the Floridan Aquifer. The major tributaries of the Peace River include Peace Creek, Saddle Creek, Charlie Creek, Horse Creek, and Shell Creek. A number of urban areas have developed within the Peace River Watershed. These include Lake Wales, Fort Meade, Bowling Green, Bartow, Wauchula, Arcadia, Port Charlotte, and Punta Gorda, among others. Land use in the headwater (Polk County) reaches of the river are dominated by phosphate mining and beneficiation, phosphate fertilizer manufacturing, and allied support services. Phosphate has been mined in this region for more than a century. Large areas of old mined areas have been reclaimed, and created wetlands are numerous. Citrus, cattle ranching, and other agricultural activities occur in Polk County but are more common in downstream counties (DeSoto, Hardee), where mining is projected to occur. Combined effects of mining, farming, municipal supply, and other activities has caused the flows of fresh water in the upper Peace River to decline significantly through time. Declining flows are most apparent upstream, and declines are not measured at downstream gaging sites such as Arcadia. Land use near the Peace and Myakka Rivers, near Charlotte Harbor, was historically cow-calf ranching. After World War II, vast areas of ranch land and natural land cover were subdivided and sold on installment plans as single residential lots. Communities of North Port, Port Charlotte, and Punta Gorda have grown rapidly as a result, and hundreds of thousands of platted, sold lots will be developed in the near future. (1.1 million platted lots in the southwest Florida region.)

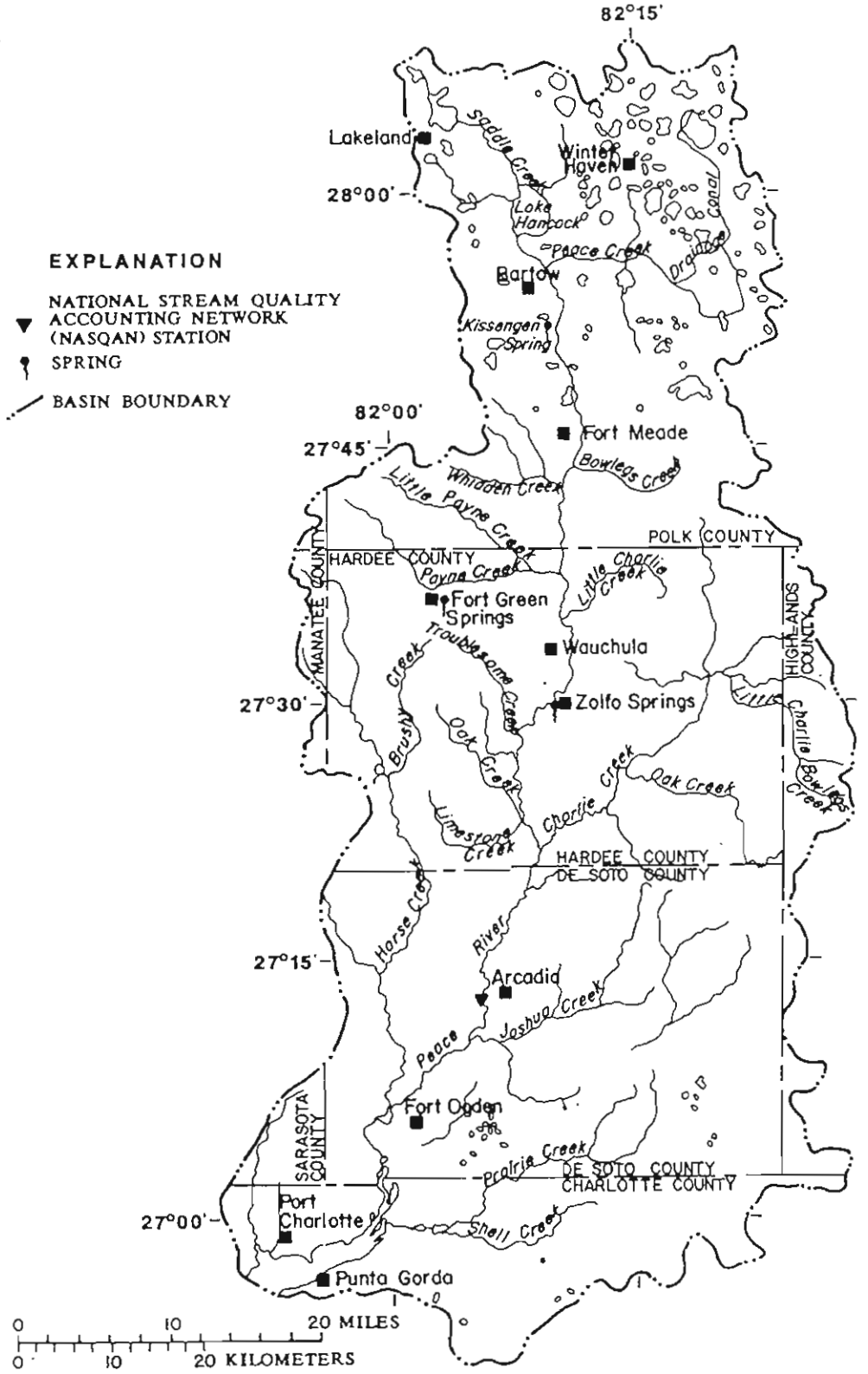


Figure 5.--Peace River basin.

*Charlotte Harbor (Proper).

KEY WORDS AND CONCEPTS: Protected wetlands, seagrass losses, urbanization, canals, septic tanks in old and new neighborhoods, EMAP monitoring, strong public support, mature and recent management programs.

This sub-area is comprised of the main portion of the estuary: the largely open body of water, primarily within Charlotte County, which is known as Charlotte Harbor. It includes upper, middle, and lower harbor reaches and tidal waters connecting the Harbor to the Gulf of Mexico through Boca Grande Pass. Tidal effects on water level extend far up the Peace and Myakka Rivers from the Harbor. Although salt water extends up rivers during periods of low flow, typical summer flows freshen the rivers to their mouths and cause the Harbor to stratify with respect to vertical density (salinity) gradients. Hypoxia is a natural process in the Harbor. Remarkable features of this sub-area's geography include the fact that nearly all wetlands (mangrove forests, salt marshes) surrounding the Harbor are publicly owned. Very large upland buffer areas, and many islands, are also publicly owned. Other upland buffer areas were converted to "interceptor waterways" during earlier phases of residential development.

*Lemon Bay/Gasparilla Sound/Cape Haze Complex.

KEY WORDS AND CONCEPTS: Intracoastal Waterway, tidal inlets, barrier islands and beaches, Port Boca Grande, sea grasses, fisheries, national wildlife refuges.

The Lemon Bay-Cape Haze Complex is a series of narrow embayments, with their coastal watersheds, extending southward from the vicinity of Venice, in Sarasota County, along the Cape Haze/Englewood shoreline of Sarasota and Charlotte Counties, and curving eastward to the southeast tip of the Cape Haze Peninsula. The interconnected waterways in this area are typically lagoonal, and are separated from the Gulf of Mexico and open waters of Charlotte Harbor by a series of barrier islands. The exception to the lagoonal pattern is Gasparilla Sound, which is a broad, open body of water. Lemon Bay proper, the northernmost portion of the estuarine complex, is a 15 mile long, narrow embayment separated from the Gulf of Mexico by Manasota Key (actually a peninsula stretching southward from Venice) and Knight Island. Bay waters meet the Gulf at Stump Pass, between the two islands. Historically, there was another pass; now called Blind Pass; on Manasota Key. However, this pass is now closed. Old Knight's Pass, on Knight Island, is another former pass. The Gulf of Mexico can also be reached through Placida Harbor, to the south, and the Venice Bypass Canal (Intracoastal Waterway), to the north. The Canal was dredged in 1966 by the Army Corps of Engineers, and provides a navigation route between the Sarasota Bay NEP area and Lemon Bay. Similarities between the Sarasota Bay NEP study area and this sub-area of the Charlotte Harbor NEP are several, including: geometry of Lemon Bay and Little Sarasota Bay; influence of the ICW; shoreline types and wetland trends; distribution and abundance of sea grasses; effects of upland development, including septic tanks, and the evanescent nature of tidal inlets. Sarasota Bay CCMP action plans will be transferable directly to this sub-area of the new NEP. South and east of Placida Harbor is the large open body of water known as Gasparilla Sound. This area is part of the Gasparilla Sound - Charlotte Harbor State Aquatic Preserve. Gasparilla Sound communicates with the Gulf of Mexico through Gasparilla Pass. The Pass is located between Little Gasparilla Island and Gasparilla Island. Southward, Gasparilla Sound merges into the southwesterly extension of Charlotte Harbor proper. Gasparilla Sound has three major freshwater tributaries, all located on the Cape Haze Peninsula. The southern portions of these watersheds are part of the State's Charlotte Harbor State Reserve System and are predominantly in their natural condition. East of Gasparilla Sound, and separated from it by a series of small barrier islands, is Bull Bay. The islands surrounding Bull Bay are uninhabited and are either part of the Charlotte Harbor State Reserve or the Island Bay National Wildlife Refuge. Turtle Bay is a large embayment within the Cape Haze Peninsula. Like Bull Bay, its entire area is encompassed either by the State Reserve or the National Wildlife Refuge.

*Pine Island Sound/Matlacha Pass.

KEY WORDS AND CONCEPTS: traditional sea trout fishery, lost scallop fishery, intracoastal waterway, interceptor waterways, national wildlife refuge, tidal inlets, barrier island development.

These are the two large Lee County estuaries immediately south of Charlotte Harbor, proper. The two waterways are separated by Pine Island, a relict upland area isolated by sea level rise. Four barrier islands separate the Sound from the Gulf of Mexico: Cayo Costa, Little Captiva, Captiva and Sanibel. The Sound is connected to the Gulf of Mexico, indirectly, by Boca Grande Pass; and, directly, by Captiva Pass, Red Fish Pass, Blind Pass and San Carlos Bay. Freshwater is supplied to Pine Island Sound mostly by sheetflow from the surrounding islands. However, numerous small creeks and swampy areas on Pine Island also provide freshwater; as does the Sanibel River on Sanibel Island. Periodically, during large releases from the Caloosahatchee River, outflow can discharge freshwater to the southern portion of the Sound. Matlacha Pass is the narrow body of water between Pine Island, Little Pine Island, and the mainland area of Cape Coral. The Pass has no direct connection to the Gulf of Mexico. It is connected indirectly through Charlotte Harbor (Proper), to the north, and San Carlos Bay, to the south. Freshwater is provided through numerous creeks and swampy areas on both the mainland and the Pine Islands.

*Tidal Caloosahatchee Watershed.

KEY WORDS AND CONCEPTS: Lake Okeechobee, commercial navigation traffic, locks, excess freshwater inflows, urban river, manatees, salinity and turbidity shocks, agricultural and urban runoff.

This sub-area includes the western-most portion of the Caloosahatchee River Valley and San Carlos Bay. To the east, the sub-area extends to the Army Corps of Engineers' W.P. Franklin Locks. The Tidal Caloosahatchee River communicates with the Gulf of Mexico through San Carlos Bay. The major freshwater source into the watershed is the upstream portion of the Caloosahatchee River. However, significant sources of freshwater also include Telegraph Creek, the Orange River, and smaller tributaries. Considerable freshwater also enters the River from urban runoff and the Lee County area's extensive network of navigational and drainage canals. The modern Caloosahatchee is a channelized flood control and navigational waterway. As such, it is part of the cross-state Okeechobee Waterway: from the Atlantic Ocean to the Gulf via the St. Lucie River, Lake Okeechobee and the Caloosahatchee. The distance from the W.P. Franklin Locks to the Gulf of Mexico is approximately 30 miles. Land use in the upper (east) basin is still dominated by rangeland and agricultural uses; although urbanization is increasing. Freshwater and tidal wetlands also constitute a major land use within the watershed. The urbanized communities of Cape Coral, Fort Myers and North Fort Myers dominate land uses along the lower portion of the river. San Carlos Bay is influenced directly by flows from the river. The majority of the Bay's shoreline is vegetated by mangroves. The economy of San Carlos Bay is based on fisheries, tourism and marine recreation.

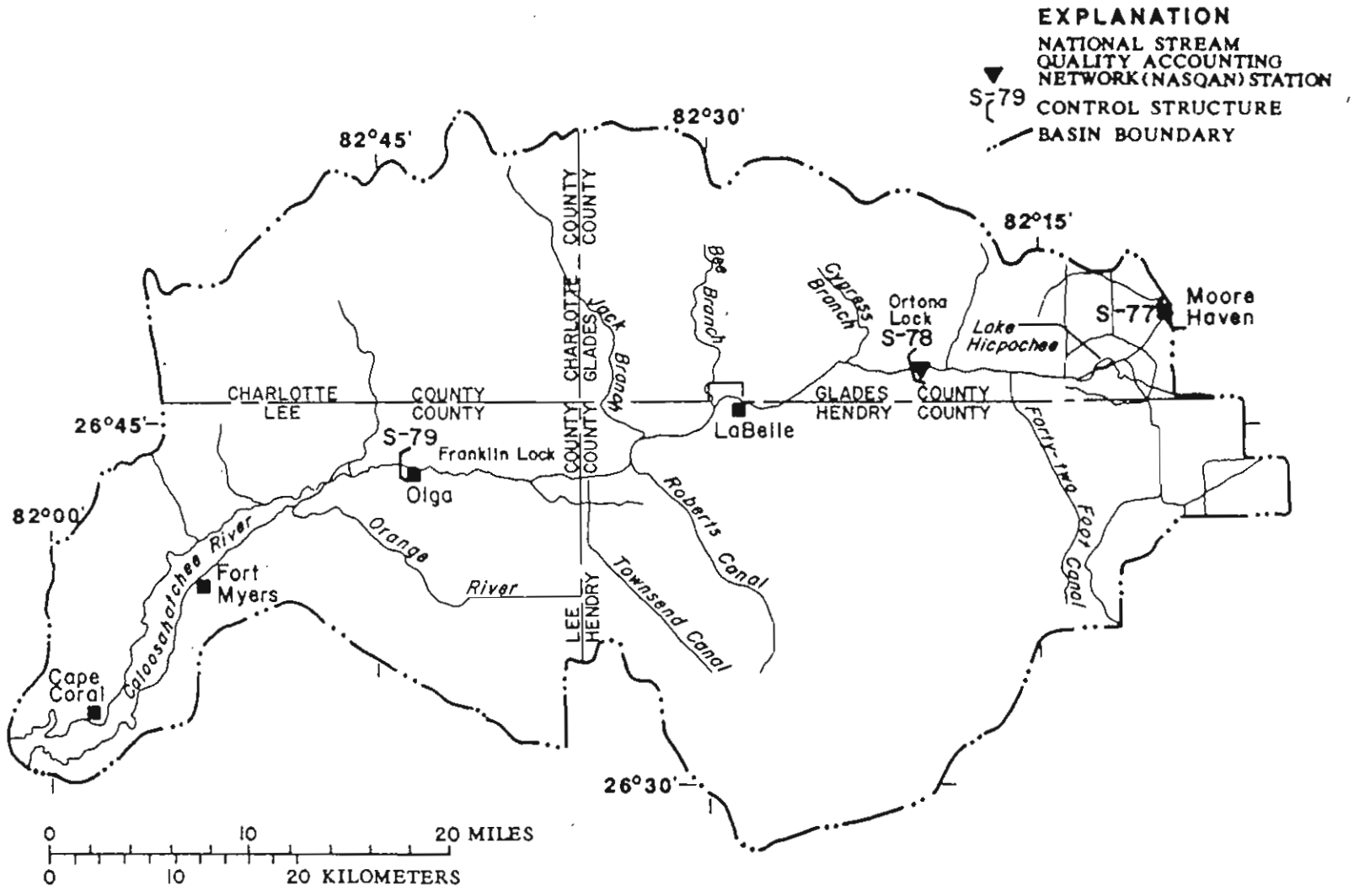


Figure 6.--Caloosahatchee River basin.

*Estero Bay Watershed.

KEY WORDS AND CONCEPTS: lagoonal waters, state special waters, Six Mile Cypress Strand, salinity intrusion, urban encroachment.

The Estero Bay Estuary extends from Matanzas Pass, near Caloosahatchee River, to the Imperial River Mouth and the Lee County/Collier County Line, to the southeast. The Bay is defined on the west by the barrier island chain extending from San Carlos Bay south to the County Line. These same boundaries are largely contiguous with those of the Estero Bay State Aquatic Preserve. The tributary watersheds of Estero Bay also enjoy State protection as the "Estero Bay Tributaries Special Waters". The surface water area of Estero Bay is slightly more than 15 square miles. The inland watershed extent encompasses 293 square miles (primarily within Lee County). There are no incorporated cities within the watershed. However, several large residential developments occur on the mainland. Much of the barrier island chain has been developed as part of the Fort Myers Beach and Bonita Beach communities.

The Bay communicates with the Gulf of Mexico via several passes between and among the various barrier islands. From north to south, these are Matanzas (or Estero) Pass (which also connects to San Carlos Bay), Big Carlos Pass between Estero Island and the Lovers Key Island Complex, New Pass between the Lovers Key Complex and Big Hickory Island, and Big Hickory Pass between Big Hickory Island and Bonita Beach Island. The major islands forming the outer barrier island chain are Estero Island, the Lovers Key Complex (Long Key, Lovers Key, Black Island), Big Hickory Island, Little Hickory Island and Bonita Beach Island (the latter extends south of the County Line and away from the Watershed). The numerous islands are dominated by mangrove vegetation. Extensive seagrass beds occur within the many shallow bays. Structural projects have been completed, or are underway, on Hendry Creek, Ten Mile Canal, and the Kehl Canal to increase water levels and to protect these resources against saltwater intrusion. The Estero River east of U.S. 41 has slow conveyance and is considered a good recharge area, as is the Imperial River east of 1-75. The Estero River Watershed also receives flows from the Six Mile Cypress Strand, in Central Lee County, which is an important recharge area.

Add Arnold Committee language

*Groundwater

The entire State of Florida is underlain with an enormous, complex system of porous limestone or sand aquifers. Unlike much of Florida, however, the aquifers under the Charlotte Harbor area contain only limited amounts of freshwater suitable for public water supplies without extensive and expensive treatment. Prior to the burgeoning growth of this area, the groundwater supplies were adequate to sustain moderate agricultural and domestic needs. But as more wells were drilled in search of more freshwater, the inadequacy of the supply became apparent. As increasingly greater amounts of water were withdrawn from the coastal aquifers, water pressure in the aquifers were correspondingly reduced, allowing salt water to intrude into and contaminate the aquifers. Consequently, local domestic water supplies have come to rely on increasingly saline water. Today all but the most saline water is considered a potential valuable source of treatable freshwater, although reverse osmosis and desalination treatment process are the most expensive.

The top layer of the groundwater system is the water table aquifer. It consists of a blanket of sand, shell and clay deposited during the Pleistocene Epoch and varies in thickness from only a few feet to more than 100 feet. The water table aquifer is used extensively in some areas and frequently yields water of good quality, but hard in character and high in color and iron. Nonetheless, in these areas this aquifer provides the only groundwater suitable for domestic use without desalination and extensive treatment. The well fields of Englewood, Cape Haze, Gasparilla Island and Ft. Myers all tap this aquifer.

The water table aquifer is so close to the surface that it is recharged locally by rainfall. But its proximity to the surface also makes it vulnerable to damage and contamination from development activities. Throughout the Charlotte Harbor area the water table aquifer has in fact been lowered by drainage improvements and the construction of hundreds of miles of residential canals. This has greatly aggravated the problem of salt water intrusion.

In many areas the water table aquifer has also been contaminated by saline water rising upward through agricultural wells drilled into deeper, highly salty artisan aquifer formations, such as the Lower Hawthorne and the Suwannee. Many of these wells have been abandoned, but remain uncapped. As a consequence, salt water flows up the abandoned well casing and freely contaminates the water table aquifer, as well as mid-level aquifers. According to the U.S. Geological Survey, there may be between 8,000-12,000 free-flowing wells in the Charlotte Harbor region. The Southwest Florida Water Management District and local governments are attempting to locate and plug many of these wells. However, efforts are very expensive.

The water table aquifer makes a valuable contribution to the overall groundwater system. However, this aquifer is more readily affected by development than any other aquifer. the combination of lowered water tables, salt water intrusion, contamination by uncapped abandoned wells and pollution from septic tanks has greatly reduced its potential for increased future use as a public water supply.

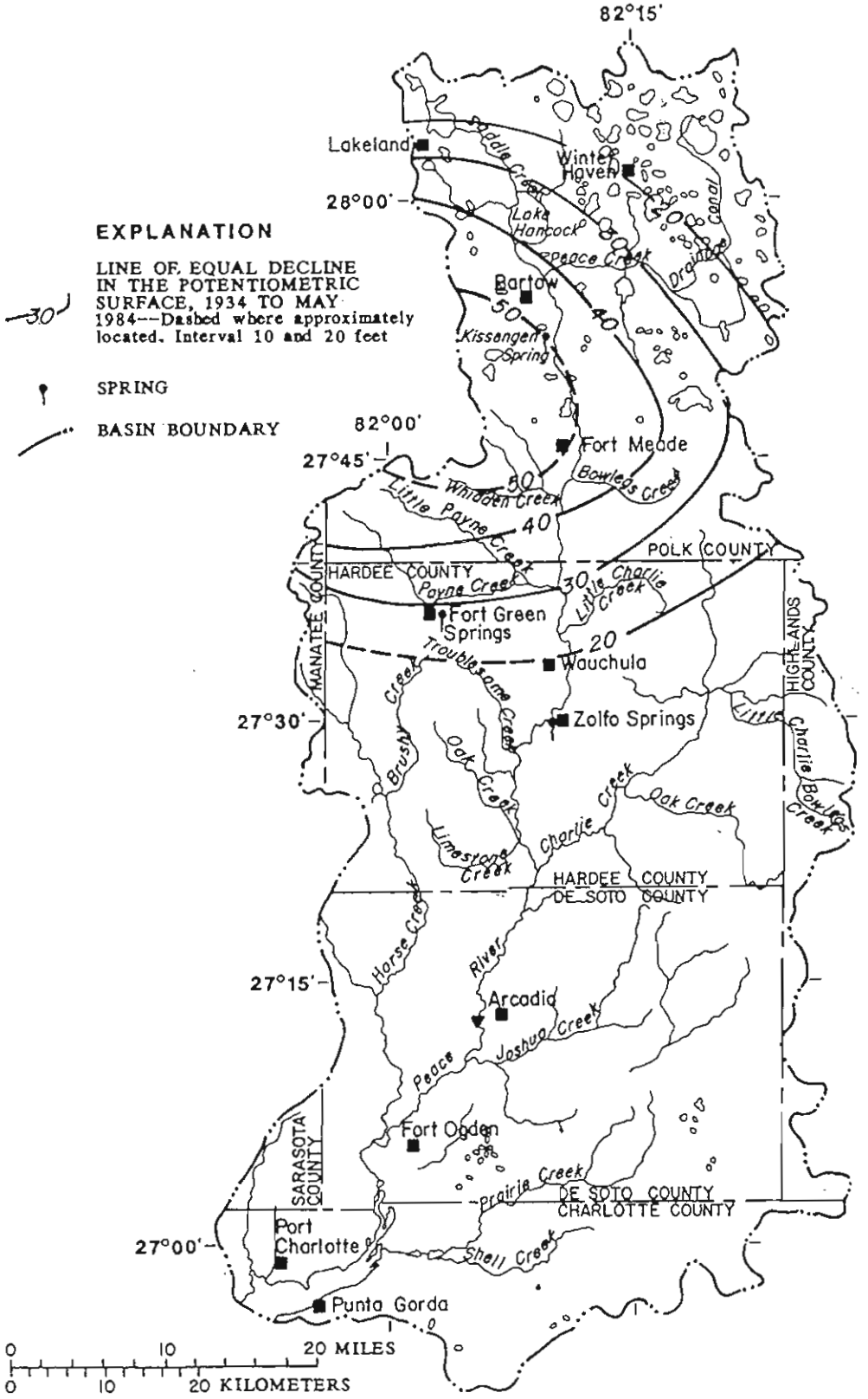


Figure 12.--Generalized decline in the potentiometric surface of the Floridan aquifer system, 1934 to May 1984.

*Surface Water Budget

Charlotte Harbor and its adjoining waters are estuarine by virtue of fresh water mixing with salt water from the Gulf of Mexico. Gulf waters fill all lands below sea level even without fresh water inflows. To reduce the salinity of tide waters, some 1.7 million acre-feet, by half or more requires a substantial quantity of fresh water. How much? In terms of average daily discharge gaged in cubic feet per second (cfs),

Myakka River near Sarasota	244 cfs
Big Slough near Myakka City	28 cfs
Deer Prairie Slough near North Port	21 cfs
Peace River at Arcadia	1,084 cfs
Shell Creek near Punta Gorda	348 cfs
Caloosahatchee River near Olga	1,740 cfs

...provides for a minimum gaged inflow of 3,465 cfs. Arbitrarily doubling this value to account for runoff from ungaged coastal areas, direct rainfall, and groundwater contributions approaches an average daily influx of about 7,000 cfs, a total inflow compatible with estimates made by the U.S. Geological Survey. If the Harbor and adjoining inshore tidal areas were dry, a 7,000 cfs rate of fresh water inflow would fill them in about 4 months!

As large a rate of inflow as 7,000 cfs is, it is instructive to note that such flow is less than that of Florida's fourth largest river, the Choctawhatchee.

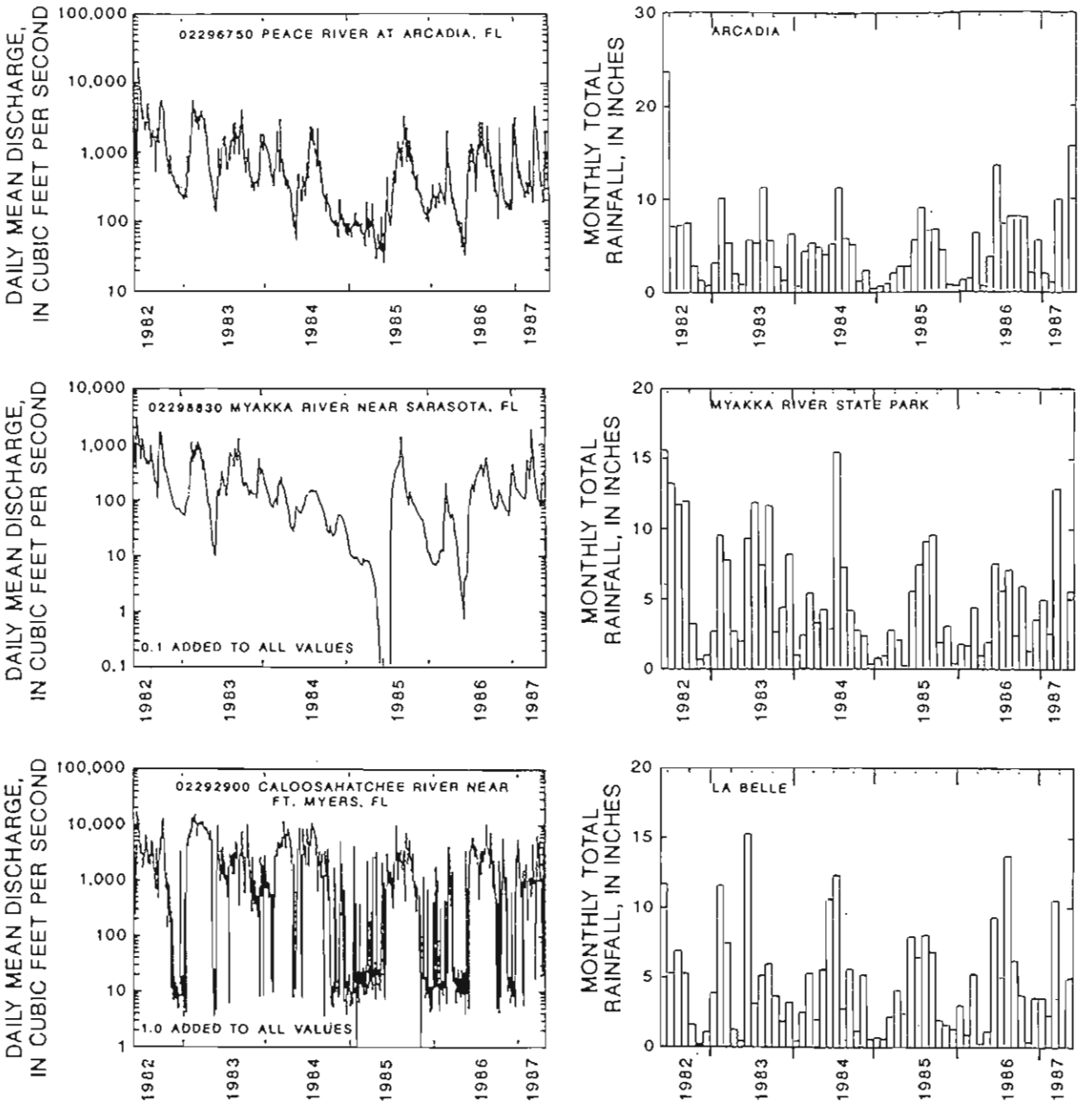


Figure 4. Daily mean discharge and monthly rainfall in the Peace, Myakka, and Caloosahatchee River basins, June 1982 to May 1987.

tidal canal networks and filling of adjacent low-lying areas for residential development of the city of Cape Coral (Goodwin, 1991). The 400 mi of dredged canals within the 104-mi^2 area of Cape Coral have altered historic drainage patterns to the lower tidal Caloosahatchee River. The canals receive freshwater from direct rainfall, runoff from the basin adjacent to the canals, freshwater inflow from inland canals, and seepage from the surficial aquifer (Goodwin, 1991). This freshwater eventually enters the tidal Caloosahatchee River about 3 mi upstream of the mouth.

Hydrographs of daily mean discharge for the most downstream gages on the Peace, Myakka, and Caloosahatchee Rivers and corresponding monthly rainfall at one site in each basin are shown in figure 4. Gage locations are shown in figure 1. Factors of 0.1 and 1.0 ft^3/s were added to the daily mean discharges for the Myakka and Caloosahatchee Rivers, respectively, to allow use of a semilog plot. Minimum discharges at these gages are actually 0 ft^3/s. Discharges measured at the Peace and Myakka River gages shown in figure 4 represent 58 and 38 percent, respectively,

*Hydrological Alterations

Hydrological alterations in the region take many forms. Some, like channelization of the Caloosahatchee River, have been massive. Others, like ditching and drainage of farmlands in the upper Myakka River, have been numerous but poorly documented or analyzed with respect to their cumulative impacts. The least-well understood aspect of hydrological alterations concerns changes in large-scale meteorological patterns in the region-- the possibility has been raised that urbanization or agricultural conversion of rural lands may affect the setup of convective cloud systems, land-sea temperature differences, or summer thunderstorm activity.

Watershed alterations are numerous. In the Myakka basin ditching and drainage of wetlands is common. The possibility that altered hydroperiods are causing tree mortality in Flatford Swamp is presently under study. Diking in Tatum Sawgrass, and construction of the Clay Gulley cutoff, altered the location, timing and amount of water entering Myakka River State Park. Dikes in Tatum Sawgrass aggravate flooding downstream. Though not well understood, it generally is accepted that the construction of a dam in Upper Myakka Lake and levee in Vanderripe Slough affected river flows. A cutoff from the lower River to Curry Creek diverts an estimated 10% of peak flows from Charlotte Harbor to the Gulf of Mexico near Venice. Impoundment and straightening of Big Slough also has affected its contributions of water to the tidal river.

The most significant changes to the hydrology of the Peace River have occurred in Polk County. Reduced recharge to the Floridan aquifer, and extreme pumping, caused the cessation of flow from Kissengen Springs. At times, the entire flow of the Peace River has been seen to disappear into the river bed, probably entering the intermediate aquifer. Headwater tributaries of the Peace River in Polk County have been almost completely eliminated, the result of large-scale land modifications caused by mining. The loss of these tributaries resulted in changes in headwater habitat and water quality, as well as losses in water supply for the river. Still farther upstream, numerous structural changes affect the Winter Haven Chain of Lakes. Stage regulation, inter-connecting channels, and wetland losses radically change natural headwater flows to the upper Peace. Downstream, a major tributary, Shell Creek, is impounded as a water supply reservoir for the City of Punta Gorda, and the Peace River/Manasota Regional Water supply Authority diverts water from the river for offstream storage.

The region's most massive hydrological changes occur in the Caloosahatchee River and watershed. The river has been connected to Lake Okeechobee, and is used with other rivers and canals to manage lake levels. The river is channelized for flood control and navigation, transforming a shallow, meandering stream with natural banks into a straighter, deeper, and unnatural waterway. Water flow is regulated by three control structures and lock systems. Water levels are maintained at levels favorable for agriculture--resulting in occasional upstream flows of water. A growing network of secondary canals in the watershed bring runoff and irrigation waters to the main channel. As a result, massive discharges of freshwater to the lower river estuary and San Carlos Bay may have as much flow from the watershed, as from Lake Okeechobee.

The hydrological integrity of tidal waters has been changed, though less extensively than in rivers and watersheds of the region. The Intracoastal Waterway created a relatively deep north-south channel through Lemon Bay, Gasparilla Sound, and Pine Island Sound, affecting tidal prism energy and inlet stability. Numerous spoil areas also were formed by ICW construction. Scallop populations in lower Pine Island Sound and San Carlos Bay were eliminated by hydrological changes caused by construction of the Sanibel causeway. Impoundment of Sanibel wetlands for mosquito control caused extensive mangrove mortality, which has since been ameliorated by good management practices. Interceptor waterways on the Cape Haze and Cape Coral peninsulas collect runoff from canal systems and store large volumes of brackish water inland of fringing mangrove systems. Their ecological effects on mangrove hydrology are not well studied.

Groundwater changes, in addition to those described for Polk County, are regionally extensive. Overpumping of groundwater in Manatee and Southern Hillsborough counties has affected potentiometric surfaces and lateral flow patterns in the Myakka basin. The majority of southwest Florida is designated as a Southern Water Use Caution Area by the Southwest Florida Water Management District, and saltwater intrusion into coastal aquifers in Sarasota, Charlotte and Lee counties has been occurring at a steady pace for more than two decades.

EXAMPLES OF HYDROLOGICAL ALTERATIONS IN GEOGRAPHIC SUB-AREAS OF THE CHARLOTTE HARBOR NEP

	Decreased Flow	Increased Flow	Altered Timing	Altered Location
Myakka Basin	Peak flow transfer to coastal basin via Blackburn Canal	Big Slough Channelization	Drainage of Tatum Sawgrass	Clay Gulley Cutoff; Vanderripe Slough levee
Peace Basin	Loss of Kissengen Springs	Polk County point source discharges	Lake Hancock regulation	Charlotte County drainage/canal systems
Caloosahatchee Basin	Reduction of dry season flows to tide	Agricultural tail-water runoff	Drainage of Lake Okeechobee	Sanibel Causeway
Coastal Systems*		Myakka River popoff to Venice	Salinity barriers (Coral Creek)	Drainage culverts, interceptor waterways

*Estero, Lemon Bays; Pine Island, Gasparilla Sounds; Matlacha Pass

*Whither Water

We divert and augment water from streams in many ways. No water is presently taken for water supply from the Myakka River, though the Blackburn Canal - Curry Creek system diverts peak flows to Venice, ostensibly for flood control. North Port takes about 1 million gallons per day (mgd) from canals collecting in Big Slough. The Manasota/Peace River Water Supply Authority diverts about 6 mgd from the Peace River near Fort Ogden, and over the next few decades may increase diversions to 20- 30 mgd. Withdrawals vary on schedules set by the SWFWMD, though the impact of present and future diversions remains one of the most controversial public issues in the region.

Punta Gorda draws about 4 mgd from Shell Creek, an impounded tributary of the Peace River. Lee County and Fort Myers draw water from the Caloosahatchee River upstream of Franklin Lock at Olga, at a combined average rate of about 10 mgd. Downstream of the lock, a power plant uses water for cooling but returns the heated water to the Caloosahatchee River. Other public water supplies in the region are provided by ground water resources.

The Myakka receives little in the way of effluent, on average less than 1 mgd. Some 25 facilities have permits to discharge domestic effluents to the Peace River and its tributaries-- these have a combined design capacity of about 20 mgd, though variations are considerable. Another 60 facilities have permits to discharge industrial effluents to the Peace River, mostly in Polk County. These discharges are unpredictable and difficult to sum as average flows, but 10 mgd is a conservative estimate. Fourteen domestic and industrial facilities are permitted to discharge a total of about 35 mgd to the Caloosahatchee River.

This tally is greatly simplified and does not include groundwater lost to streams from pumping, small diversions or inputs, or changes of flow due to changing land uses. At face value, though, permits for humans to "pipe" water in or out of rivers allow for a larger volume of discharges, than diversions. These exchanges are not perfect replacements-- in fact, they differ greatly with respect to amount, location, timing, and water quality. Moreover, the SWFWMD SWIM Program finds that most of the nitrogen and phosphorus loads of the upper Peace River originate from industrial sources. Significant reductions in nutrient loads could be accomplished by reducing such effluents, but doing so will also reduce the flows of fresh water in the River. Complex models allocating flows and wasteloads may be required to distinguish benefits from liabilities of eliminating permitted discharges.

*Declined Flows

Gaged flows of Tampa Bay and Charlotte Harbor streams, combined, were recently compared by the US Geological Survey, to flows from 11 other regions of the American Gulf coast. When analyzed for short-term or long-term trends through time, other regions have had stable or increasing stream flows. Of all Gulf coast regions, only streams of central and southwest Florida had declining flow trends (since 1940). Declining flows were evident for both short-term and long-term trends.

Declining flows throughout the region are due to a complicated combination of climate trends, over-pumping of ground waters, alterations of land use and surface runoff, impoundments, and water diversions.

In the Peace River at Arcadia, there has been a decreasing trend in 5-year moving averages of annual mean discharge since the mid 1960s. The rate of declined flow through 1980 was about minus 3 cfs per year. Rainfall deficits are associated with part of the declined flows, but another measure of declined flows cannot be explained by climate. The cessation of Kissengen Springs' flows from 1934 to 1950, and the disappearance of base flows into the streambed south of Bartow during the 1980s, implicate adverse surface impacts of excess groundwater demands.

More than groundwater stress is probably involved. Rainfall trends are stable for the Myakka River basin, as well as for the Peace basin during dry seasons, but wet season rainfall has declined significantly in the Peace basin, about a tenth of an inch per year, since 1935. Wet and dry season flows in the upper Peace River, and wet season flows in the Myakka River, show significant declines. The depression of wet season flows in the Peace extends downstream to Arcadia.

Given the importance of freshwater inflows in maintaining Harbor productivity, such trends are of concern to citizens and Harbor managers. The trends provide a backdrop against which accelerated public-supply diversions have been called into question by legal challenges. Diversions are located near tide, so as to reduce total flows by relatively small amounts for the near future. Through cooperative efforts there will be time to determine likely Harbor consequences of diverted flows, not only for downstream public supply, but also upstream-- where the larger challenge awaits of understanding all factors regulating river flow.

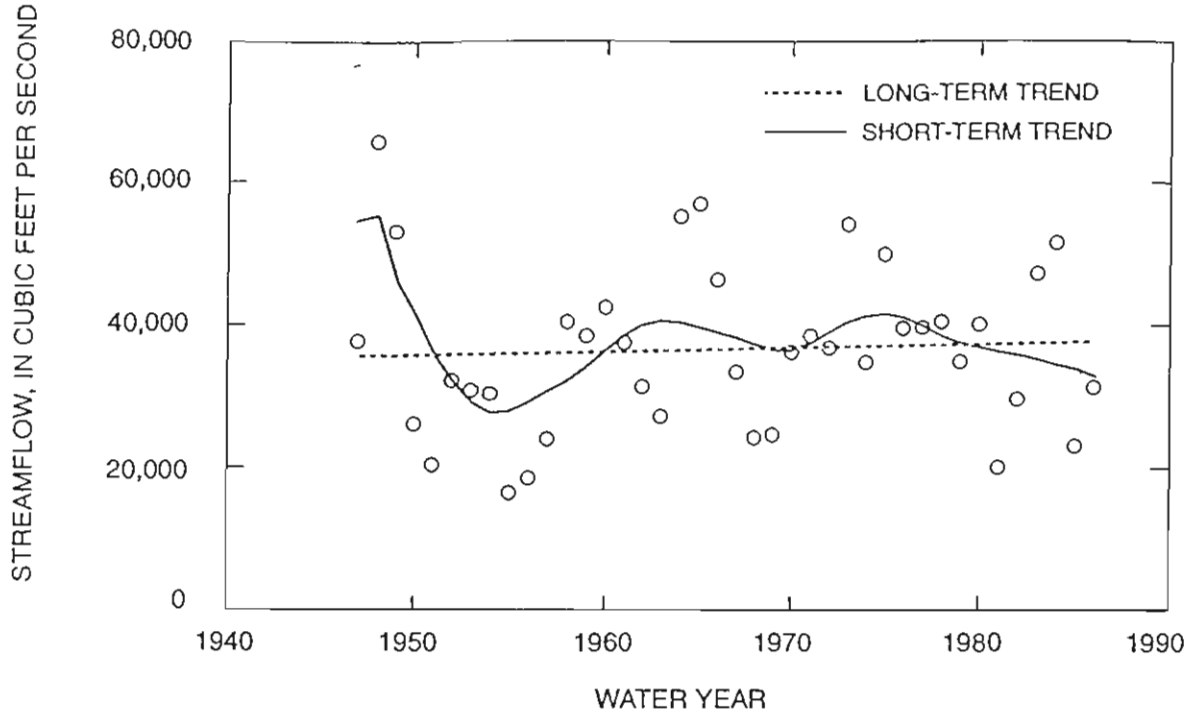


Figure 12. Temporal trends in total gaged annual mean streamflow into hydrologic segment 11, Gulf of Mexico coast (see fig. 1).

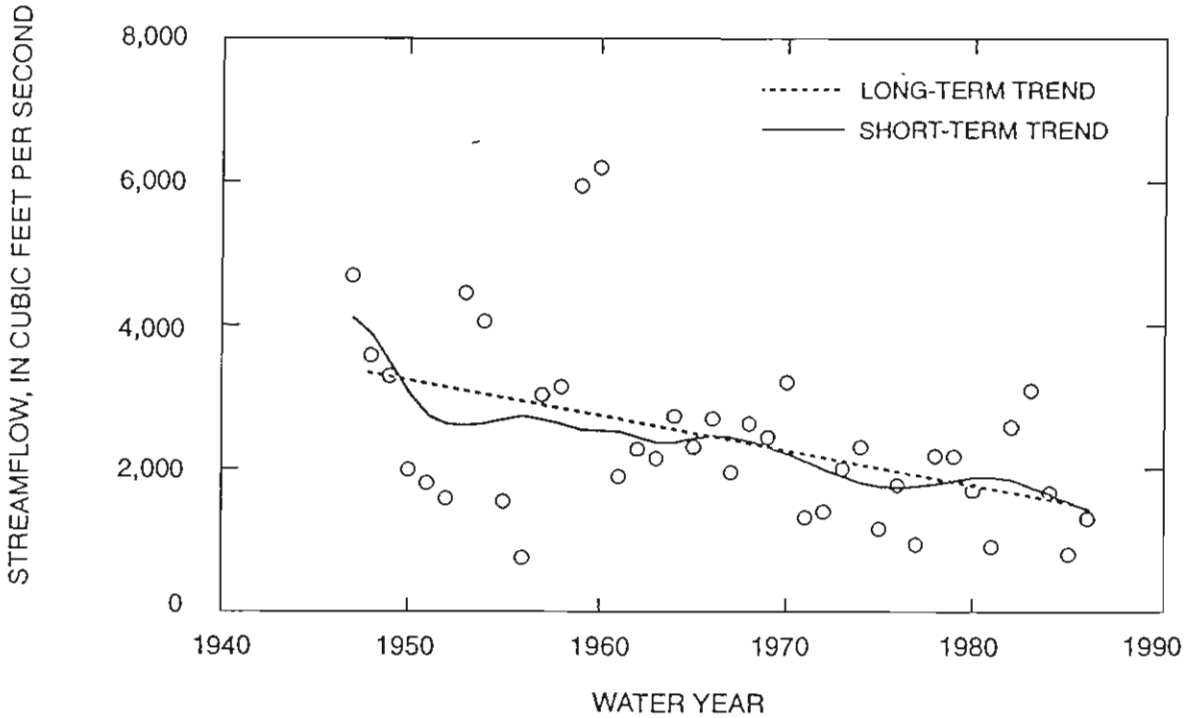


Figure 13. Temporal trends in total-gaged annual-mean streamflow into hydrologic segment 12, Gulf of Mexico coast (see fig. 1).

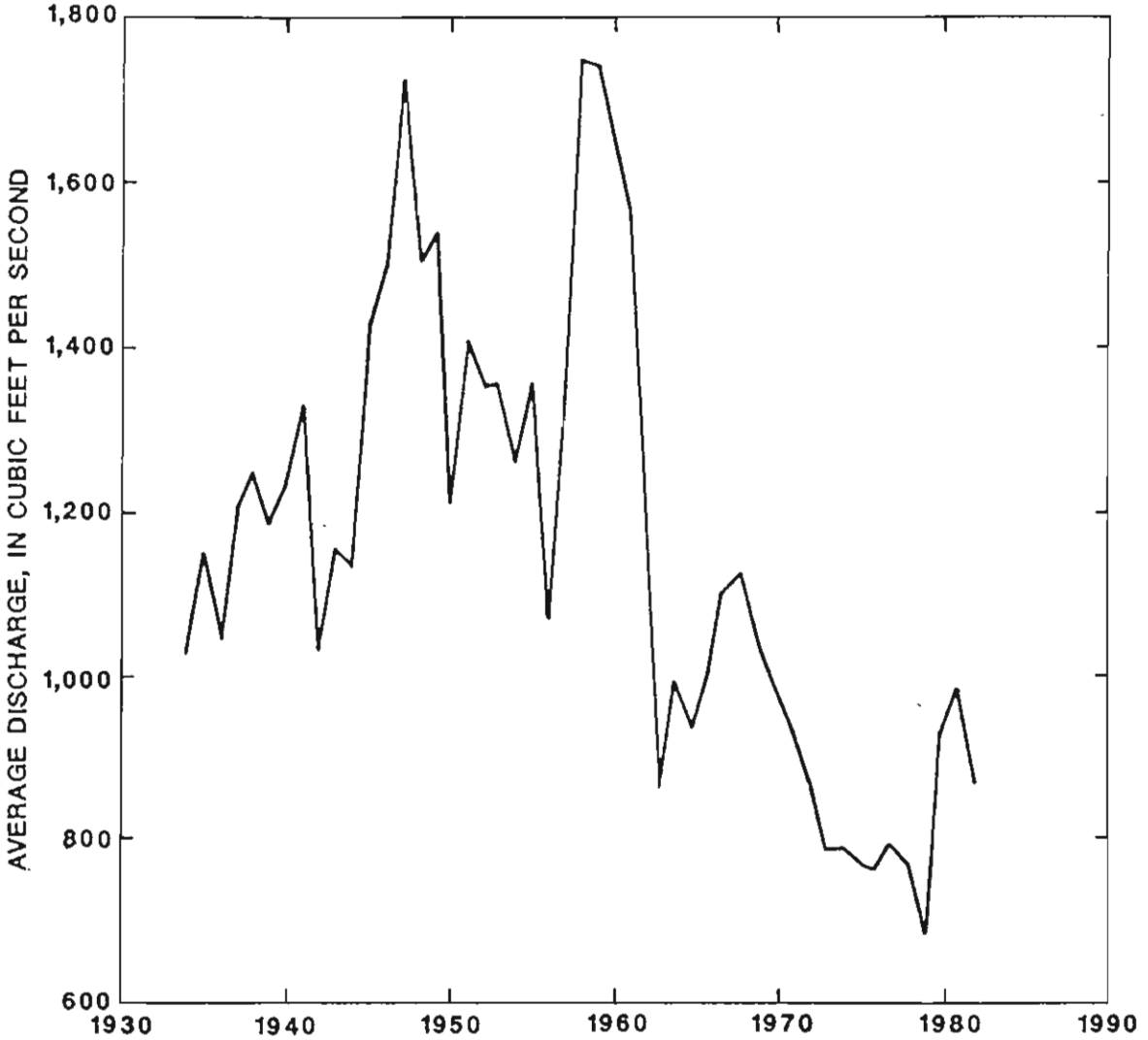


Figure 9.--Decreasing trend in 5-year moving averages of annual mean discharge for the Peace River at Arcadia.

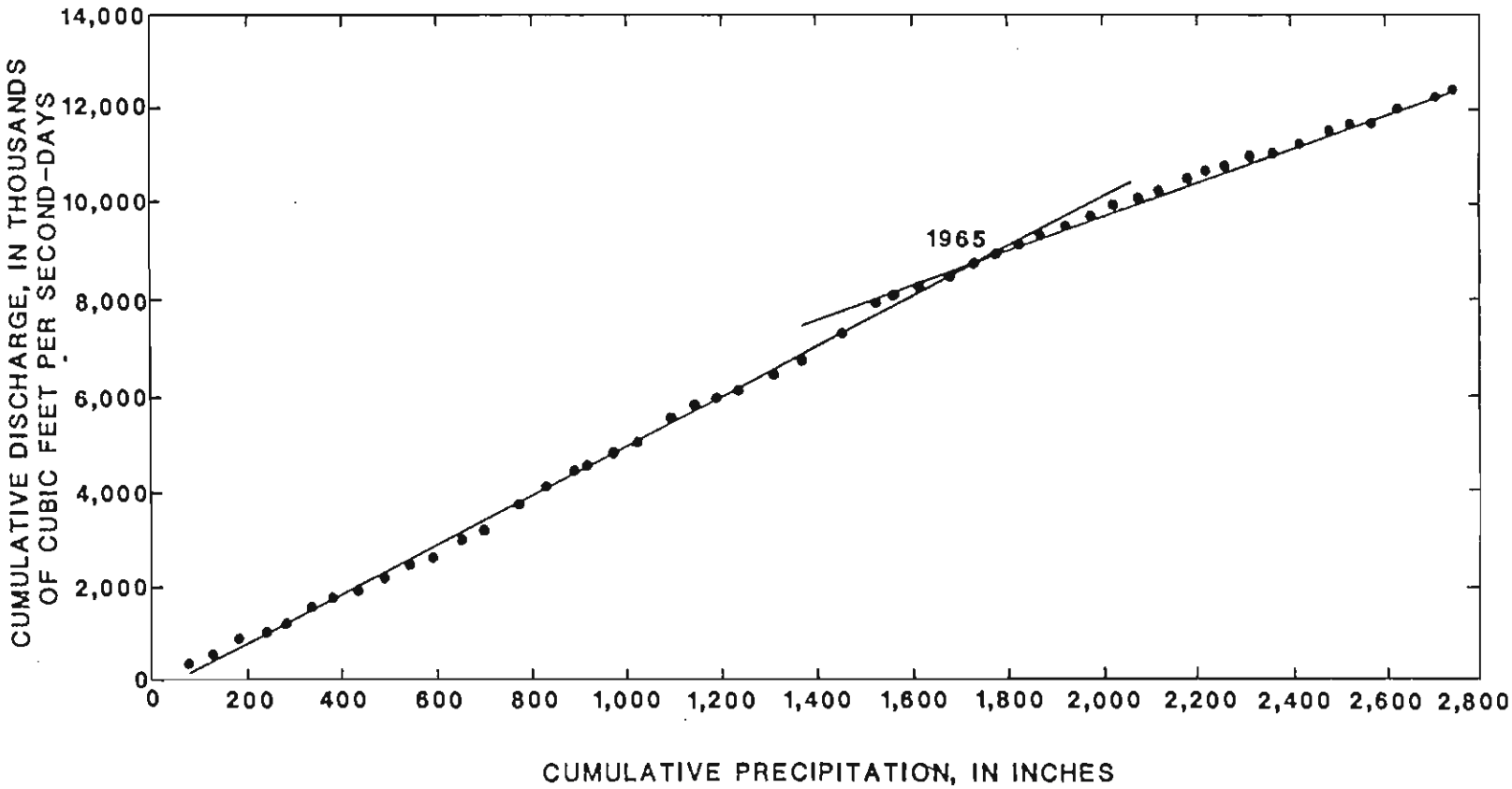


Figure 11.--Accumulated annual mean discharge for the Peace River at Zolfo Springs as a function of accumulated annual precipitation for the National Weather Service station at Bartow, 1934-84.

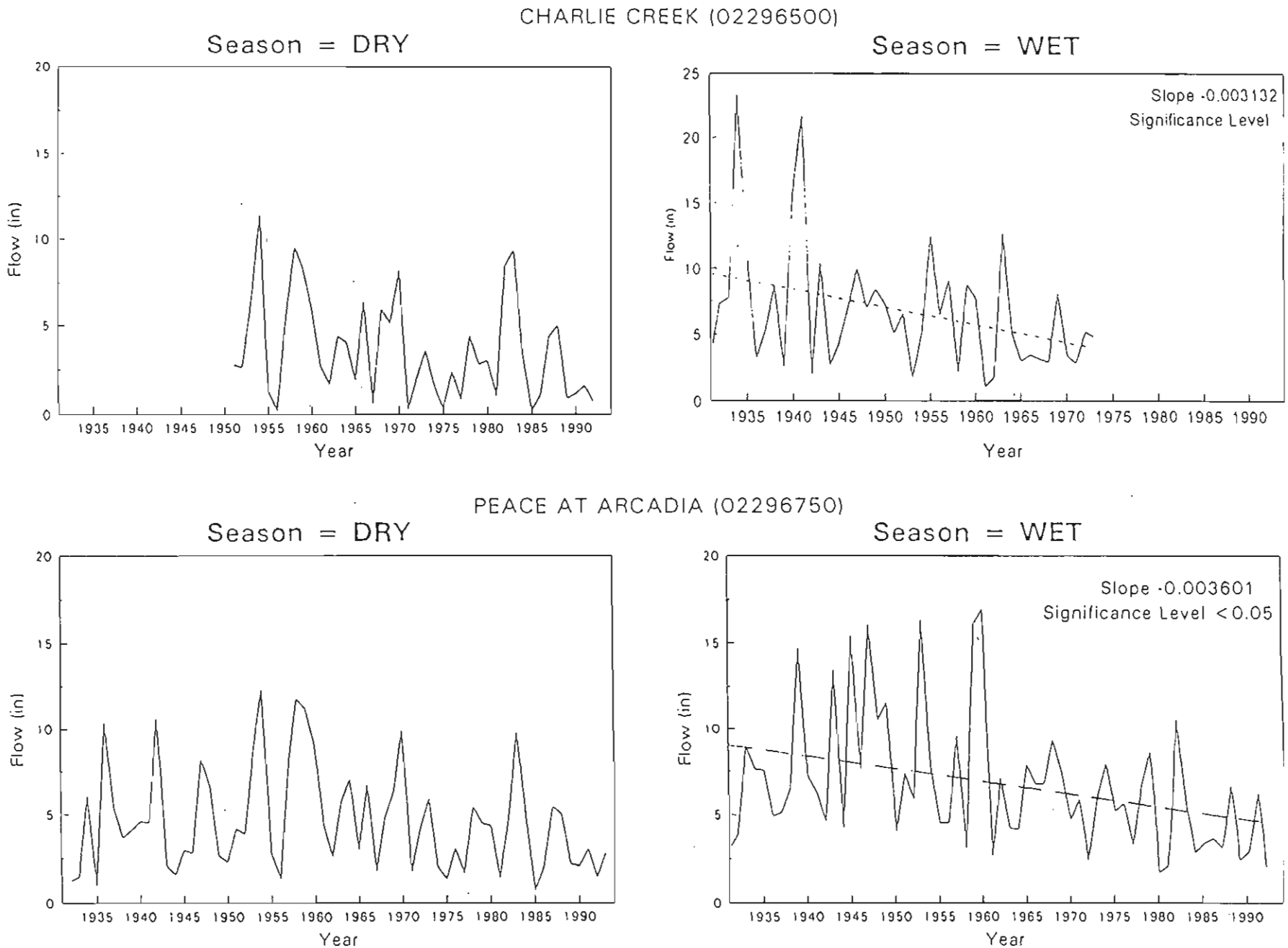


Figure 4-8. Mean dry (November- June) and wet (July-October) season flow (standardized to basin area) by water year for Charlie Creek and Peace at Arcadia gaging stations.

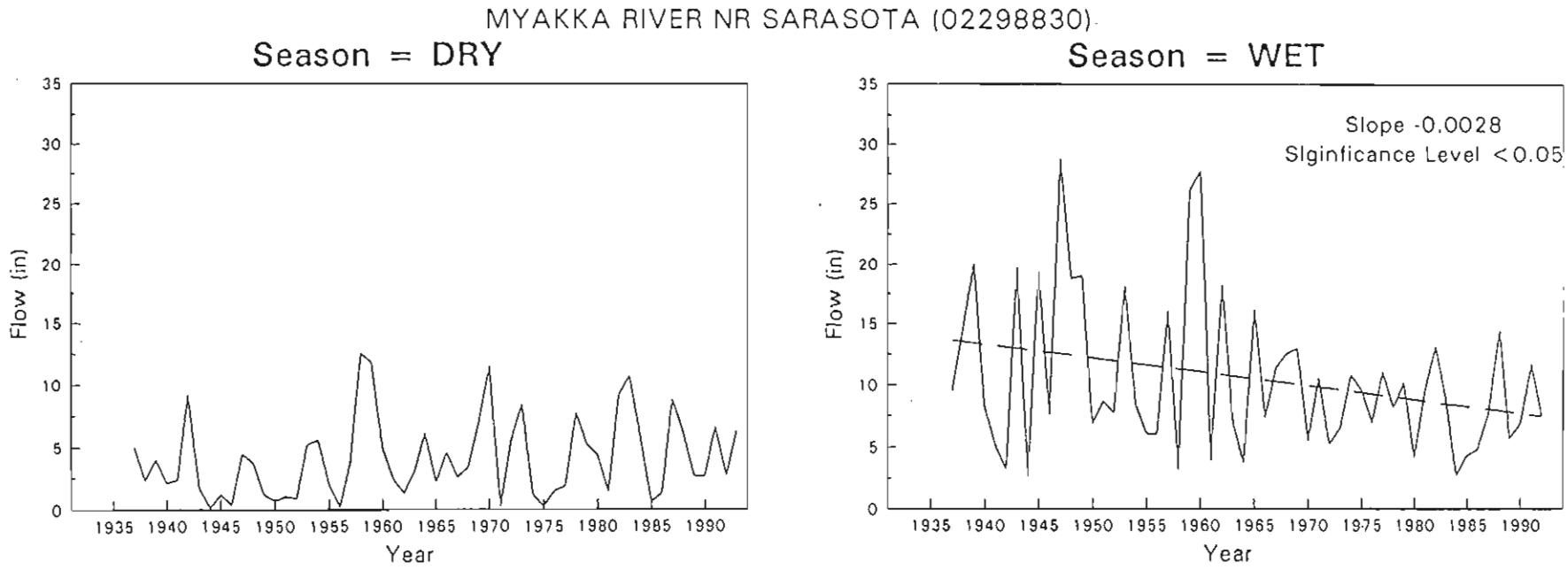


Figure 4-10. Mean dry (November-June) and wet (July-October) season flow (standardized to basin area) by water year for the Myakka River near the Sarasota gaging station.

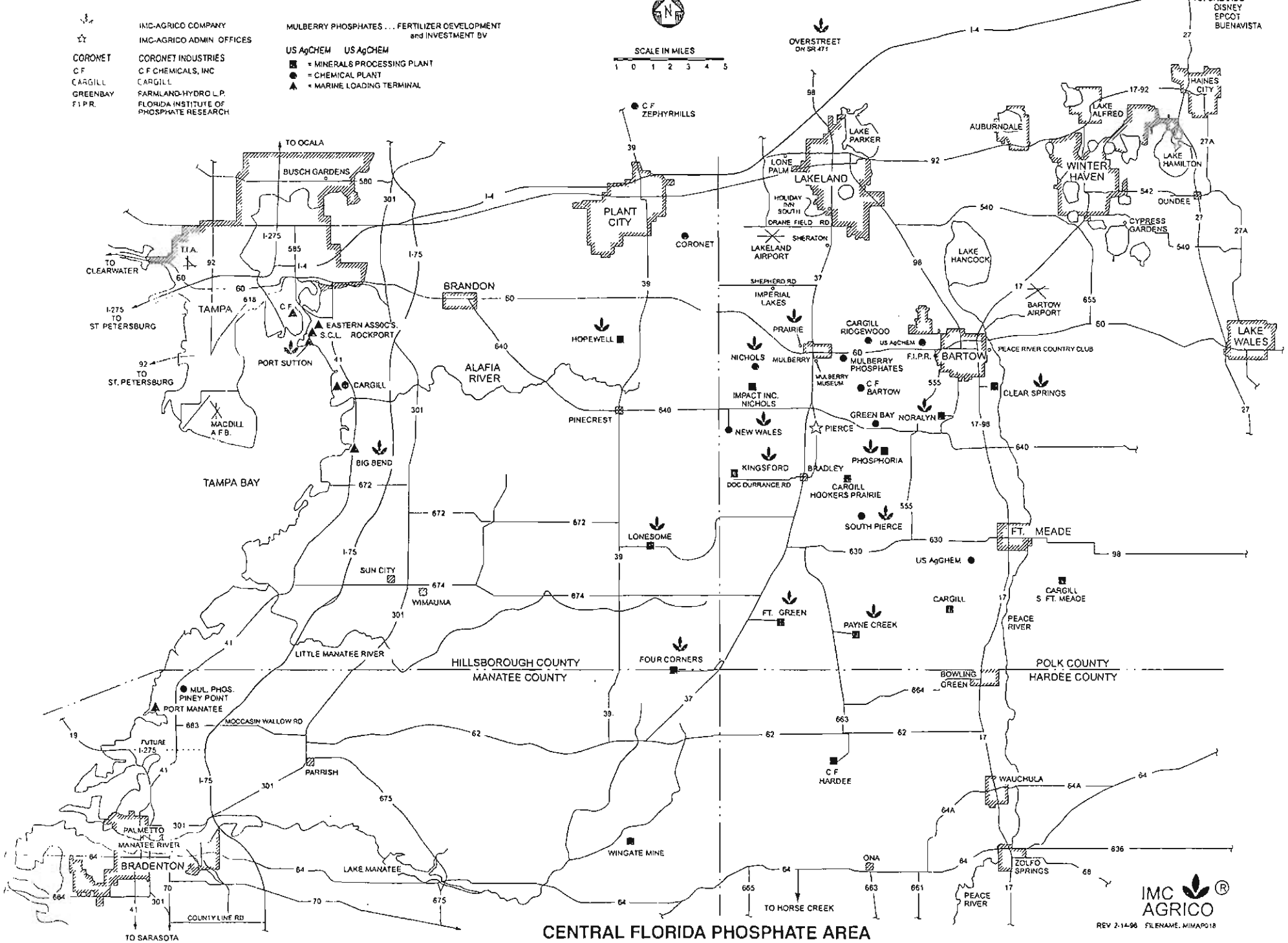
*The Hydrology of Phosphate

Phosphate deposits occur in most NEP counties. Deposits are buried by surface sediments and topsoils. Deposits are extracted by dragline, slurried by water jets, and pumped to beneficiation plants where phosphate is separated from other materials, concentrated, and sorted. From there the phosphate goes to chemical plants via rail, for eventual manufacture into fertilizer. Beneficiation residue is pumped into clay settling areas ("slime ponds") which cover large tracts of land within the mine site. Fertilizer plants also produce an unwanted residue, gypsum or phospho-gypsum, which is stacked into enormous piles.

Modern phosphate operations treat water much differently than in the past. Earliest mining occurred directly in the bed of the Peace River. For decades, mines stripped the land with little reclamation of natural topography, much less of wetlands or other natural systems. Clay settling areas were poorly confined and managed, resulting in frequent and catastrophic spills. Gypsum stacks were unlined, so acidic, fluoride- and radionuclide-enriched waters were connected directly to groundwaters. Process wastewaters were discharged directly to lakes and rivers. And most of all, the industry relied heavily on ground water for slurries, beneficiation, and chemical processing.

Today, mines are planned with numerous environmental considerations. Companies and state agencies seek to achieve regionally significant patterns of habitat restoration. The Florida phosphate industry has created more wetland acreage than all projects in all other states, combined, and the industry is pioneering restoration and creation of rarer or more fragile plant communities, such as wire-grass meadows. Mines recycle more than 95% of their water resources, drawn increasingly from surface sources to reduce impacts on aquifers. Clay settling areas are built according to high standards of design and maintenance, and all new gypsum stacks at fertilizer plants are lined to isolate spoils from groundwaters. A typical large mine may have only one or a few discharge sites, and all are operated according to federal and state permits. It is not unusual for discharge sites to have zero discharge in all but the wettest periods of a year, and more often than not, the discharged water meets or exceeds water quality conditions of the receiving surface waters.

Such changes have brought benefits and costs. The incidence of spills to the Peace River is much lower than previously, and phosphate concentrations in the River have been declining for several years. Still, hydrological and chemical impacts must be reckoned. Of primary concern is the cumulative impact to surface and ground water supplied to the river as a result of within-mine and between-mine operations. Does the high recycling rate and low discharge rate of a modern mine mean that rainfall and storm runoff fails to reach the river? Although a given mine unit must be used and restored in three years, including its local hydrology, what are the implications of multiple mine units operating on staggered schedules within the larger mine site? What are the accumulated hydrologic changes of multiple mine sites in the Peace basin? How will expansion of mining into Hardee and DeSoto counties affect groundwater and surface water contributions to river flows? These are among the most critical and important technical questions facing water managers and ecosystem managers in the region.



CENTRAL FLORIDA PHOSPHATE AREA

*Salinity

Salinity, or the proportion in water by weight of salts and other matter expressed as salt, is a key property of our estuaries, as important to fish and wildlife as oxygen, or food. Saltier or marine waters confront organisms with great physiological stresses. Estuarine waters, where salinity typically varies, prevent certain species from thriving. Truly freshwater and truly marine species do not flourish in estuaries. Plants and animals of estuaries have evolved adaptations to life in a fluctuating bath of salts.

Salinity gradients are strong across the Harbor, with lowest salinities in river mouths and highest salinities in tidal inlets. Salinity typically is higher near the bottom than surface, in deeper Harbor waters. Salinities also vary seasonally, being lowest during the rainy season and highest during the dry season. These patterns, gradients, and trends serve as signposts and time-givers for estuarine organisms.

The continued maintenance of the proper salinity ranges is crucial to the vitality and overall productivity of these estuaries. Most estuarine species can survive in a wide range of salinities. Few, however, can withstand abrupt changes. Sessile organisms, such as oysters, are immobile in the adult stage; consequently, they are particularly vulnerable to rapid ar adverse salinity changes.

Salinity levels in the estuaries fluctuate naturally and seasonally in response to rainfall intensity and frequency. Permanent disruptions in salinity levels can occur from widespread upland drainage improvements, such as draining wetlands, channelizing rivers, diverting river flows, impounding streams or creeks, and clearing land. These activities, along with the installation of impervious surfaces, alter the rate and amount of upland runoff. When wetlands are drained or filled the rainfall that would ordinarily be retained here and gradually released, rapidly runs off into nearby streams and ultimately to the estuaries. This excess freshwater depresses salinity levels, resulting in stresses that inhibits the growth of, or kill, many estuarine dependent animals. During the dry season this effect is reversed because upland drainage improvements deprive the estuaries of needed freshwater, causing salinity levels to rise adversely. Estero Bay, the Caloosahatchee River estuary and upper Charlotte Harbor are affected by these problems.

A two-pronged approach will be needed to manage salinity in the region. Where serious changes to natural salinity patterns have occurred, effort is needed to restore the amounts and timing of freshwater inflow so that salinity gradients and variations are less harmful. The Caloosahatchee River is a likely candidate for salinity mitigation. In undisturbed areas, diligence will be needed to prevent hydrological changes from causing unwanted salinity impacts. In Charlotte Harbor, diversions of water from the Peace River have been controversial, prompting numerous studies to monitor low-salinity areas for signs of environmental impacts.

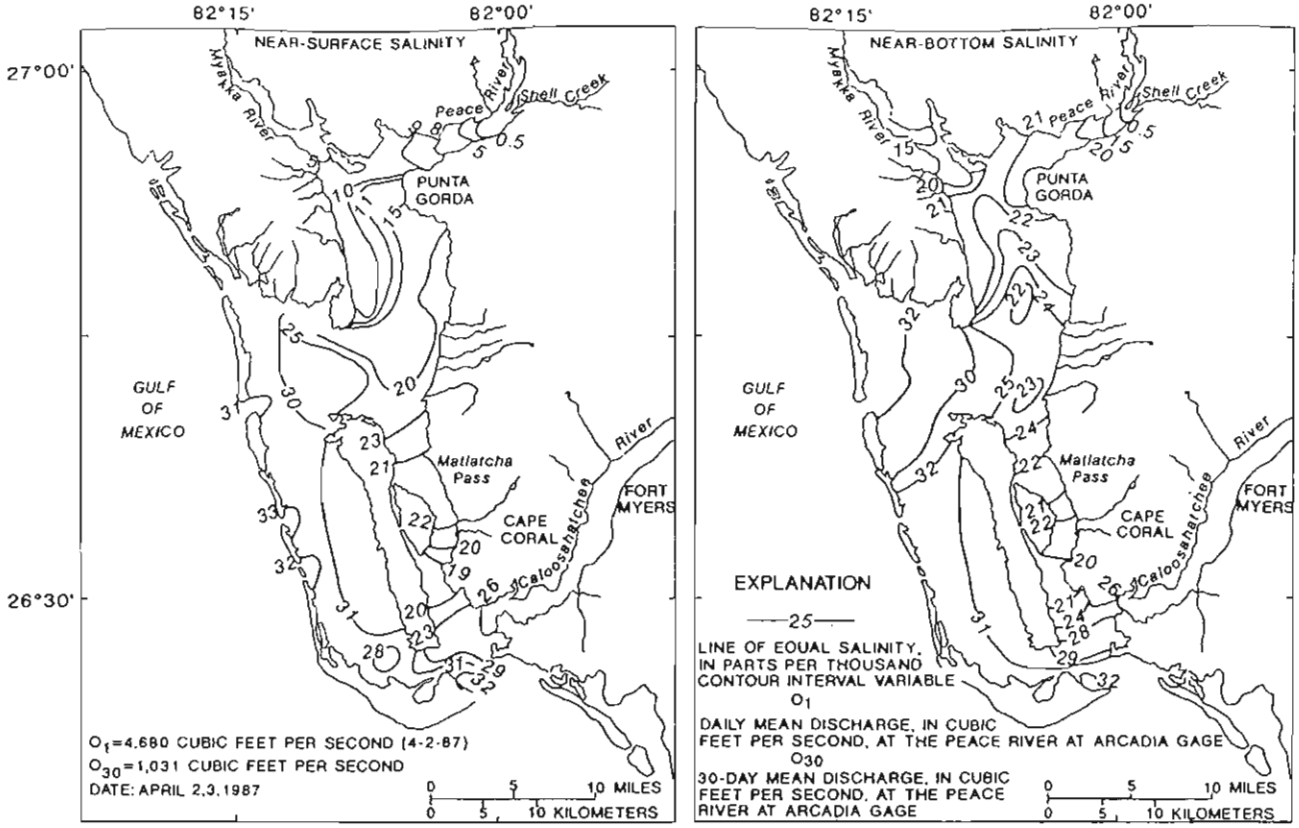


Figure 15. Near-surface and near-bottom salinity contours for April 2-3, 1987.

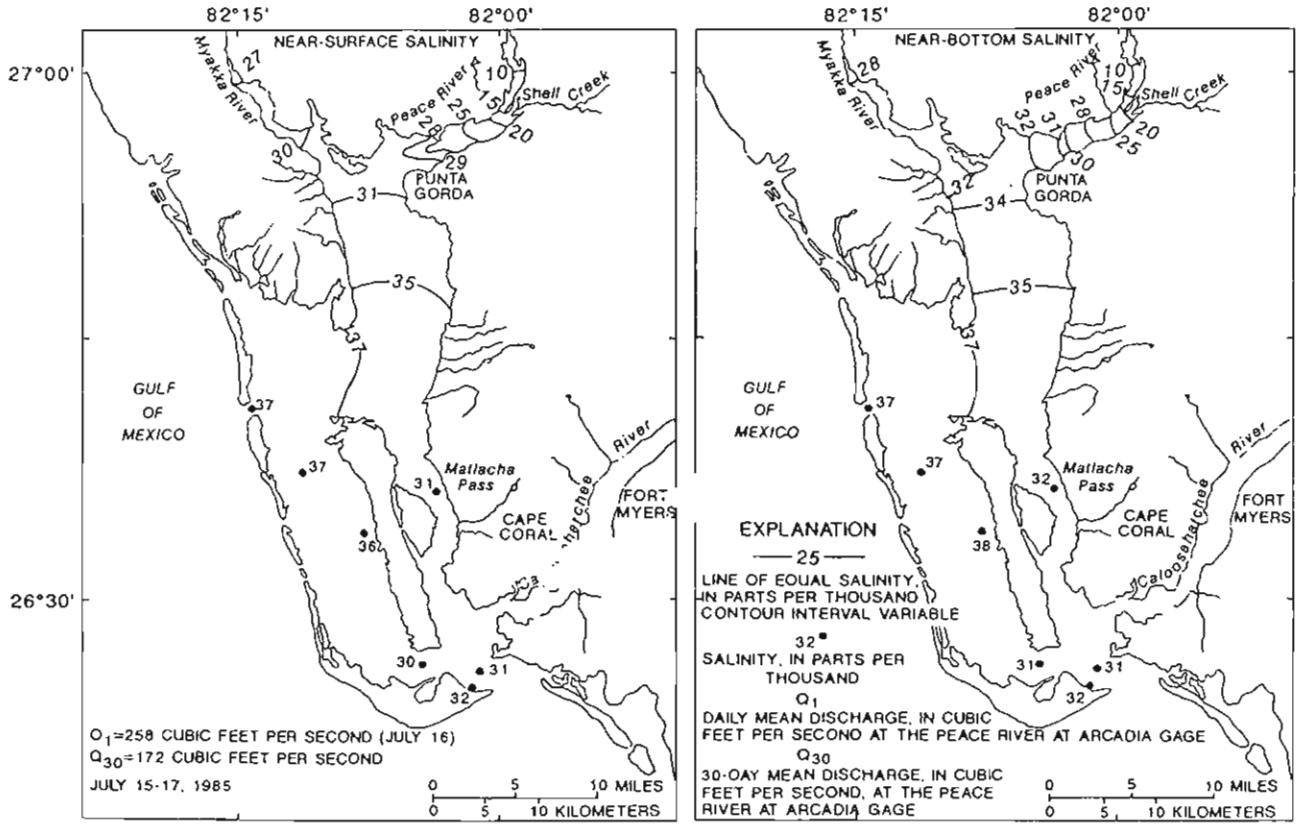


Figure 16. Near-surface and near-bottom salinity contours for July 15-17, 1985.

*Hypoxia

Dissolved oxygen is critical for the maintenance of plants and animals in fresh and salt water. The concentration of oxygen gas dissolved in water is regulated by water temperature, salinity, oxygen produced by photosynthesis, and the respiration of microbes, plants, and animals. Oxygen concentrations typically range up to 10 or 12 parts per million (ppm). Florida standards seek to maintain oxygen levels above 4 ppm to protect fish and wildlife, although some natural Florida waters may have lower levels for reasons unrelated to pollution. Levels below 2 ppm are called "hypoxic" and waters with no oxygen are called "anoxic". Numbers and kinds of plants and animals in hypoxic waters are significantly lower than in oxygenated waters, and anoxic water is inhabited by only a few pollution-indicator species.

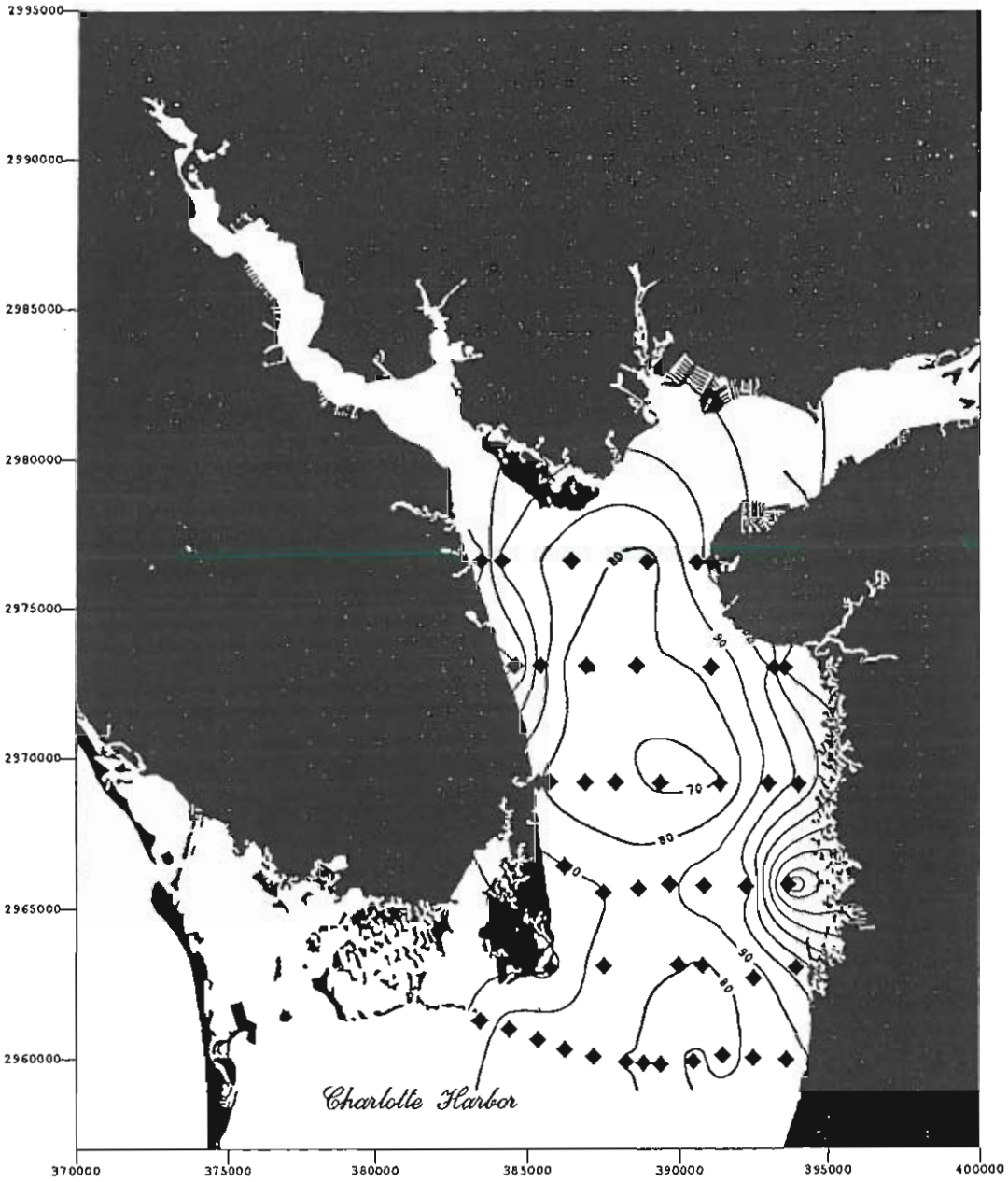
Shallow estuary waters can become hypoxic for short periods of time in the early morning, after long warm nights when plants and animals deplete oxygen reserves. Sarasota Bay seagrasses experience periodic episodes of hypoxia. Fauna respond by leaving affected areas, moving toward the surface of the water, or "closing up" their burrows or shells. Such hypoxia also occurs over Harbor grasses, but the dominant hypoxia feature of the Harbor is caused by different factors.

Large flows from the region's rivers overtop deeper, denser and colder sea water with layers of shallow, less dense, and warmer freshwater. These overtopping layers act as blankets, preventing normal diffusion of oxygen from air into deeper harbor waters. Freshwater also carries organic matter that rains onto the Harbor floor, consuming oxygen as part of decomposition. Deep color in surface freshwater further inhibits oxygenation by limiting the photosynthesis of light-dependent plants. The sum effect of these processes is that dissolved oxygen falls to hypoxic levels near the Harbor floor (and in the tidal Caloosahatchee when its flows are large). After weeks of prolonged river flow during hot summer nights, anoxic conditions can develop. Fish and invertebrates capable of moving emigrate to shallow areas or toward the Gulf, to avoid suffocation. Slower animals and sedentary forms such as attached or burrowing animals perish.

Hypoxia in Charlotte Harbor occurs most commonly between the mouths of the Peace and Myakka rivers, and the Cape Haze shoals. The bowl-shaped central Harbor presents ideal conditions for hypoxia and, in fact, is the only peninsular estuary in Florida believed to become hypoxic for natural reasons.

Hypoxia plays an important role in the timing of animal movements, reproduction, and feeding, by predictably transforming the chemistry of much of the Harbor. In other regions, hypoxia is caused by human pollution, and is avoided wherever possible. Ongoing studies are revealing the modern-day size, frequency, and intensity of hypoxic conditions in the Harbor, so as to predict is future condition if nutrient loads, river flows, or other critical factors change. For the time being, hypoxia is regarded as natural and characteristic of the Harbor, but managers seek to prevent hypoxia from becoming larger, longer, or more intense.

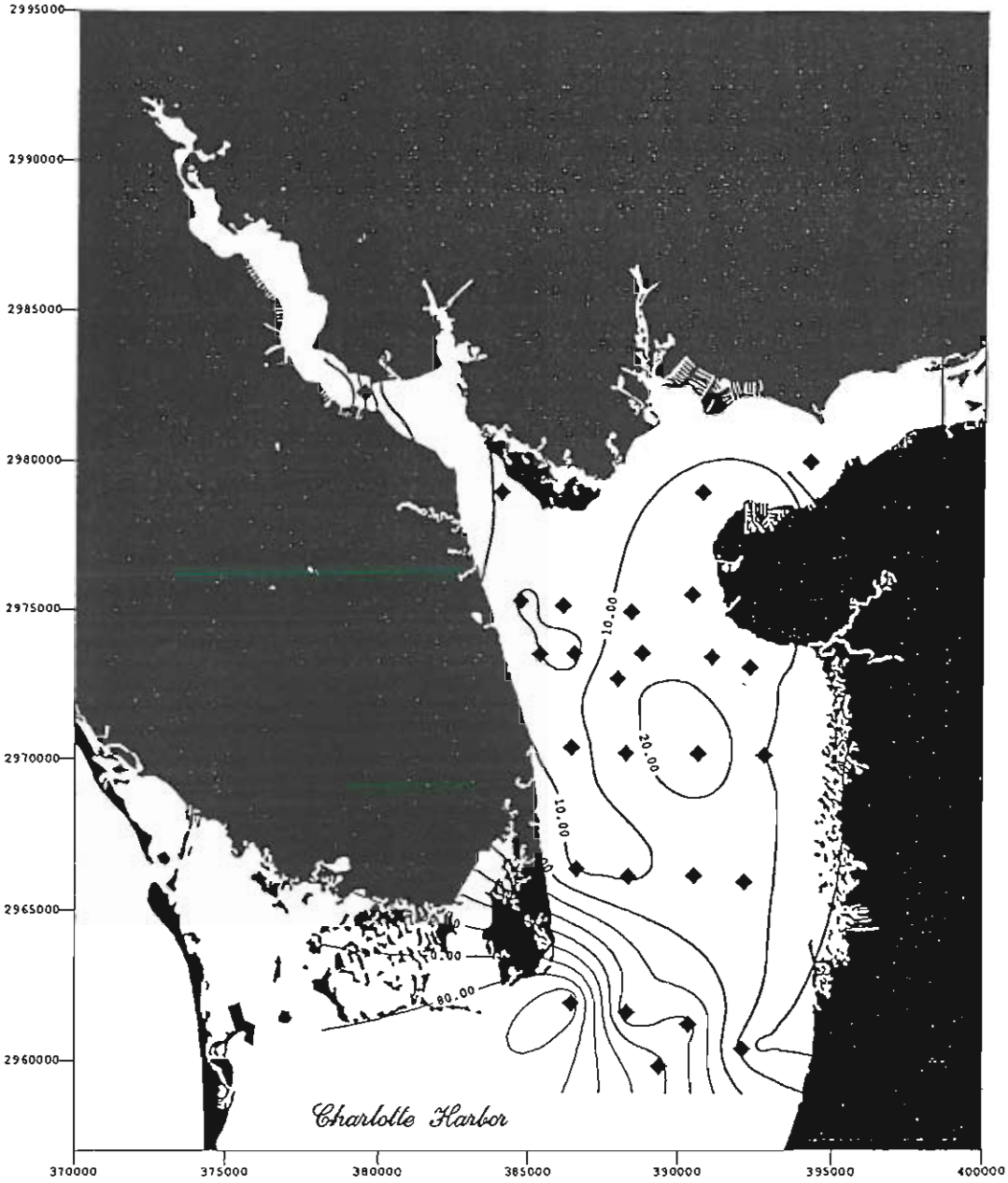
Percent Dissolved Oxygen Saturation
On Bottom - May 31, 1995.



CDM
Camp Dresser & McKee
environmental services

Data from MML and EQL.

Percent Dissolved Oxygen Saturation
On Bottom - September 5, 1995.



CDM
Camp Dresser & McKee
environmental services

*Water Quality

Water quality refers to the condition of water relative to legal standards, social expectations, or ecological health. By and large, regional water quality is fair or good but some areas have poor water quality, or declining trends.

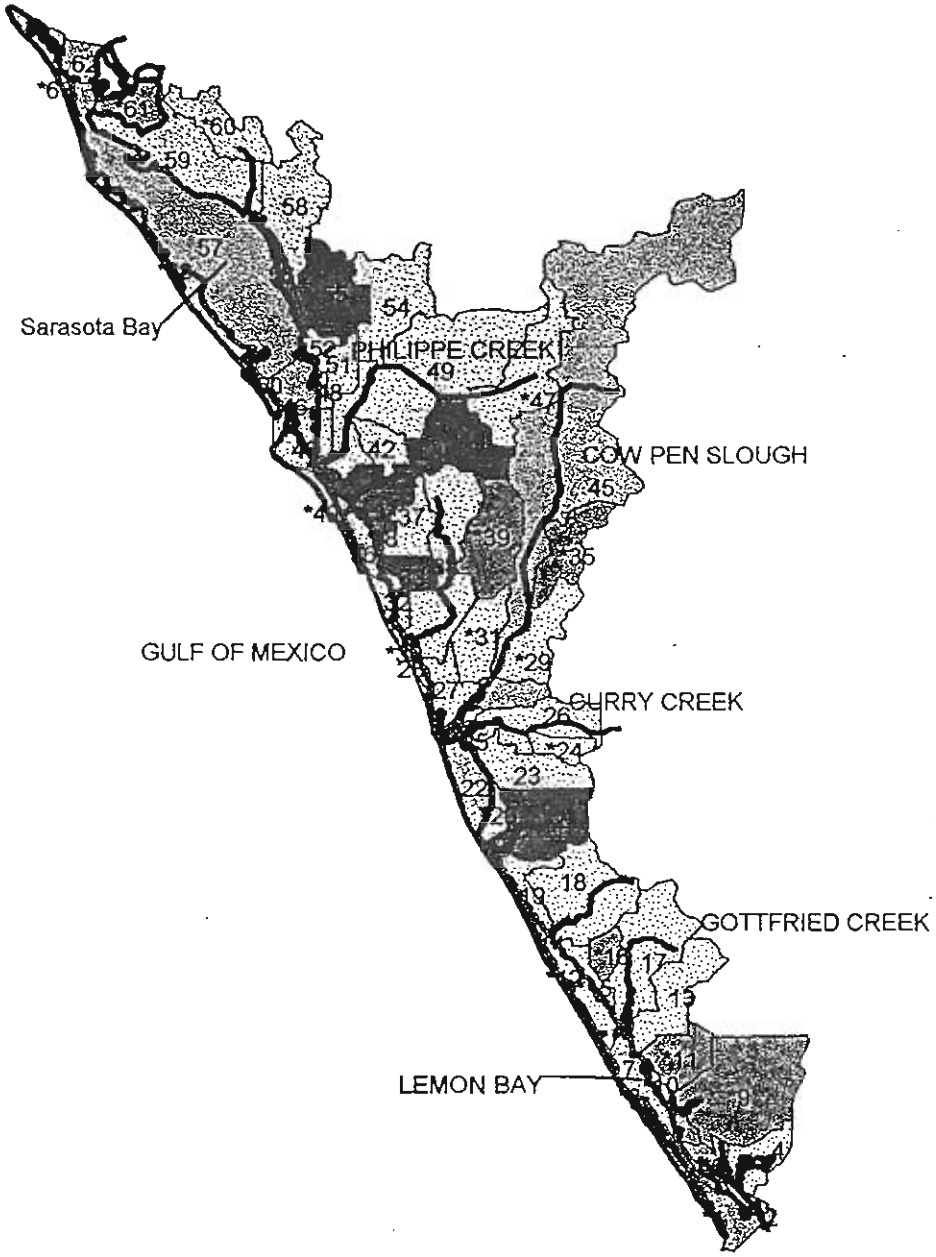
In the upper Myakka River, water quality of Owen and Wingate Creeks is poor and worsening, due to increased agricultural activity. Tree mortality in Flatford Swamp is thought by some to be due to pollution, but the issue is under study. Residents upstream of the Park have complained of turbidity, thought to originate from a permitted phosphate discharge near Myakka Head. Water quality in the Park has not changed since determinations in the 1980s that the upper lake could not process additional nutrient inputs. Water quality in the lower or tidal river generally is good.***degraded

In the Peace River system, trends of improving water quality are developing for the upstream river area, whereas water quality seems to be declining in middle river reaches, and stable in the tidal river. Upper basin waters have nutrient and algae bloom problems owing to numerous permitted discharges of wastewater and other effluents. Eight of Florida's 50 lakes most needing restoration are in the Winter Haven Chain of Lakes. Northern chain lakes are highly colored and nitrogen-limited, whereas southern chain lakes are clearer and phosphorus-limited. Banana Lake, a SWIM restoration project, and Lake Hancock have some of the poorest water quality in the State, due to low oxygen and high pH, bacteria, and nutrients. Middle river areas are "meso-trophic" or intermediate in nutrient pollution, because river flows and biological assimilation have processed upstream loads. Water quality in middle river reaches is poor between Charlie and Joshua Creeks, and fair elsewhere. Fortunately, no industrial accidents or phosphate slime spills have polluted the middle or lower river since NEP designation. The good news is a trend of decreasing phosphorus in the river; the bad news is that Peace River phosphorus levels remain among the state's highest. Horse Creek, long used as a standard or sentinel for good water quality in the Peace basin, recently has seen a trend of declining water quality. The tidal river has good water quality but is extremely sensitive to nutrient input. Nitrogen added to the tidal river during periods of low flow can cause massive blooms of phytoplankton.

The Caloosahatchee system has poorer water quality than the Myakka or Peace systems. Heavy agriculture in the freshwater river reach, plus storm runoff from urban coastal areas, combine to pollute tidal waters. Oxygen depletion is common upstream of Franklin Lock. Nutrient and chlorophyll levels are high and algae blooms occur regularly in the tidal river. The river also receives thermal effluent.

In Charlotte Harbor, proper, water quality is good. Some canal systems have poor water quality but there are no consistent associations of canal water quality to land use, septic tank density, or other influences. This ambiguous signal has led many to question the need for centralized sewers in canal communities, resulting in much local controversy in Charlotte County. Water quality in Alligator Creek is fair. Curiously, the same upper Harbor area has more radium than in either the Myakka or Peace Rivers, or lower Harbor.

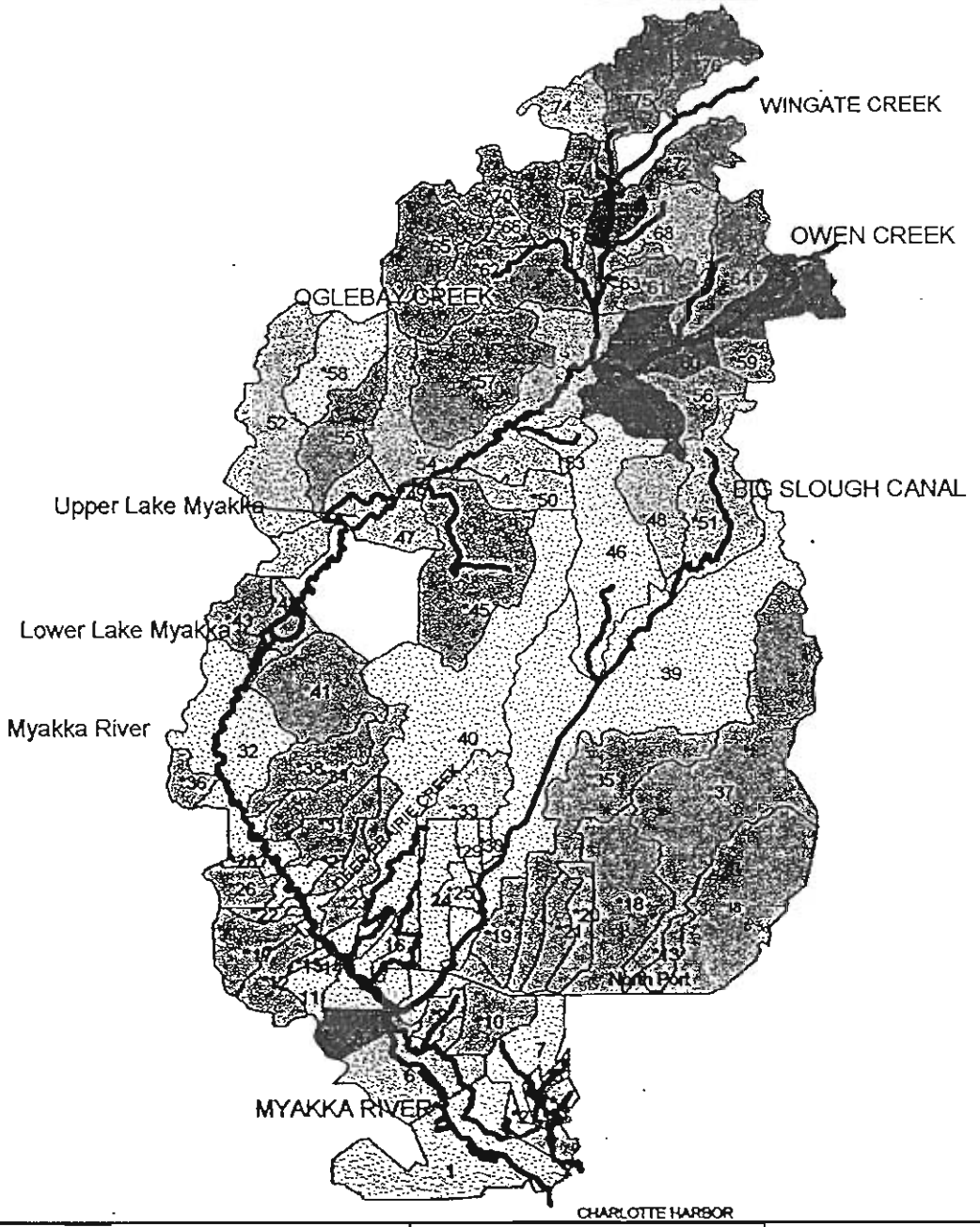
Elsewhere in the Harbor, where salinities are higher, plant growth is nitrogen limited. Increased nitrogen loads favor phytoplankton blooms and benthic algal proliferation, where the water is clear enough for adequate light penetration. Seagrass beds have diminished along their deepest edges, indicating an emerging problem with water clarity. Lemon Bay's water quality generally is good although elevated fecal coliform levels in streams has prompted the Englewood Water District to propose sewering 9,000 homes presently on septic tanks. Water quality in Pine Island Sound and Matlacha Pass is fair, and considered by FDEP to be threatened in shallows surrounding Pine Island. These waters, plus San Carlos Bay, have the most shellfish grounds where harvesting is prohibited. Worst water quality occurs in the Sanibel River.



SARASOTA BAY BASIN
03100201

AVERAGE WATER QUALITY
1984-1993 STORET DATA
WATERSHED ID NUMBERS LINK MAP TO TABLES
* INDICATES QUALITATIVE ASSESSMENT

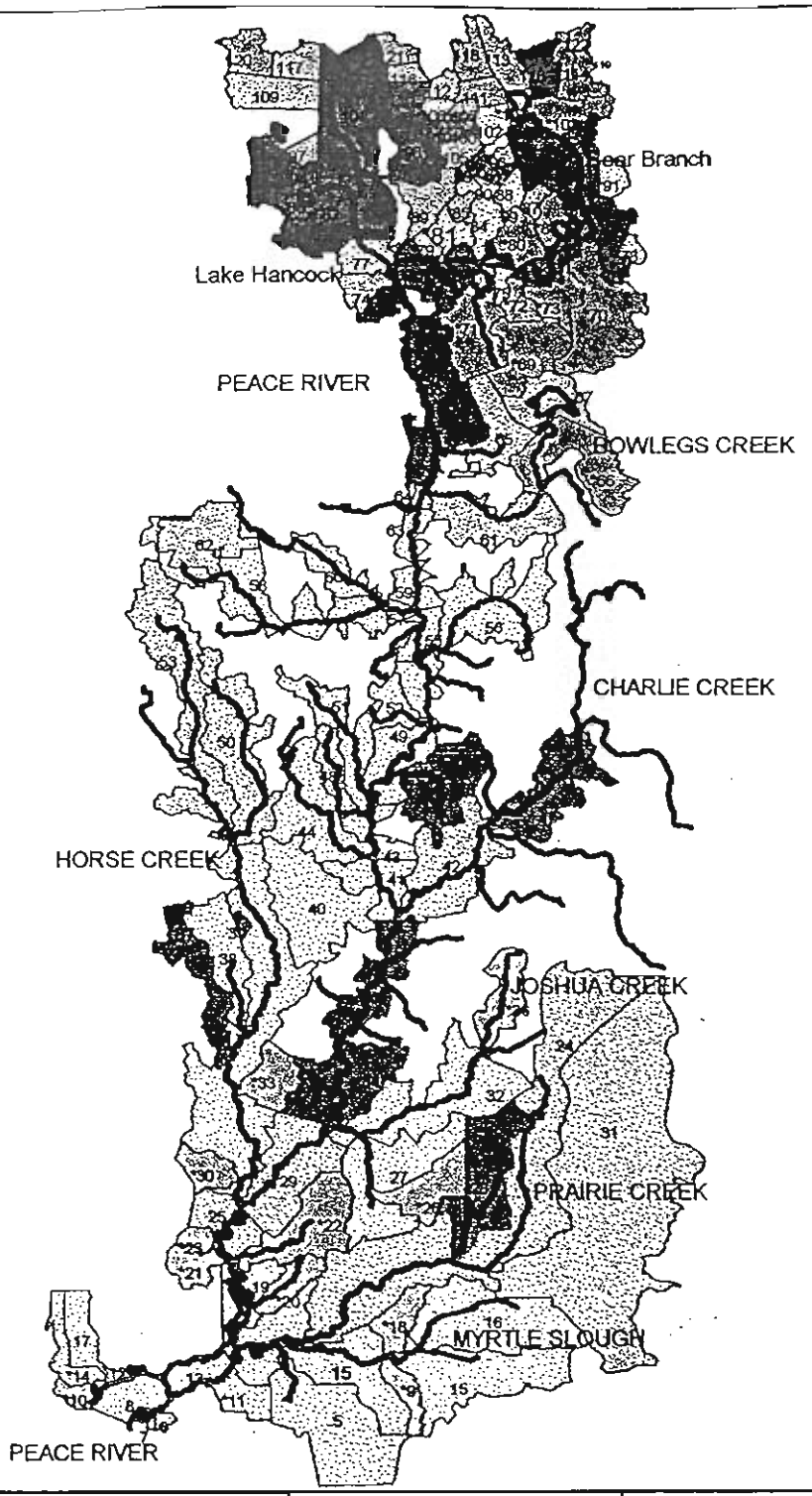
WATER QUALITY
GOOD
THREATENED
FAIR
POOR
UNKNOWN



MYAKKA RIVER BASIN
03100102

AVERAGE WATER QUALITY
1984-1993 STORET DATA
WATERSHED ID NUMBERS LINK MAP TO TABLES
* INDICATES QUALITATIVE ASSESSMENT

WATER QUALITY
- GOOD
- THREATENED
- FAIR
- POOR
- UNKNOWN



PEACE RIVER BASIN
03100101

AVERAGE WATER QUALITY
1984-1993 STORET DATA
WATERSHED ID NUMBERS LINK MAP TO TABLES
* INDICATES QUALITATIVE ASSESSMENT

WATER QUALITY
- GOOD
- THREATENED
- FAIR
- POOR
- UNKNOWN

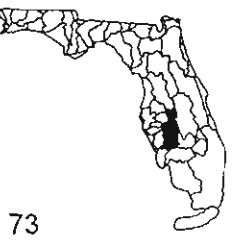


Figure 2-3

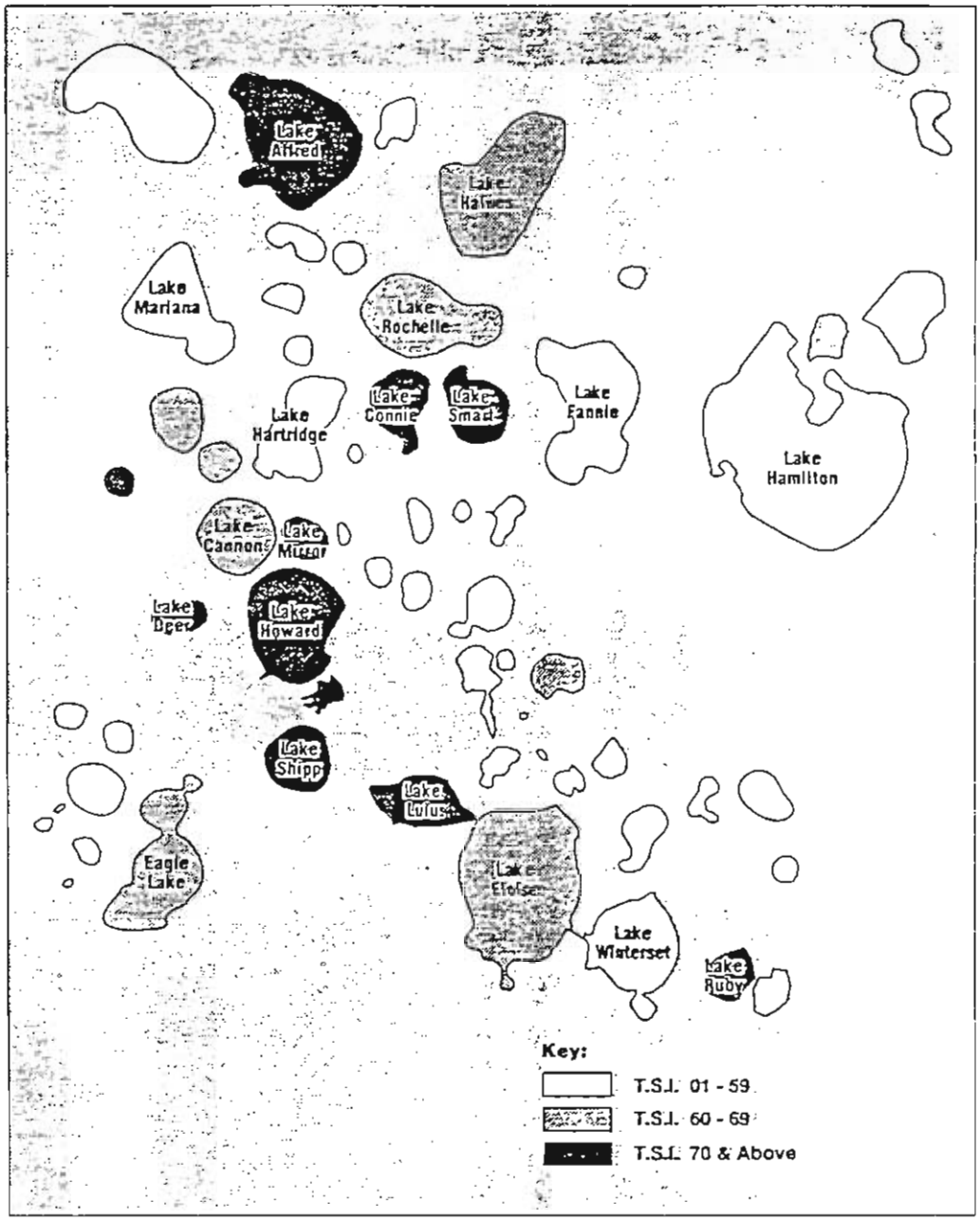
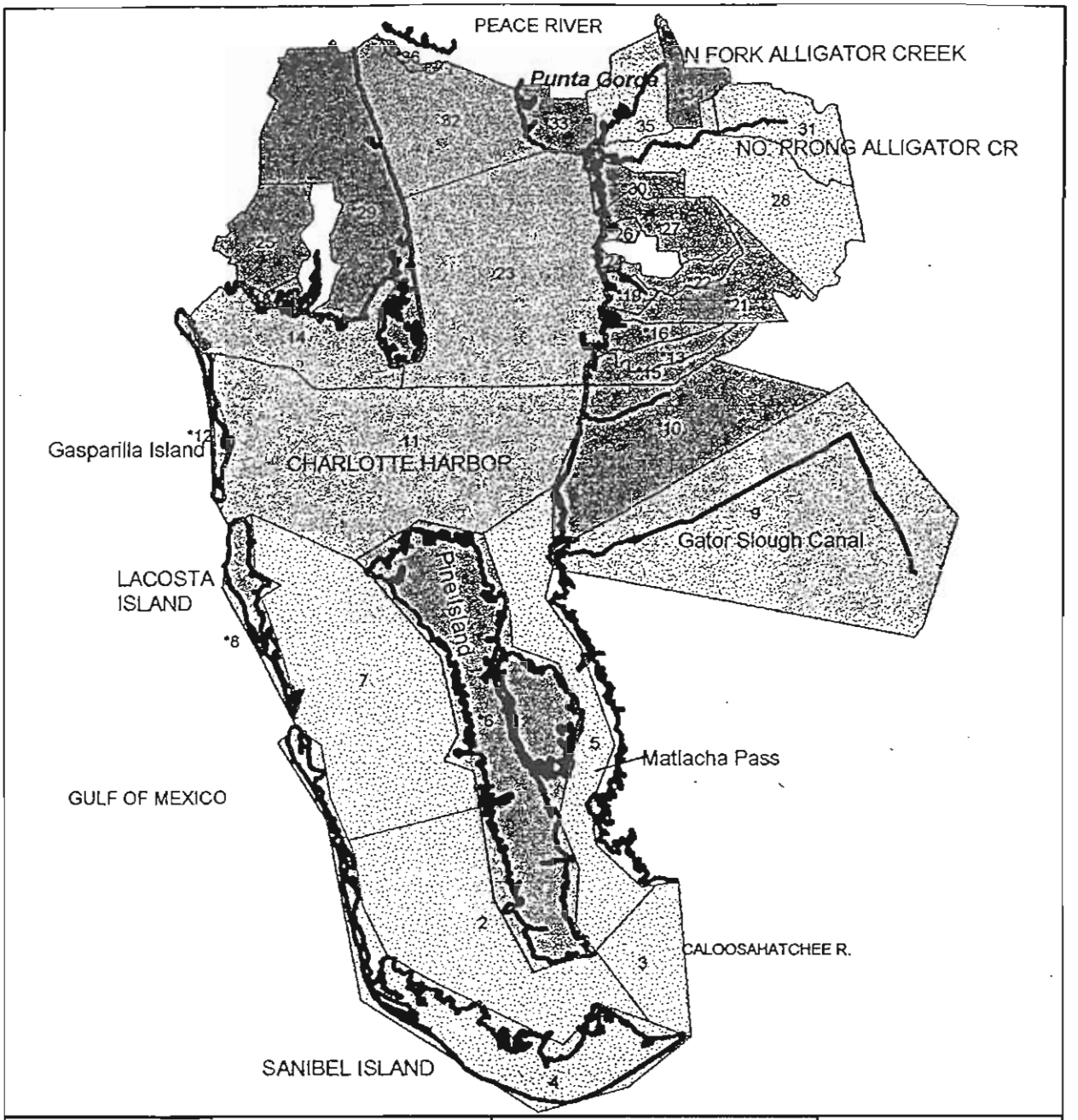


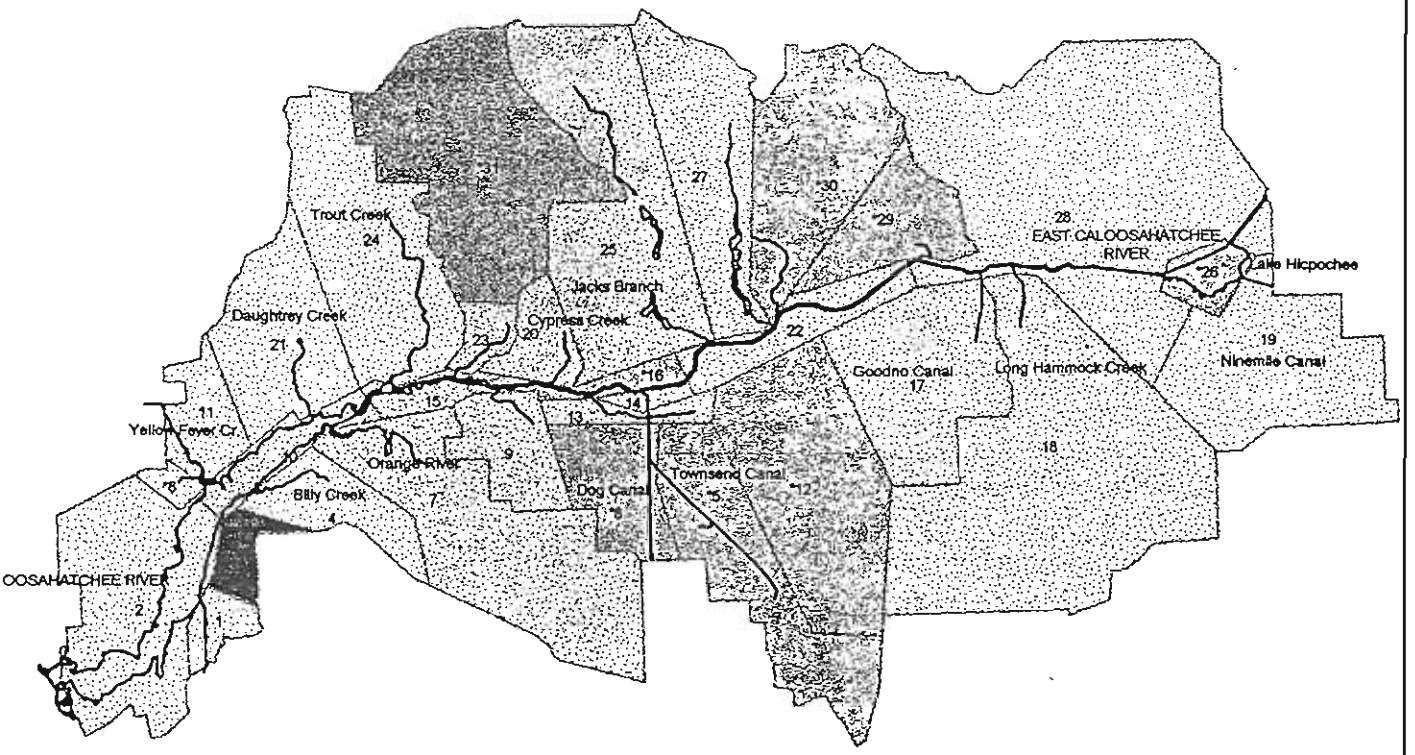
Figure 2-3. Trophic state of lakes in the Winter Haven Chain (from Polk Co. Water Resources Division, January 1990).



CHARLOTTE HARBOR BASIN
03100103

AVERAGE WATER QUALITY
1984-1993 STORET DATA
WATERSHED ID NUMBERS LINK MAP TO TABLES
* INDICATES QUALITATIVE ASSESSMENT

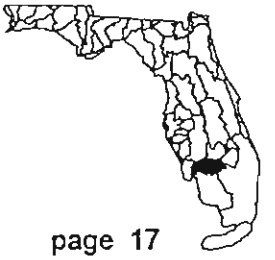
WATER QUALITY
- GOOD
- THREATENED
- FAIR
- POOR
- UNKNOWN



CALOOSAHATCHEE RIVER BASIN
03090205

AVERAGE WATER QUALITY
1984-1993 STORET DATA
WATERSHED ID NUMBERS LINK MAP TO TABLES
* INDICATES QUALITATIVE ASSESSMENT

WATER QUALITY
- GOOD
- THREATENED
- FAIR
- POOR
- UNKNOWN



*The Loadings Low-Down

"Loads" refer the amount of nutrients, toxins, or other materials delivered to a river or estuary. Sources may include rainfall, storm runoff, point-sources of pollution, or groundwater. The Gulf of Mexico may "load" sediments to lower Charlotte Harbor. Loads are the product of water volume times pollutant concentration. Loads may vary by tide, time of day, days in a week, season, or year. Macronutrients (nitrogen, phosphorus), sediment, and occasionally contaminants such as radionuclides have been of interest as loads in the Harbor region, especially as comparisons of past, present, and future conditions.

NOAA comparisons of Charlotte Harbor with other U.S. estuaries indicates that the Harbor presently receives, for its size, intermediate loads of nitrogen and phosphorus. The Harbor is neither overloaded with nutrients nor nutrient-starved, and has an intermediate susceptibility to increased nutrient loads. NOAA estimates that Charlotte Harbor receives about 2500 tons of total nitrogen (TKN) and 1000 tons of phosphorus, per year. Relative to its dimensions and flushing characteristics, phosphorus loads are high, signifying that additional nitrogen would stimulate eutrophication. NOAA estimates that 55% of nitrogen loads is agricultural in origin and 65% of phosphorus loads is industrial in origin.

Sarasota County has found that nutrient loads vary according to land-use types and intensity in the Myakka Valley. Urbanizing increases nutrient export from sub-basins, more so for nitrogen than phosphorus, but computer models have shown that wetland preservation and river buffers reduce nitrogen loads to the river.

The USGS finds that concentrations of total phosphorus are increasing with time in the Myakka River, but decreasing in the Peace. Peace phosphorus levels need to decrease beyond present levels, however. Total organic nitrogen has increased in the Peace, however, and in both rivers there are trends of increasing chloride, sulfate, and dissolved solids-- indicators of increasing groundwater influence. These trends in concentration will be the same as trends in loads if river flows remain constant.

Upper Charlotte Harbor's nutrient load is primarily from the Peace River. Upriver basins load more nutrients and suspended sediments to the River than coastal basins. Nonpoint sources cause the majority of nitrogen loads in both inland and coastal basins, though industrial sources are significant upstream of Zolfo Springs. These same patterns are true of phosphorus and suspended sediment loads to the river.

Contaminant loads are less well known than nutrient loads. Radionuclide levels are high relative to other Florida estuaries, and suggest that groundwater flows to the Harbor are on the scale of dry season river flows. Thus, any contaminants reaching the Harbor via groundwater have the potential of being significant as total loads. Pesticide loads are not directly known. Herbicide application rates are high by national standards, as are citrus and tomato insecticides, but in-stream concentrations and annual loads remain to be quantified.

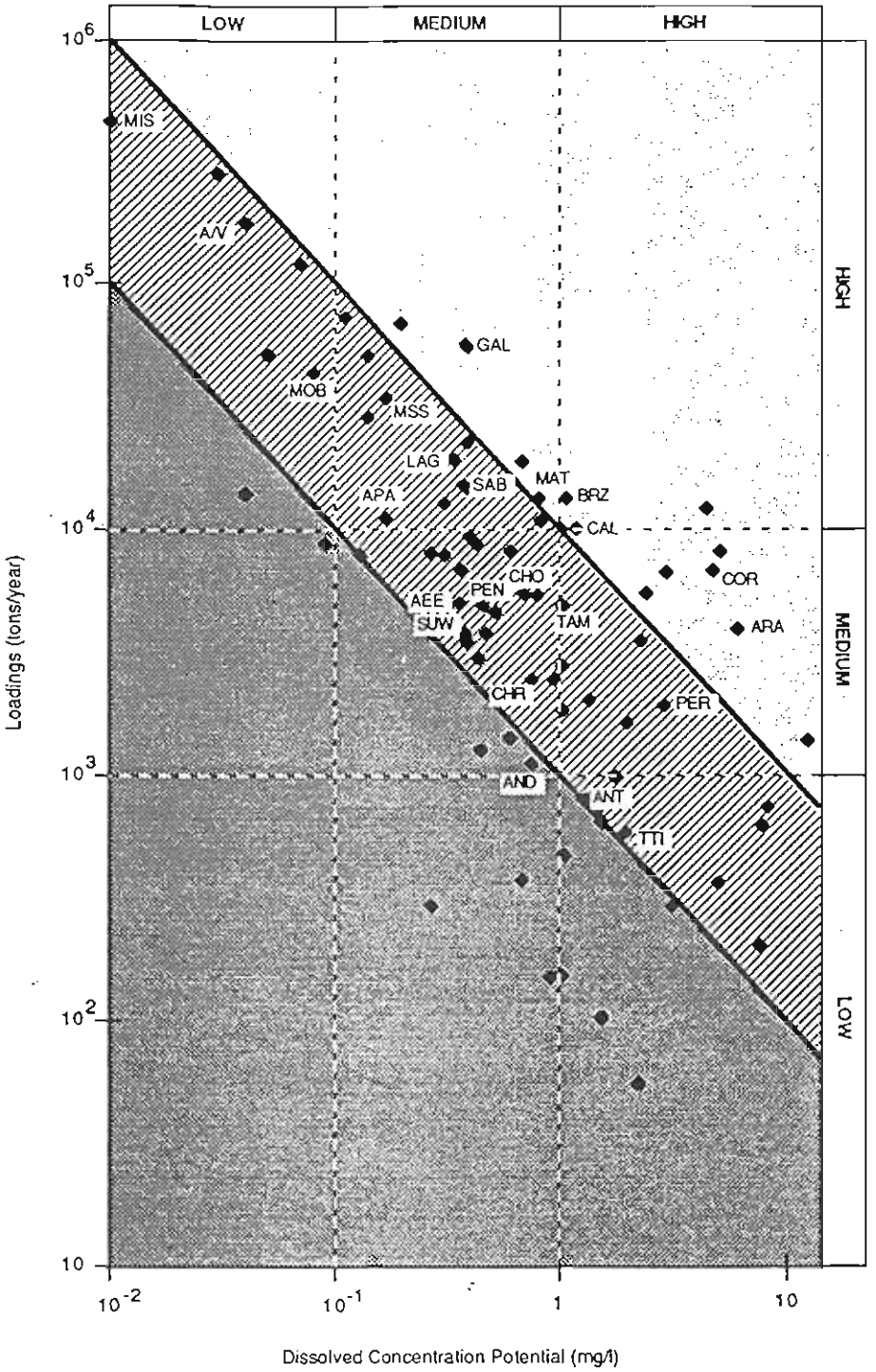
Loads need not be large to be harmful. Residents of Gasparilla Island, for example, are concerned that lawn and golf course maintenance may cause highly localized loads to nearshore seagrass beds. Small but concentrated loads of nutrients or biocides from Pine Island, zoned primarily for agriculture, may also be harmful given the close proximity of wetlands and seagrass beds. Marina runoff is comparatively

small, but high concentrations of petroleum hydrocarbons and metals already have caused locally high levels of sediment contamination.

What does the future hold for Harbor loading? The SWFWMD SWIM Program used computer models of land use, runoff, and point sources to compare modern to future Harbor loads. SWIM has forecast limited increases in nitrogen loads to the lower Myakka River, and significant increases in phosphorus load to the lower Peace River. Suspended solids are projected to decline some in the Peace and increase some in the Myakka. Elsewhere across the Harbor region north of Lee County, future loads of nutrients and sediments are forecast at near-modern levels, which is good news so long as modern levels are not damaging-- itself an unanswered question.

Loads from the freshwater Caloosahatchee to the tidal river and lower Harbor area are complex. Discharges of water from Lake Okeechobee intermingle with runoff from agricultural lands above Franklin Lock, resulting in unusual gradients of nutrients and sediment concentration, and altered timings of flow. Because load is the product of concentration and flow, lower river loads may vary significantly. New studies by SFWMD seek to quantify loads to and from the freshwater Caloosahatchee, as well as account for coastal loads to the estuary.

Figure 3a. Relative Status of Gulf of Mexico Estuaries with Respect to Nitrogen (TKN)



Concentration (mg/l)

High
- ARA
- BRZ
- CAL
- COR
- GAL
- MAT

Medium
- A/V
- AEE
- ANT
- APA
- CHO
- CHR
- LAG
- MIS
- MOB
- MSS
- PEN
- PER
- SAB
- SUW
- TAM
- TTI

Low
- AND

Refer to Figure 2 for key to estuary abbreviations

Concentration (mg/l)

LOW	MEDIUM	HIGH
Less than 0.1	Greater than 0.1 and less than 1	Greater than 1

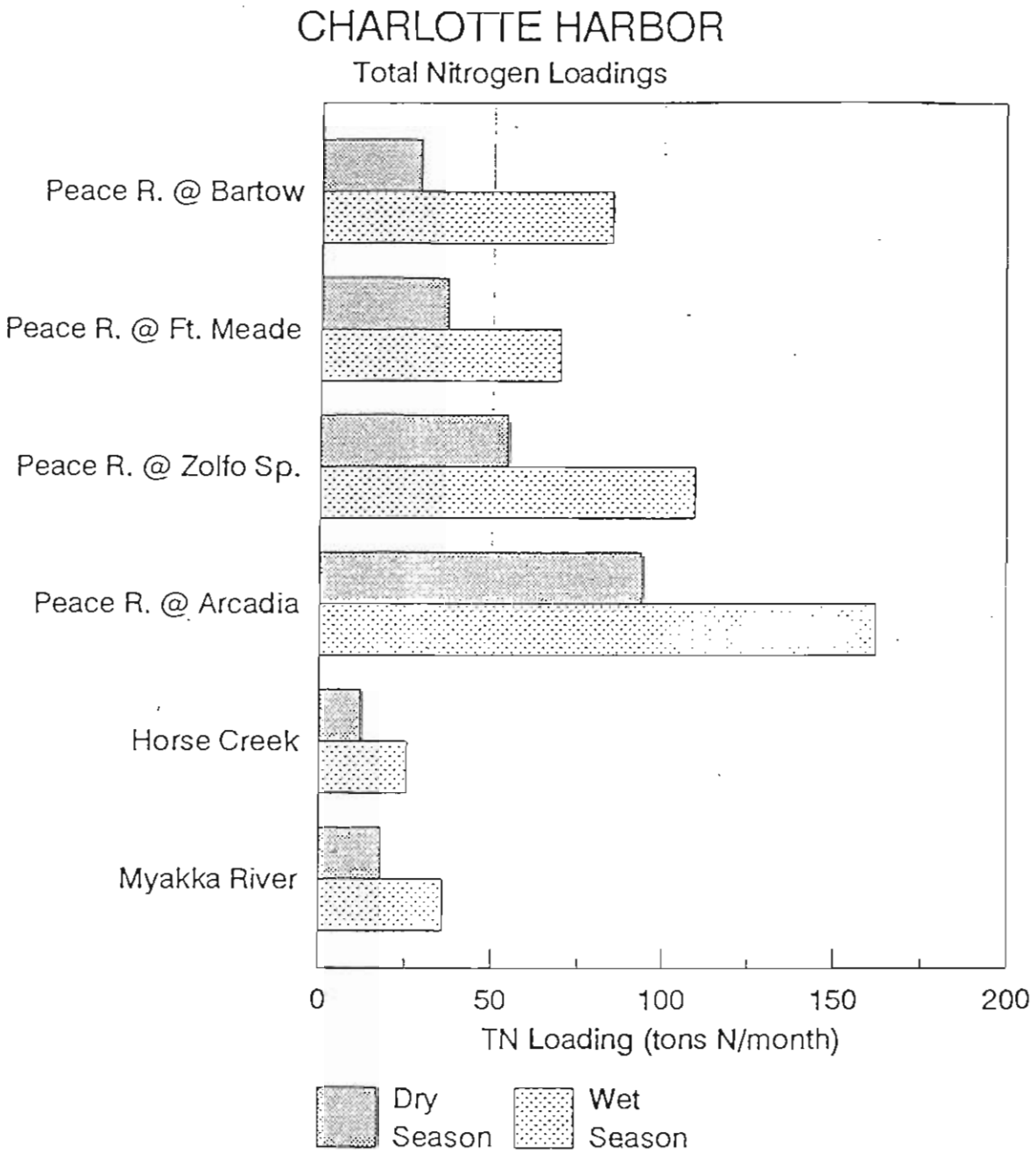


Figure 4-13. Mean total nitrogen loadings for dry and wet season months over the period of record at USGS gaging stations.

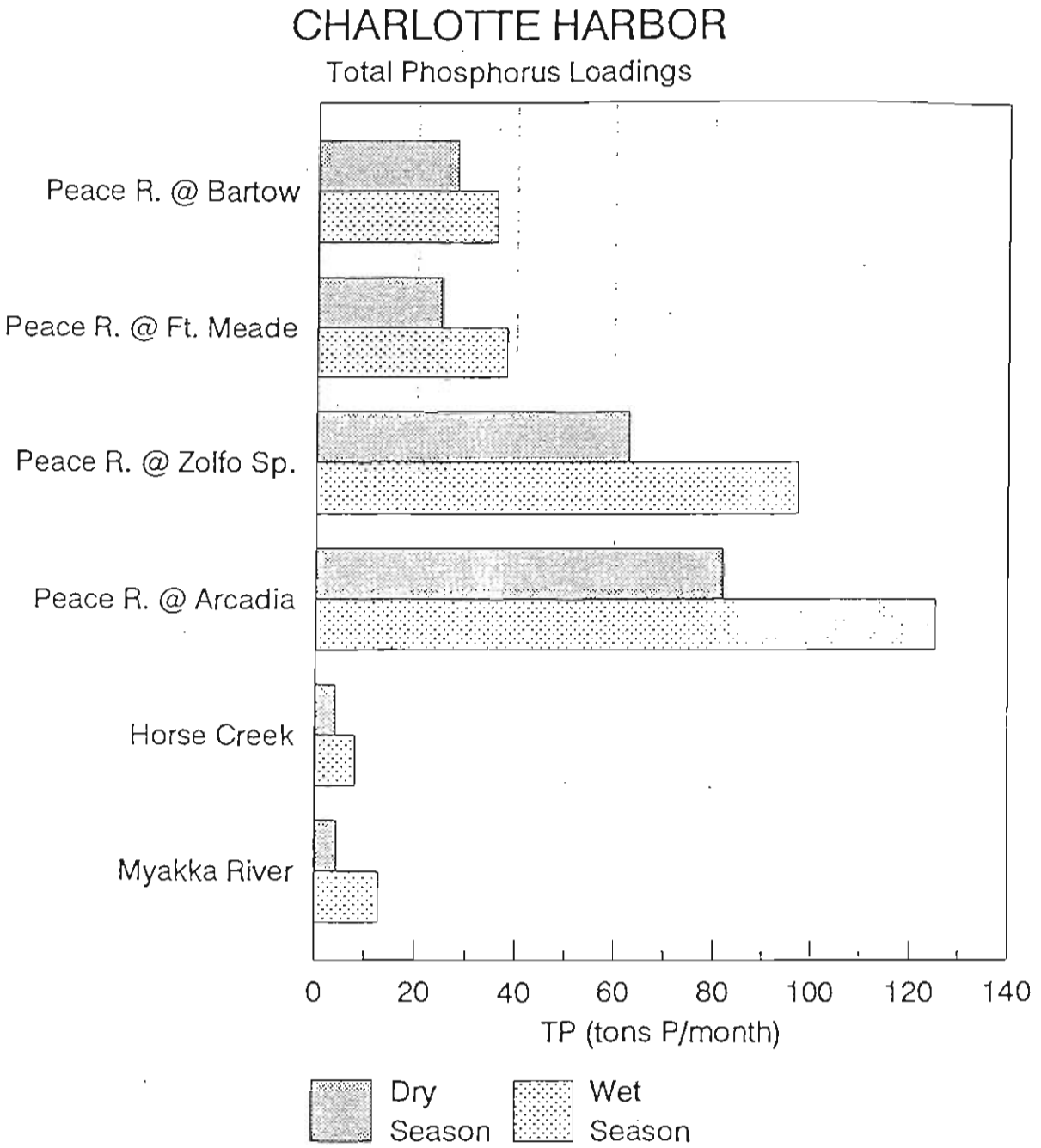


Figure 4-16. Mean total phosphorus loadings for dry and wet season months over the period of record at USGS gaging stations.

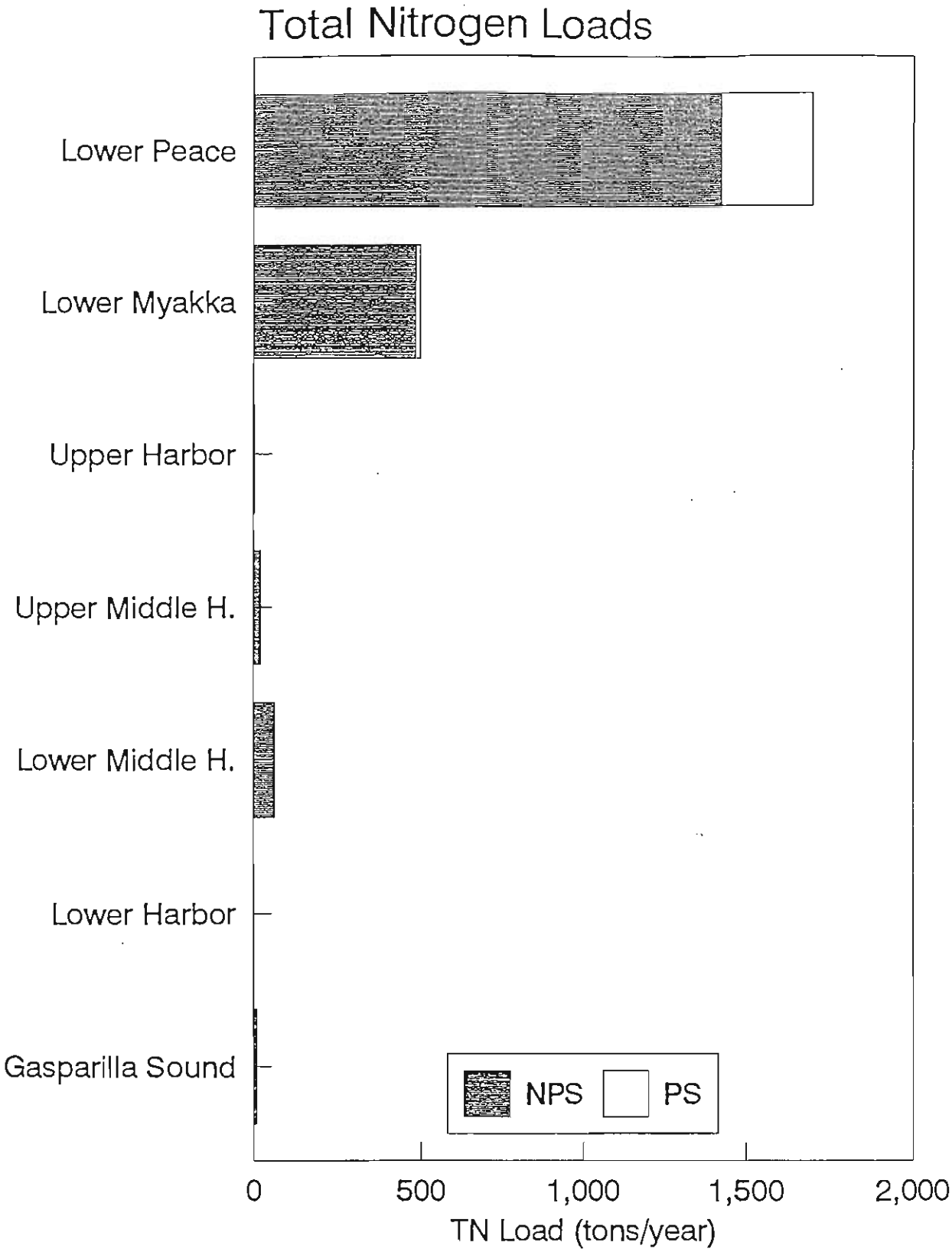


Figure 6-5. Estimated existing conditions annual nonpoint and point source loads to harbor segments - total nitrogen.

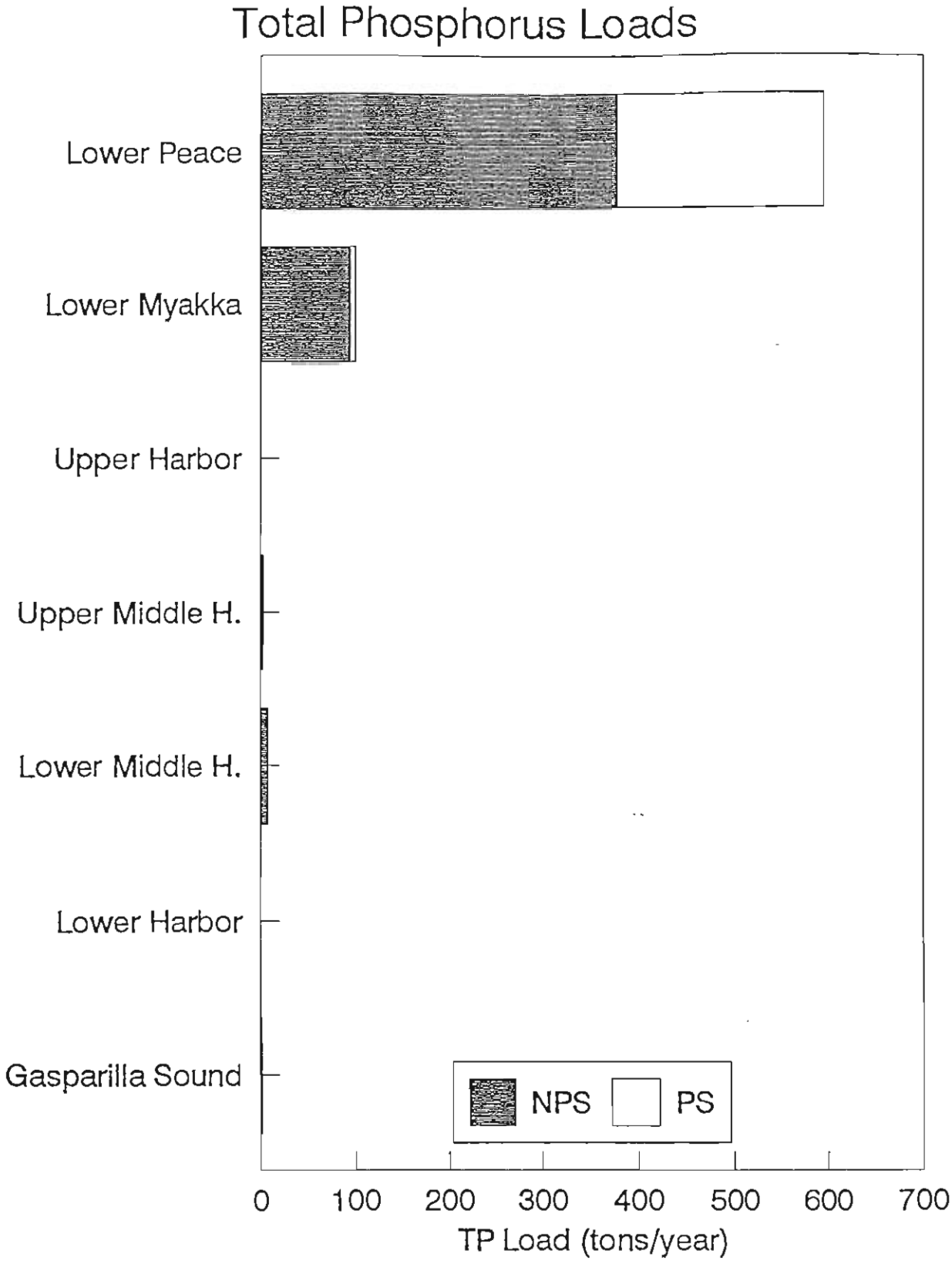


Figure 6-6. Estimated existing conditions annual nonpoint and point source loads to harbor segments - total phosphorus.

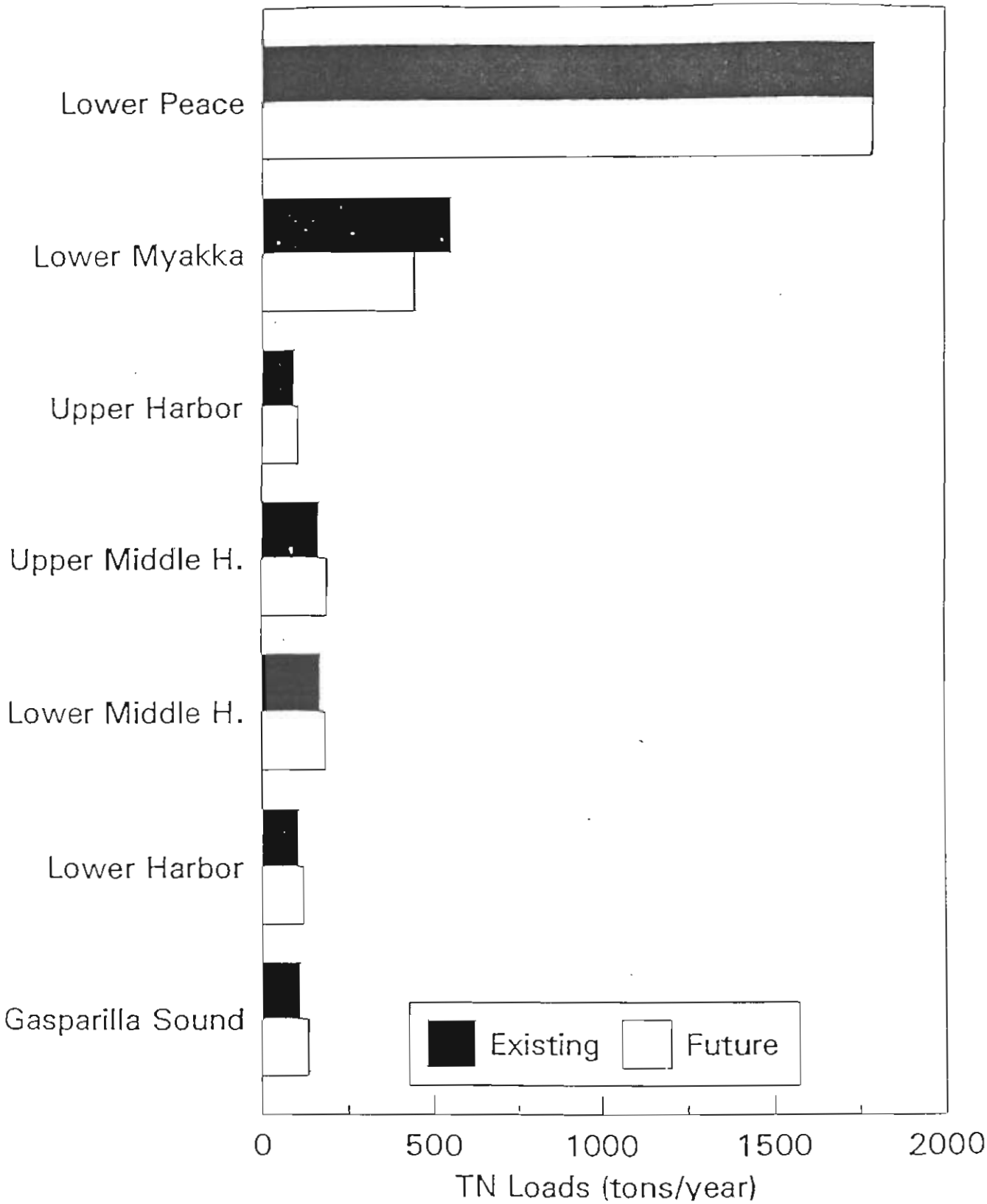


Figure 6-17. Comparison of existing and future condition loading estimates - total nitrogen.

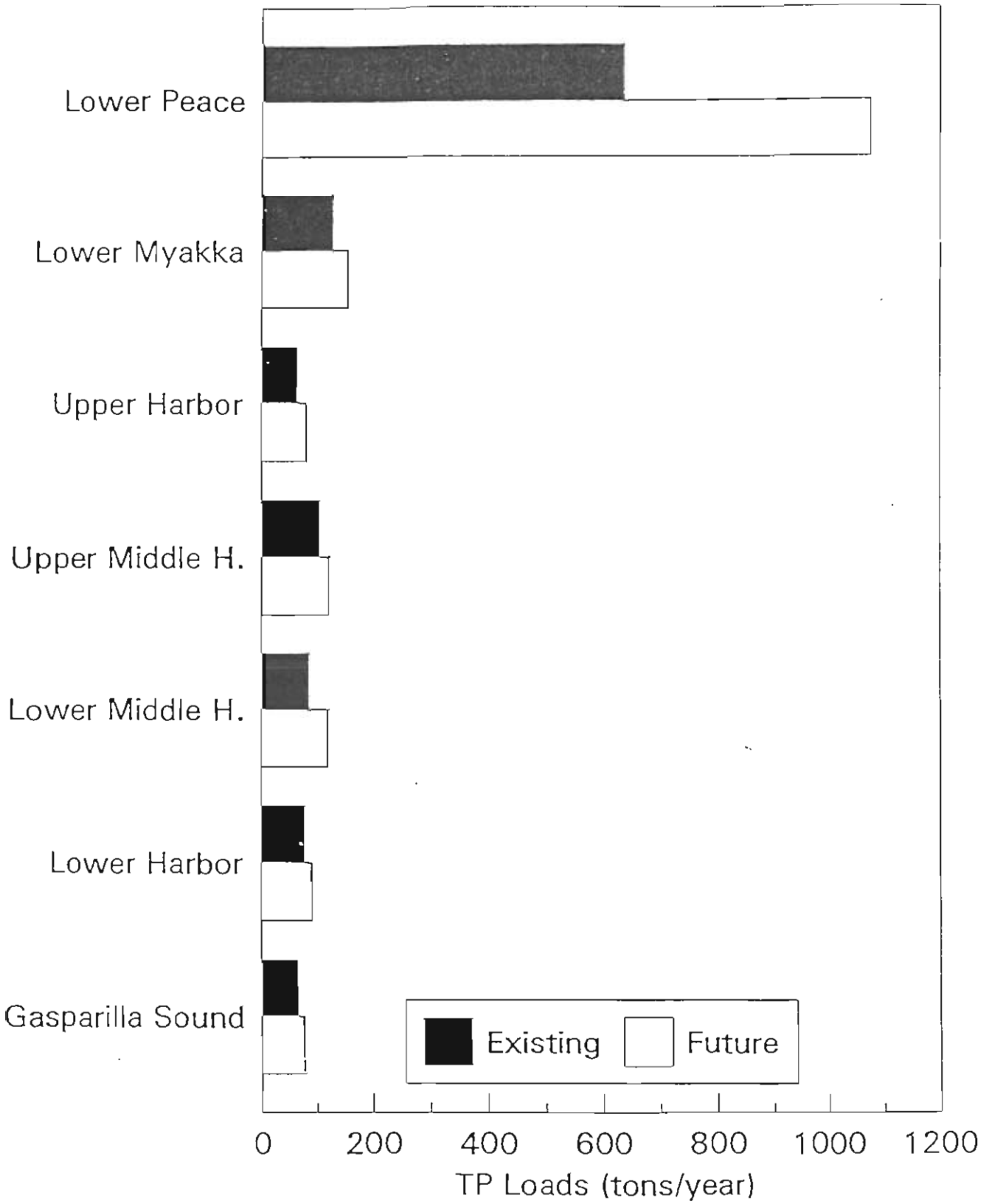


Figure 6-18. Comparison of existing and future condition loading estimates - total phosphorus.

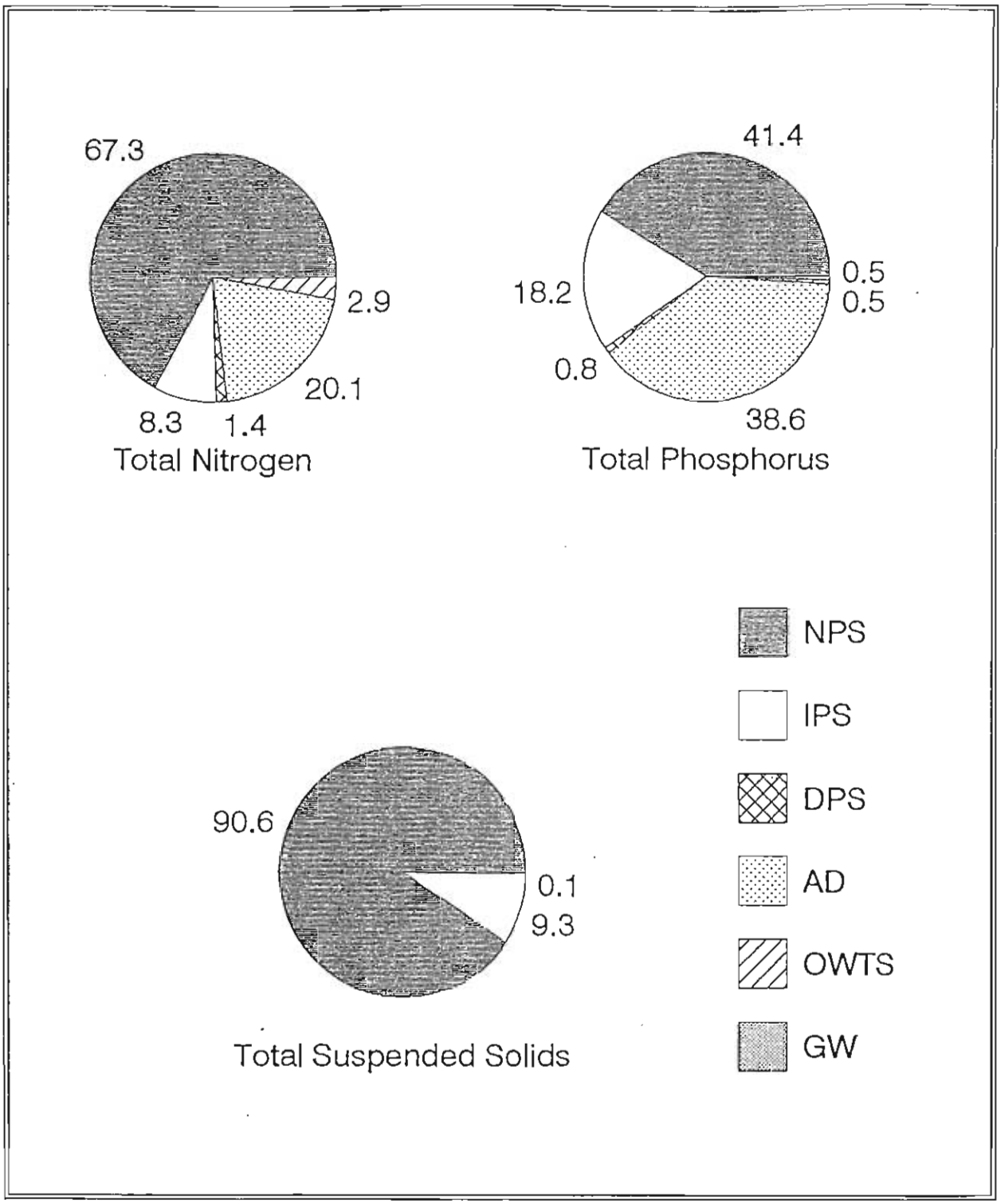


Figure 6-1. Estimated existing total annual loads.

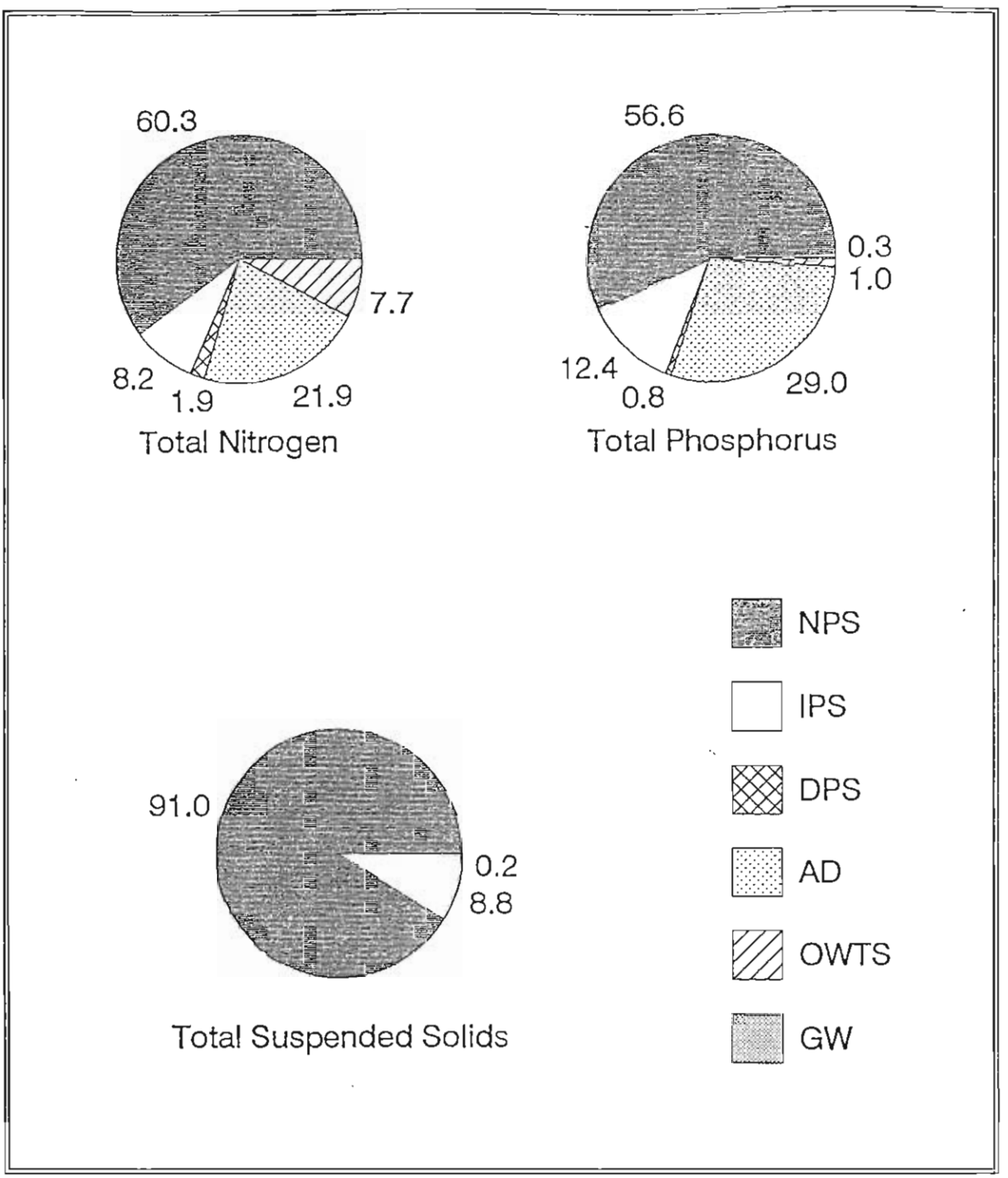


Figure 6-13. Estimated future total annual loads to Charlotte Harbor - TN, TP, TSS.

*Wastewater

Discharge of wastewater treatment plant effluent to surface waters still is common in the region, with more permitted discharges in the Peace basin than the Myakka and Caloosahatchee basins, combined. Most permitted discharges are to lakes and streams in Polk County, where treatment levels equal or sometimes exceed "secondary" levels of nutrient removal. The number of permitted discharges, and total permitted volume, has been decreasing since the 1970s as treatment facilities are regionalized, water is reused to irrigate farms, golf courses, and residential areas, or, in a few cases, wastewater is injected by deep wells into areas of salinized groundwater. In Manatee County, overland disposal of sludge from wastewater treatment plants has been controversial, but new county ordinances will bring improved management of these wastes. Manatee County also shall implement effluent reuse programs for agricultural lands in the Myakka valley. Overall, local governments have made considerable strides toward the reduction or elimination of wastewater discharges to surface waters, and, given the ecological hazards of nutrients in rivers and estuaries of southwest Florida, this trend is likely to continue.

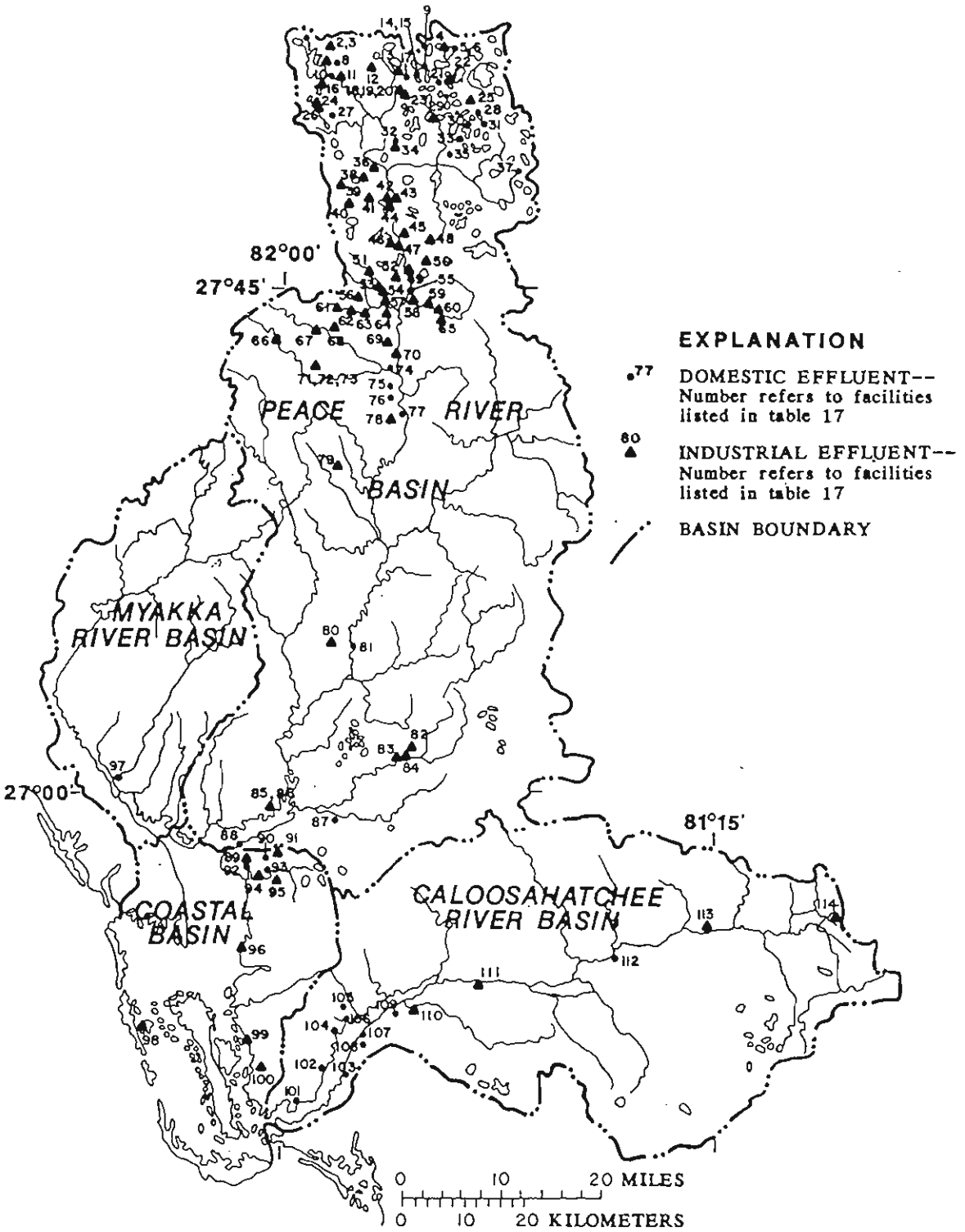


Figure 13.--Facilities that have Florida Department of Environmental Regulation permits to discharge effluent to surface-water bodies.

*Industrial Waste

The region's industrial waste situation is not unlike that for wastewater treatment plant discharges. Most permitted industrial wastes are from citrus plants, chemical plants, industries related to phosphate, or service industries. Most permitted discharges are in the Peace basin, and the majority of these are in Polk County. The number of permitted discharges from industrial sources has declined from historic levels.

Accidental discharges still occur, as in the case of discharges of phosphatic clay slime from settling areas associated with mining, beneficiation, or fertilizer production. In the past, such waste spills have polluted the entire length of the Peace River, causing massive fish kills. Compared to historic rates of accidental discharges, the incidence of such accidents has been reduced greatly. The phosphate industry now employs state-of-the-art standards and practices in the design and maintenance of earthen dams, impoundments, and surface water management systems.

*River Disasters

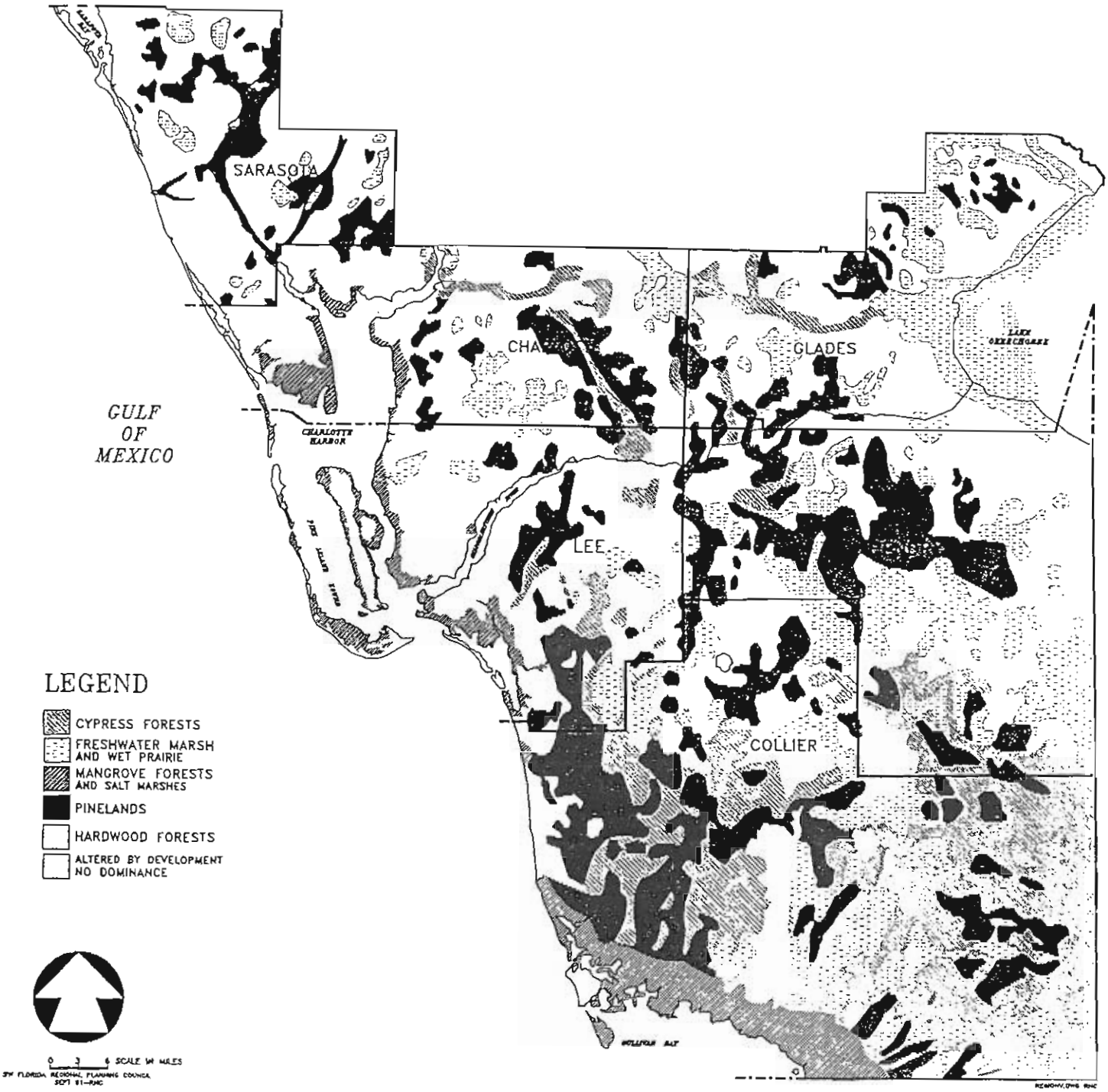
Some 30 to 40 major spills of phosphate slimes have spoiled the Peace River during the 20th century. Today the industry uses state-of-the-art designs and methods to prevent spills, but there is always a chance that another will happen. In the past, major spills have spread phosphate silt and clay throughout the entire length of the Peace River, to Charlotte Harbor, whereas smaller spills caused "slugs" of slime to move downstream as separate water masses. Slime blankets the river bottom, destroying vegetation and deep water aquatic habitats. Silts devastate freshwater mussel populations and depress other invertebrate populations, such as crayfish, severely. Fishes suffocate, causing greater than 90% losses. After the passage of a spill, water quality recovers more rapidly than bottom conditions. Phytoplankton recover in weeks and invertebrates recover in months, but fish take years to recover. Repeated spills continually retarded the recovery of the river ecosystem. Consequently, with longer intervals between spills, future accidents may be expected to have visibly greater ecological impacts. And there will be more affected people...

*Living Landscapes

One hundred and forty years ago, to divide southwest Florida into townships and ranges, a small band of men dragged survey chains due north, south, east, and west. So precise was their work that modern surveyors may still locate signs and marks left by these brave explorers. What landscapes did they cross? On a hypothetical survey from the Highlands Ridge to the Gulf of Mexico they might have worked and rested in every major habitat characteristic of the Harbor region...

Sand Pine Scrub	a fire-maintained desert-like habitat with many unusual species of plants and animals, but little drinking water;
Scrubby Flatwoods	like sand pine scrub but occurring in small patches, with other pine species dominant;
Sandhills	Arid pines and oaks with wiregrass ground cover, perhaps along the Peace in (present day) De Soto County;
Hammocks	hardwood or broadleaf evergreen growths in dry (xeric--cabbage palm and live oak), moist (mesic--water and laurel oak, magnolia), or wet (hydric-- swamp bay, sweetgum) areas;
Pine Flatwoods	the region's primary forest, with slash pine in wetter areas and longleaf pine in drier ones, rich in wildlife;
Dry Prairie	treeless plains of wiregrass saw palmetto, and broomsedge-- no place to be when fires come;
Hardwood Swamps	Large hardwood trees like black gum and red maple, with few bald cypress, but plentiful game when not flooded;
Cypress Swamps	usually wet though droughts and fires common, these are the "deep swamps" everyone feared-- or felled;
Swamp Thickets	miserably dense and wet stands of shrubs near standing water, too tall to see over but prized by birdlife;
Wet Prairies	often wet flatlands between dry prairie and marsh, maidencane and cordgrass are common but prone to burn, which makes hiking easier;
Freshwater Marshes	in all shapes and sizes and wet at least part of the year, which accounts for sedges, grasses, rushes, and broadleaf herbs, and alligators sunning among them;
Lakes and Ponds	imagine pulling chains across upper Lake Myakka or the Winter Haven lakes, without a boat!
Rivers and Streams	in summer, swift, dark water choked with fallen trees and no landing on the opposite bank;
Salt Marshes	mostly black needlerush prickles but with bulrush and cordgrass, abundant wildlife and the first signs of seafood;
Mangrove Swamps	dense, impenetrable tangles of roots and limbs wet on every spring tide or more, with diverse ground cover in light gaps-- and a riot of animal life.

Tidal Flats	Sandbars, grass flats, and oyster reefs make easy walking at low tide but mosquitoes and sting rays are constant hazards;
Coastal Strand	beaches, dunes, and scrubby backdune areas with sea oats, sea grape and cabbage palm, and wax myrtle...bright sun and little drinking water, but plenty of turtle eggs for dinner.



MAP I-13
DOMINANT NATURAL VEGETATIVE SYSTEMS
SOUTHWEST FLORIDA

*Wetland Heritage

Florida has lost about half of its original wetland resources. When last calculated (in the late 1980s), the state was losing about 17,000 acres of wetlands annually, mostly from conversions to agriculture. Freshwater wetlands in the Harbor region have suffered greater losses than saltwater wetlands. Wetlands along tributaries of the Peace River in Polk County were destroyed when stream beds were mined. Other streams, lakes, sloughs, and grassy wetlands were destroyed by mines, and never restored. Fortunately, new mining replaces lost wetlands, often in amounts greater than naturally occurred. Farming accounts for the largest loss of freshwater wetlands. Prior to World War II, many wetlands were simply drained by connector ditches. In recent years, wetland conversions to farmland or open water have accelerated, especially among very small wetlands falling below regulatory thresholds. Even today, it is not unusual for a local government or wetland agency to permit ephemeral wetlands, such as those heavily used by wood storks, to be deepened into permanent ponds integrated into stormwater treatment systems. The state and water management districts have moved aggressively to purchase large wetlands with water supply, ecologic, or recreational value, mostly in river corridors. Still, other freshwater wetlands are being destroyed through unchecked invasions of introduced plant species such as the cajeput or punk tree, Melaleuca. Punk trees have ravaged Lee County wetlands and are extending in range northward through inland areas of Sarasota County. Fortunately, agencies and citizen groups are rolling up their sleeves to eliminate these weeds-- a heroic act of historic significance for the region's ecology.

Salt water wetlands have fared comparatively better. Owing largely to citizen initiatives, local and state governments have acquired enormous tracts of coastal wetlands, and some barrier islands or island tracts. Nearly all of the mangrove coast from Placida to Estero Bay are preserved as public or private conservation lands. Around Charlotte Harbor, these wetlands are further protected through public acquisition of extensive "buffer uplands", also administered by the state aquatic preserve system. Resource managers fear that saltwater wetlands will face the "death by a thousand cuts" syndrome on privately owned shorelines.

*Mangroves

One of the most distinctive features of the estuaries are the mangrove forest that form broad, verdant bands around the area's bay and lagoons. Mangroves cover several thousands of acres and in many places extend inland several miles from the open Harbor. Mangroves perform a vital and irreplaceable role in maintaining the Charlotte Harbor area's valuable fisheries, providing habitats for large numbers of birds and wildlife and buffering inland areas against storm surges.

The mangrove forests of Charlotte Harbor are composed of three different species: the red mangrove, the black mangrove, and the white mangrove. Their distributions are controlled by land relief, frequency of tidal flooding, upland runoff and the levels of salinity. Extensive research has demonstrated the value of mangroves to the overall productivity of estuaries, primarily through the detritus-based food chain. Mangroves annually produce and shed large quantities of leaves. After the mangrove leaves fall into the water they are quickly reduced to detritus-sized particles an date washed into the main body of the estuary by tidal action. Bacteria, fungi and protozoans colonize this detritus, increasing from five to six percent when it falls into the water, to as high as 21 percent, after twelve months on the estuary. This enriched detritus is a major food source for a variety of marine animals, such as striped mullet and pink shrimp.

In varying degrees all three species of mangroves help stabilize shorelines and act as buffers to storm-driven tides and waves, thereby protecting inland areas from the excessive flood damage. Mature mangroves, twenty to thirty feet tall, provide a similar protection against the direct force of storm winds and tides. Unlike the housing developments that frequently displace them, mangroves are adapted to the damage caused by hurricanes; they rejuvenate quickly after a damaging hurricane and grow to maturity in 20 to 25 years.

Large areas of mangroves have been lost to dredge and fill practices aver the years. In addition to such direct losses, mangroves are also sensitive to alterations in upland drainage. In many areas drainage improvements for agricultural and urban development have reduced overland flows of freshwater into the mangroves and increased the amount and rate of concentrated runoff. When this occurs, salinity balances are disturbed, the flushing of detritus is reduced and nutrients are washed directly into the bays without the benefit of filtration.

Development in the mangroves forests of Charlotte Harbor adversely affects water quality hurricane protection and the fisheries and wildlife that sustain the area's tourist economy. Additionally, the high cost of developing these areas is ultimately paid for by the taxpayers in terms of flood damages, shoreline protection programs, and water quality corrective measures. It is clear that developments in the mangroves should be kept to the absolute minimum in order to maintain the free, natural functions performed by these forests.

*A Little off the Top, Please

Mangrove trimming has become a controversy throughout peninsular Florida. Trees and sometimes parts of forests may be pruned severely just for occasional scenic pleasures. Severe pruning kills red mangroves and sets back the growth, reproduction, and productivity of other species. Excess trimming also increases mangrove susceptibility to cold and wind stress during winter months. Trimmed trees are less valuable as wildlife habitat, than natural trees. Still, waterfront residents sometimes plant mangroves in order to soften their shorelines, landscape with nature, or improve wildlife habitat. Soon after, the plantings grow into trees, obstructing views or impeding access to the water. A balance must be sought that improves upon current regulations that residents find confusing and damaging o Harbor resources.

*Trends in Coastal Fish and Wildlife Habitat

Four decades following World War II were sufficient for changes in the abundance of critical Harbor habitats to become obvious. Most but not all changes have been declines. Throughout the region,

Tidal Flats declined by 76% from a 1945 area of 11,206 acres;

Saltmarsh declined by 51% from 7,251 acres;

Oyster Reef declined by 39% from 806 acres, and

Seagrass declined by 29% from 82,959 acres.

Overall, 58 square miles of key habitats upon which fish and wildlife species depend had vanished-- 36% of 1940s area. What caused such declines? Salt marsh loss can be attributed directly to major land developments that filled marshes, channelized them, or both. Dredging and circulation changes are strongly related to seagrass loss, and patterns of loss also implicate turbidity and pollution.

Causes for lost oyster and tidal flat areas are more uncertain, and probably involve multiple factors. Many lost areas were not physically destroyed, but rather converted to other habitat types. The most common conversions were to mangrove forests!

Perhaps surprising to some, the acreage of mangroves actually increased over 4 decades by 10%, up 5,107 acres from 51,524 acres. Much of the increase resulted from mangroves colonizing tidal flats and oyster reefs. Mangrove losses did occur, however, near Punta Gorda, Sanibel, and Fort Myers. There, development of shorelines caused the most mangrove loss.

Large-scale losses of habitat are hopefully things of the past. Small scale losses, and system-wide conversions, may be expected for human and natural reasons. The cumulative effect of numerous small developments will detract from remaining areas of habitat. Mitigation may stem net losses from such acts. Sea level rise is a natural process that may accelerate mangrove invasions of other habitats, as well as reshape the mix of habitats found in tidal rivers.

Table 7. CHARLOTTE HARBOR FISHERIES HABITAT COMPONENT ACREAGES

Habitat Component / Year	Mangrove 1945	Mangrove 1982	Non-Vegetated Tidal Flat 1945	Non-Vegetated Tidal Flat 1982	Oyster Reef 1945	Oyster Reef 1982	Saltmarsh 1945	Saltmarsh 1982	Seagrass 1945	Seagrass 1982
USGS Quadrangle Name										
El Jobean	3433	4321	757	126	0	4	1762	1528	1632	894
Punta Gorda SW	6885	8251	2930	1079	173	28	436	169	6881	5760
Placida	1083	968	267	142	55	56	157	0	2610	1566
Bokeelia	3544	3731	52	31	0	38	29	24	12154	11367
Port Boca Grande	39	32	0	0	0	0	0	0	382	66
Captiva	1033	1121	57	0	0	2	0	7	19907	10162
Wulfert	1392	1426	0	0	0	0	0	0	2749	1674
Sanibel	3067	2943	148	3	8	10	22	0	5296	3940
Punta Gorda	4310	2799	858	95	4	5	550	140	892	772
Punta Gorda SE	2821	3502	1081	255	0	0	424	0	4246	3562
Matlacha	4243	5821	1268	51	0	8	462	0	5780	4940
Pine Island Center	8937	11291	2324	358	515	303	709	197	11462	9684
Fort Myers Beach	6032	5955	775	362	2	3	767	747	3586	2626
Fort Myers SW	1936	1190	378	53	0	0	1384	341	1465	189
Estero	2769	3280	311	168	49	31	549	394	3917	1293
TOTAL	51524	56631	11206	2723	806	488	7251	3547	82959	58495
Acreage Change	+5107		-8483		-318		-3704		-24464	
Percent (%) Change	+ 10%		- 76%		- 39%		- 51%		- 29%	

*Habitat Alteration

Projects of diverse origin contribute to habitat loss and conversion. Common projects in the Charlotte Harbor area, according to federal permit review records, include bulkheads, docks, hosing developments, maintenance dredging, navigation projects and marinas, and bridges and roads (in descending order). In coastal areas, mangroves and marshes are the habitats most affected by proposed projects. Most proposals are for small areas, typically less than an acre in size, but proposals are numerous. Fortunately, the number of permit applications is down by 40% from 1980, but hundreds of acres are potentially threatened each year, even now. Despite diligent agency efforts at mitigation and avoidance, a slowing but downward trend in remaining habitat is expected for the foreseeable future.

*Unwelcome Guests

While the beauty of Florida's peopled lands is due in part to many species of introduced plants used in landscaping, more than a few plant species are out of control in the Harbor region. The NEP "most wanted" list includes:

Australian Pine: 3 species of pine-like trees introduced to Florida a century ago; planted as wind-breaks across south Florida and as erosion control in coastal areas; shallow roots allow winds to topple trees; encroaches upon coastal vegetation; spreads easily.

Brazilian Pepper: a Christmas holly look-alike introduced to Manatee and Charlotte counties in the 1920s; easily spread by animals; forms dense stands of limbs and canopies; displaces wildlife and native plants, encroaching into wetlands; sap injures sensitive handlers.

Punk Tree: aka cajeput or Melaleuca, here since 1900s and also used as windbreak; consumes water prodigiously and so harms wetlands; forms dense thickets; displaces wildlife. Papery bark and stinking blossoms. Seeds germinate after fire damage.

Hydrilla: entered Tampa in 1950s from Africa, this aquatic plant grows as dense strands with whorled leaves; chokes waterways and depletes oxygen; displaces native plants and native fish species. Control efforts steadily making progress.

Water Hyacinth: Large floating plant with dark green leaves and lavender flowers, introduced to St. Johns River last century. Impedes water flow and boat traffic; depletes oxygen upon rotting; aggravates jams and flooding; like hydrilla, under increasing management.

*An Unequaled Natural Heritage

Charlotte Harbor and the southwest coast of peninsular Florida shared a heritage of natural resources as bountiful and awe-inspiring as any region of America. Our heritage reflects the geological history, geographic location, and biological evolution of the world's only humid and sub-tropical peninsula. Coastal waters abounded with fishes, enough to impede the progress of sailing ships and row boats. Birds were so numerous as to eclipse the sun when their flocks took wing. Naval stores of pine, cypress, and oak seemed without limit. Not that the region was a benign Eden, though. Mosquitoes swarmed after sudden rains in numbers sufficient to kill livestock and their owners. Wild cats, venomous snakes, alligators, bears, sharks, and other wildlife were elements of everyday life for explorers and settlers--they endangered humans rather than being threatened with extinction.

Extinctions came early for some species, at least from Florida or Harbor landscapes or waters. The West Indian monk seal, Florida's only native pinniped, was the first to disappear. Nineteenth century plume hunters drove several coastal bird populations to precipitously low levels, and completely eradicated others. Manatees, sawfishes, alligators, and cats were killed indiscriminately, for sport or trophies, or simply from fear. Sturgeon have all but disappeared from the Peace River. Bay scallops have all but disappeared from Pine Island Sound.

*Habitats and Living Resources (biodiversity)

Fish and wildlife resources of the region are supported by 9 upland habitats plus 5 forms of freshwater wooded wetlands, 2 forms of freshwater herbaceous wetlands, 4 forms of freshwater aquatic habitats, and 11 forms of tidal wetlands, submarine grass beds, tidal mud flats, and open Harbor waters. Beds of submerged aquatic vegetation (SAV), and tidal wetlands, are especially abundant and productive:

Diversity and Abundance of Estuarine Habitat in Charlotte Harbor

Resource	Number of Species	1982 Area (acres)
Submerged Aquatic Vegetation	5	58,495
Mangroves	4	56,631
Tidal Marsh	11	3,547
Oyster Reef Communities	1	488
TOTALS:	21	119,161 (186 sq. mi.)

Fifty significant tracts of fish and wildlife habitat occur in coastal counties, alone. Such habitat diversity supports a large and diverse fauna, as shown below.

Minimum Faunal Species Diversity of the Charlotte Harbor NEP Area

Group	Species Number
Marine Invertebrates	591
Freshwater Fishes	66
Marine Fishes	273
Amphibians	24
Reptiles	55
Birds	316
Mammals	44

These 1.369 species greatly understate the region's actual biodiversity. The great animal group of insects are not included in this estimate. Nor or introduced plant and animal species, or the riot of microscopic and microbial life invisible to naked eyes. Still, by conventional comparisons, the Harbor region fares well as a part of peninsular Florida.

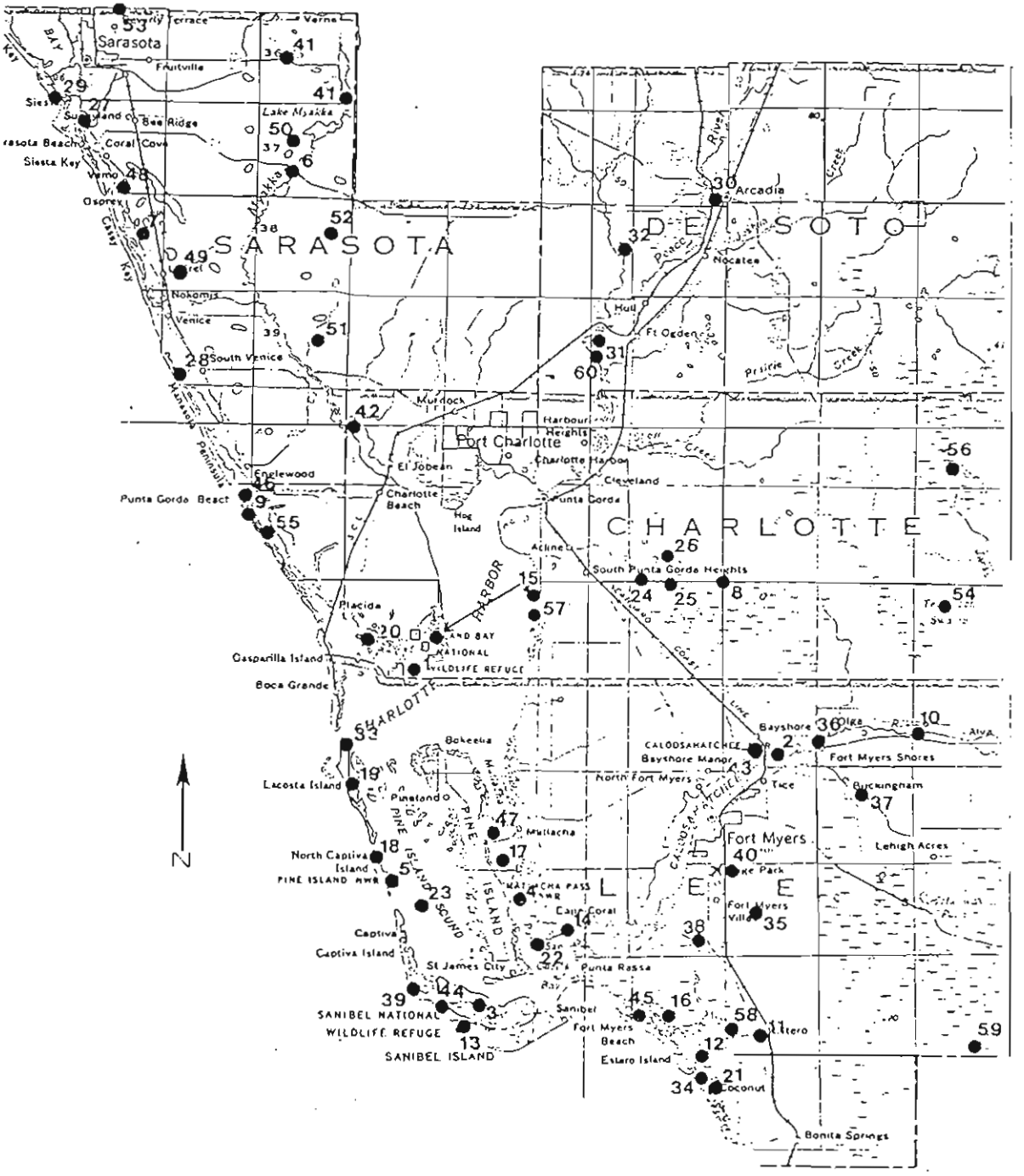


Figure 4. Significant Tracts of Fish and Wildlife Habitat

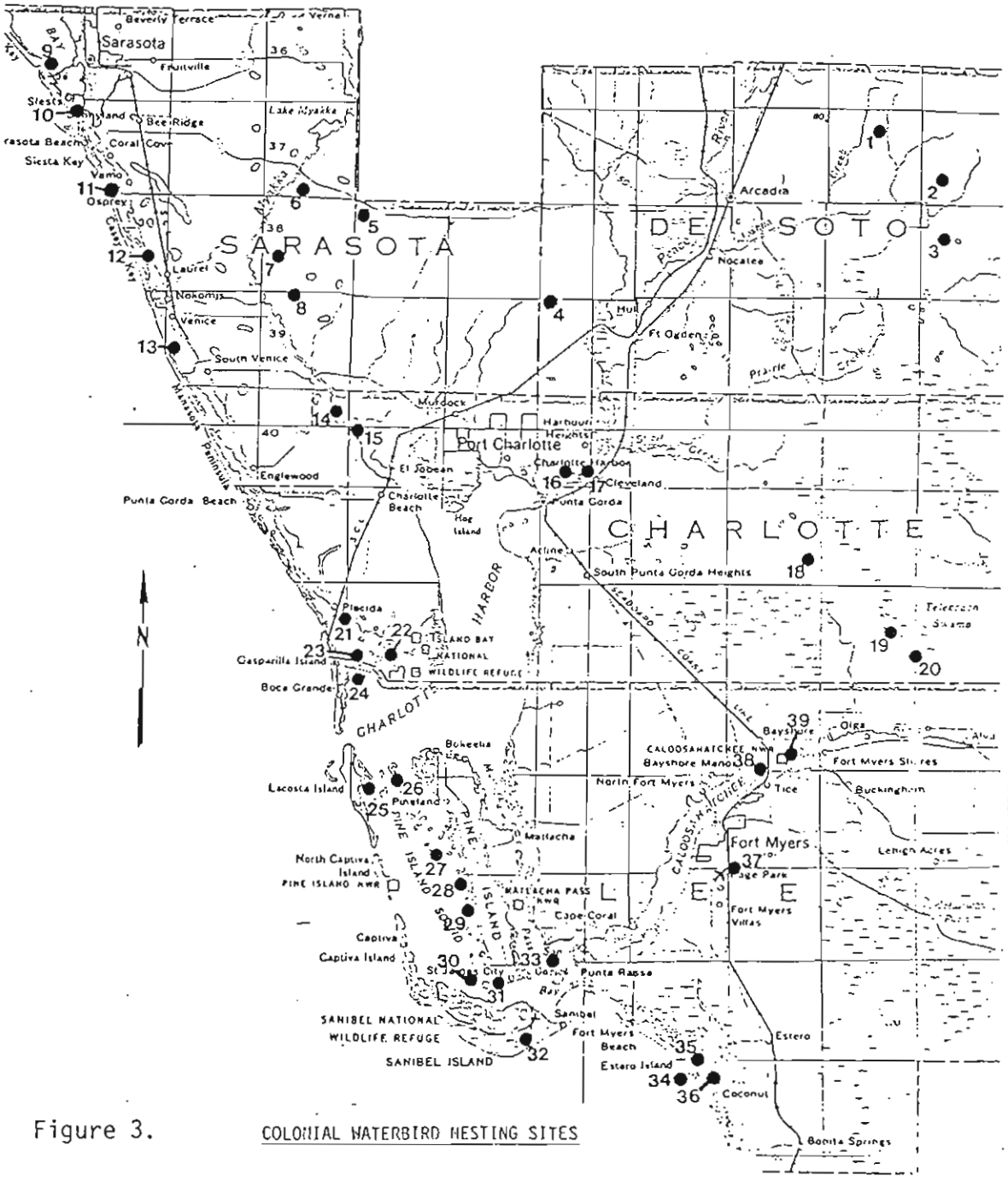


Figure 3. COLONIAL WATERBIRD NESTING SITES

*Commercial and Sport Fisheries

The Harbor is highly significant to the State of Florida as a nursery ground for marine and estuarine species. Up to 90% of commercial and 70% of recreational species landed in Florida spend all or part of their lives in estuaries. Many species, such as the prized game fish Centropomis undecimalis (snook) occur in large numbers throughout the Harbor's major tributaries. Florida's record snook, a 44 lb. 3 oz. giant, was caught with conventional tackle at Fort Myers, in 1984!

The main fishery species of commercial and recreational value in the Charlotte Harbor NEP area include black mullet, spotted sea trout, red drum, black drum, king whiting, flounder, blue crab, pink shrimp, stone crab, hard clam, snook, tarpon, grouper and sea bass, snapper, Florida pompano, permit, bluefish, sand sea trout, spanish and king mackerel, sheepshead, and several species of sharks.

Commercially valuable fisheries and add substantially to the overall economic base of Charlotte Harbor's three gulf counties. In 1995, Lee County alone had combined commercial and finfish landings of 9.6 million pounds, worth $16.1 million dockside. Lee County often leads all of the state in the commercial landings of cobia, flounder, jewfish, black mullet, permit, pompano, spotted seatrout, lane snapper, mangrove snapper and tripletail. These dollar values of Lee county's fisheries landings do not take into account the value added from processing, packing, freezing and shipping.

In 1995, Lee County was Florida's fourth most productive seafood county, down from second place just 20 years ago. County landings have remained relatively stable while landings elsewhere have risen. (Landings of Charlotte and Sarasota Counties combined average one-third of Lee's.) Despite declines in some wetland types and areas since World War II, commercial landings of most fishery species have not declined in Lee County. Exceptions include declines in landings of pink shrimp, blue crab, and scallop.

The bountiful water off Charlotte Harbor also provide some of the best saltwater sport fishing in the world. Snook, tarpon, redfish and spotted seatrout are just a few gamefish found here. About one third of all the tourists who come to Florida came to fish. As result, the Charlotte Harbor counties derive substantial economic benefits from the maintenance of a healthy estuarine and coastal sport fishery. It is difficult to establish a precise monetary value because of the industries' close relationship to tourism facilities and services but
FDEP data indicate that 21.4% of our population engage in recreational fishing.

One in five people average 9 to 10 fishing trips each year, spending about $423 in the process for tackle, fuel, bait, ramp fees and the like. It is also estimated that the average fishing investment (boat, rods and reels, tackle, electronics, etc.) per angler with a boat included is $19,643. Anglers without boats invest $556 each, so the total angling investment in the region exceeds $1.1 billion dollars (1991-92 data for Charlotte, Lee, Collier, Glades and Henry Counties).

TABLE III-58
SUMMARY OF MARINE LANDINGS - SELECTED YEARS

Year	Food Fish (000 Lbs.)	Food Fish ($000)	Shell Fish (000 Lbs.)	Shell Fish ($000)	Shrimp (000 Lbs.)	Shrimp ($000)	Total (000 Lbs.)	Total ($000)
Charlotte								
1975	2,939	N/A	283	N/A	172	N/A	3,394	N/A
1976	2,203	N/A	602	N/A	101	N/A	2,906	N/A
1978	2,419	N/A	784	N/A	140	N/A	3,343	N/A
1983	4,260	1,392	338	194	96	233	4,694	1,819
1986	3,241	1,391	301	314	87	198	3,629	1,903
1989	3,368	2,223	512	859	67	125	3,946	3,207
Collier								
1975	3,911	N/A	1,055	N/A	1	N/A	4,967	N/A
1976	2,639	N/A	817	N/A	2	N/A	3,458	N/A
1978	2,402	N/A	1,329	N/A	0	0	3,731	1,976
1983	1,787	1,161	816	2,325	0	0	2,603	3,486
1986	2,697	2,824	1,280	2,569	0	0	3,977	5,393
1989	4,679	3,088	1,448	2,432	0	0	6,126	5,520
Lee								
1975	11,860	N/A	102	N/A	5,169	N/A	17,131	N/A
1976	10,260	N/A	184	N/A	5,164	N/A	15,608	N/A
1978	10,358	N/A	166	N/A	5,169	N/A	15,693	12,304
1983	10,184	6,711	832	709	3,491	9,994	14,507	17,414
1986	7,573	4,805	4,836	10,939	3,798	10,282	16,207	26,026
1989	7,340	4,844	1,529	2,568	2,481	4,615	11,349	12,027
Sarasota								
1975	544	N/A	157	N/A	0	0	701	N/A
1976	311	N/A	6	N/A	7	N/A	324	N/A
1978	122	N/A	0	0	0	0	122	0
1983	306	191	21	74	12	38	339	303
1986	607	226	19	34	0	0	626	260
1989	1,469	970	56	93	0	1	1,525	1,064
Region								
1975	19,254	N/A	1,597	N/A	5,342	N/A	26,193	N/A
1976	15,413	N/A	1,609	N/A	5,274	N/A	22,296	N/A
1978	15,301	N/A	2,279	N/A	5,309	N/A	22,889	14,280
1983	16,537	9,455	2,007	3,302	3,599	10,265	22,143	23,022
1986	14,118	9,246	6,436	13,856	3,885	10,480	24,439	33,582
1989	16,855	11,124	3,544	5,953	2,549	4,741	22,947	21,818
% of State								
1975	19.3	N/A	5.2	N/A	16.7	N/A	16.1	N/A
1976	16.0	N/A	5.4	N/A	17.7	N/A	14.3	N/A
1978	16.6	N/A	7.3	N/A	15.3	N/A	14.5	15.5
1983	16.3	15.5	5.4	8.3	10.8	15.9	12.9	13.9
1986	12.0	14.2	12.4	15.1	14.6	19.8	12.1	14.7
1989	18.5	18.5	9.9	9.9	10.6	10.6	15.2	13.2

* Total may not equal sum of breakdown due to non-food fish not identified in this table.

Source: National Marine Fisheries Service, unpublished data for selected years.

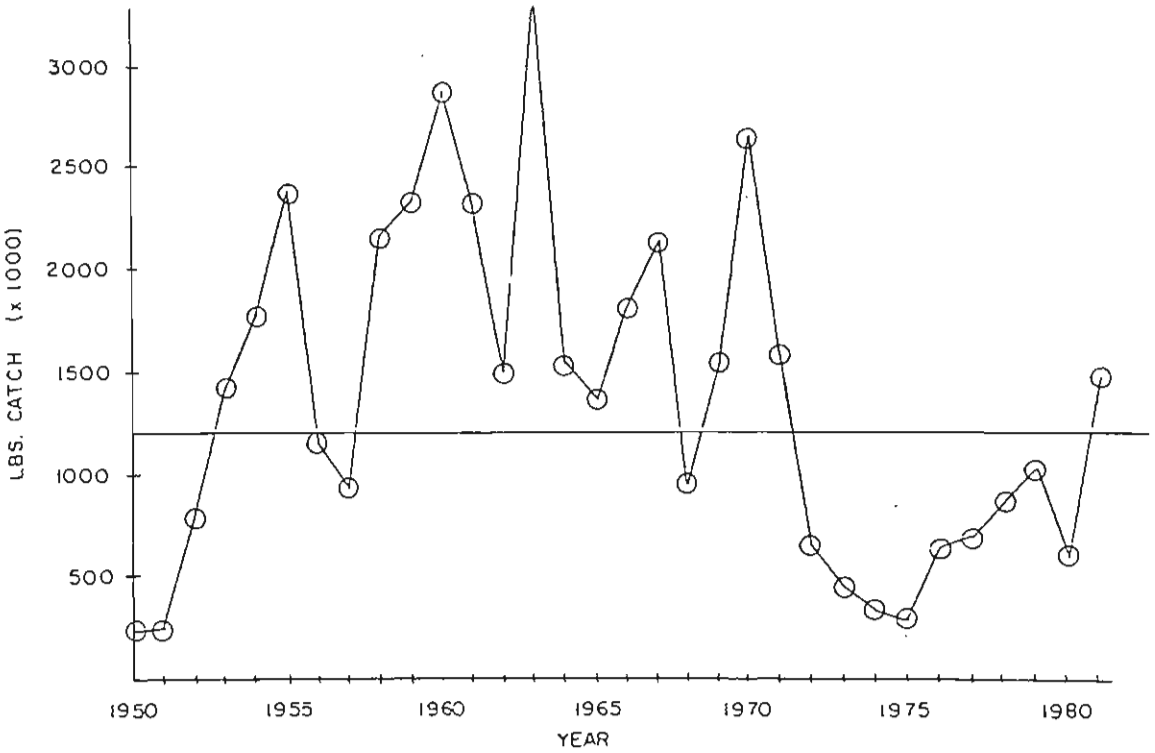


Figure 12. Annual summaries of Florida Landings for blue crab landed in the Charlotte Harbor area. Horizontal line indicates the 30 year average.

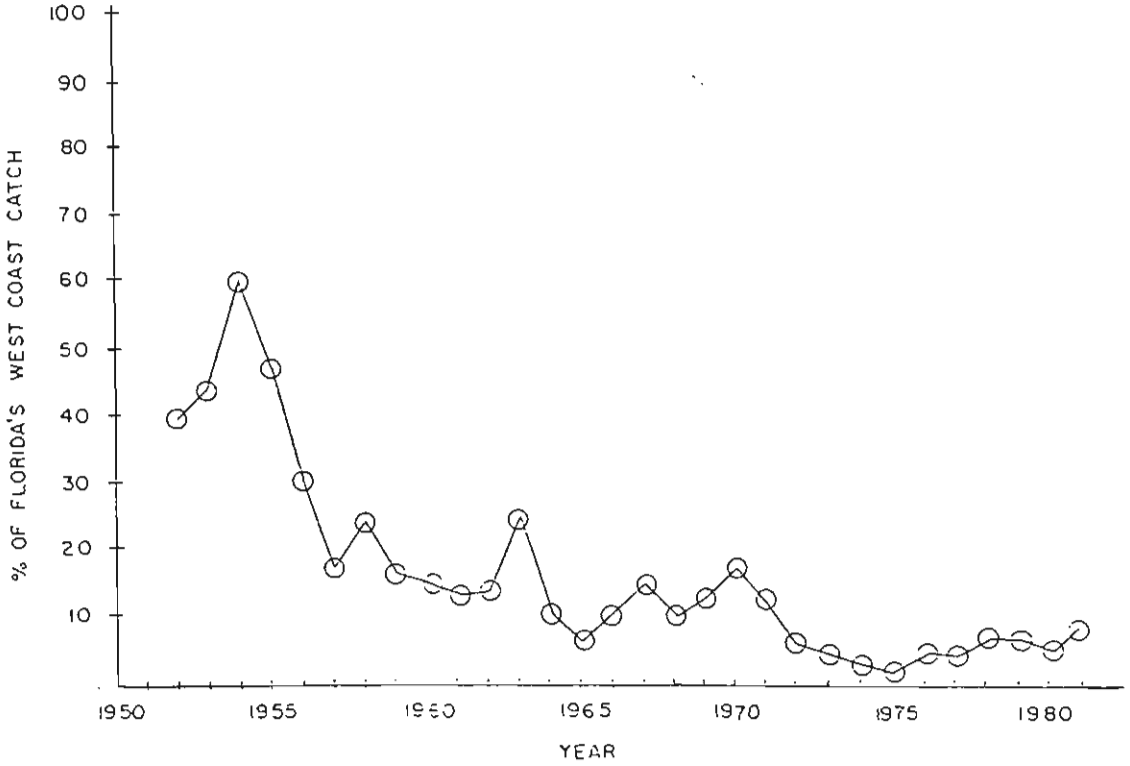


Figure 13. Annual summaries of Florida Landings for blue crab landed in the Charlotte Harbor area over the amount landed for the west coast of Florida.

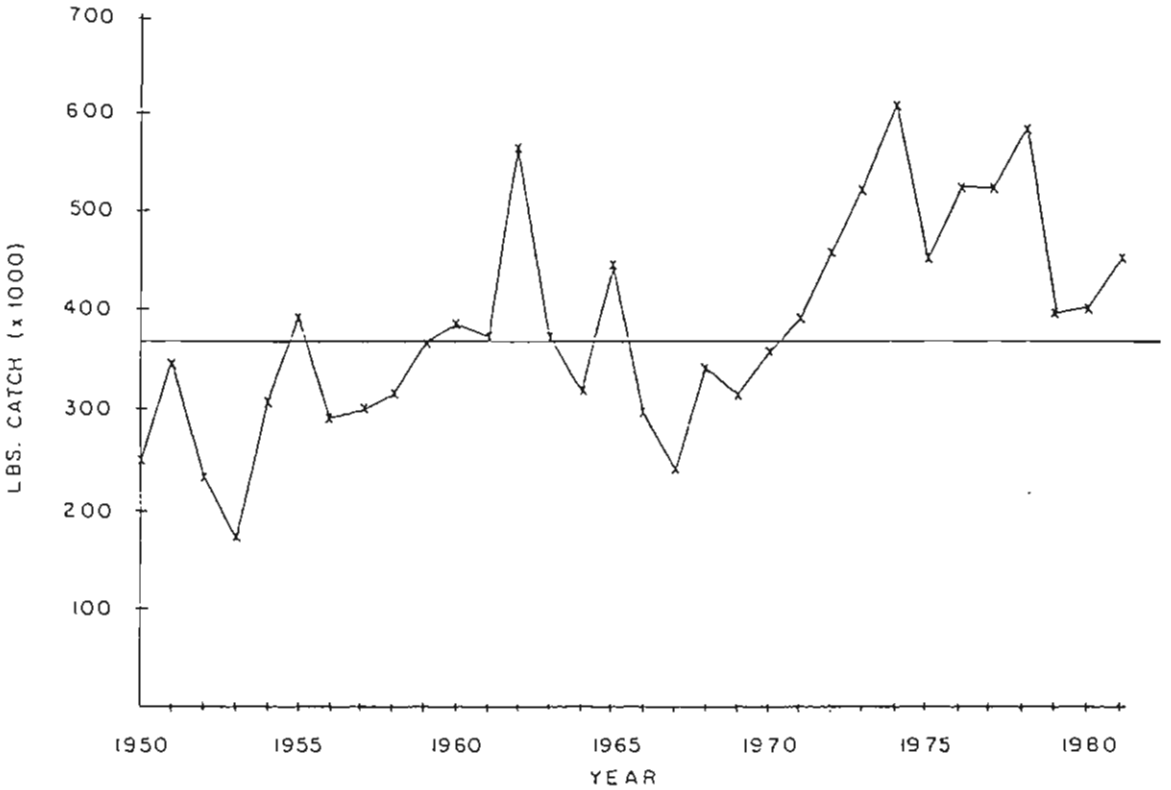


Figure 6. Annual summaries of Florida Landings for red drum landed in the Charlotte Harbor area. Horizontal line indicates the 31 year average.

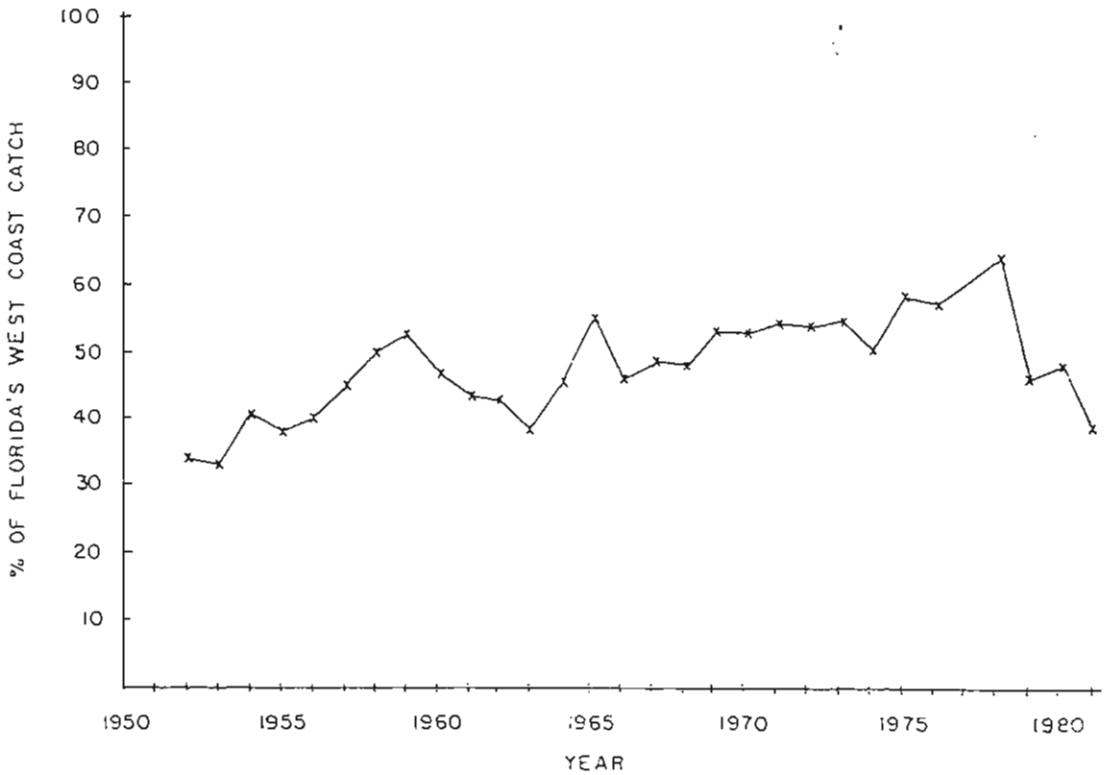


Figure 7. Annual summaries of Florida Landings for red drum landed in the Charlotte Harbor area over the amount landed for the west coast of Florida.

*Fish Stories

Snook-- linesiders spawn near inlets during summer nights. Spawning aggregations can be enormous. Eggs fertilized in sea water develop into larvae and then early juveniles. Late juveniles show up in brackish water ditches, ponds, creeks, and wetlands miles inland from their barrier-island birthplace. Young snook feed voraciously where small prey are available. Tidal rivers connecting to the Harbor are prime nursery grounds for pre-adult ("not quite legal") snook, and lunkers, too. A fish camp 17 miles up the Myakka River is called "Snook Haven" for good reason. Snook are common in the Peace River at Arcadia, 80 miles from Charlotte Harbor.

Tarpon-- icon of the Charlotte Harbor National Estuary Program for very good reason, this is the ultimate sport adversary for anglers in the region. Each summer, tarpon gather in Boca Grande Pass and nearby Harbor waters in pre-spawning schools, to feed in preparation for offshore migration. Nowhere else do such huge numbers of fish mass as near Boca Grande, testimony to the productivity of Charlotte Harbor. Then tarpon head out to sea some 50 to 100 miles, to spawn. Unusual eel-like larvae called leptocephali (singular, leptocephalus) migrate back to the Harbor to mature. Young tarpon are found in habitats used by young snook, so it is not uncommon for anglers seeking bass in the Peace River near Fort Ogden to see schools of immature tarpon roll by. Schools of older animals patrol the middle harbor in search of baitfish schools, or crabs swimming at the surface, easy prey chased up from deeper hypoxic waters. The largest tarpon, weighing hundreds of pounds, are the much-sought prize winners in prestigious tournaments that draw anglers from around the world. Although a few animals may be landed, nearly all of the giant fish caught by hundreds of anglers in dozens of boats now are released alive, often with tags allowing scientists to study populations and migrations.

Sharks-- illustrate the complex habitat values of the estuary. More than a dozen species are native to the Harbor. Some species, such as nurse and bull sharks, spend most of their time inshore. Other coastal species utilize the Harbor as mating areas or pupping grounds. Sharks tagged in the Harbor migrate throughout the west Florida coast, Gulf of Mexico, and Caribbean Sea. As top carnivores, sharks play a key role in the regulation of lower trophic levels, and they support a fishery of international significance. Shark utilization of Charlotte Harbor is particularly intense near Gasparilla Sound, lower Pine Island Sound, and San Carlos Bay. Sawfish, a protected Florida species, occurs near the mouth of the Myakka River.

*Fisheries Old and New

Fisheries of Charlotte Harbor are a mix of the old, the new, and the borrowed. A century ago men cast nets for mullet. A recent ban on other nets has caused a return by many fishing families to the art of cast-netting. The century-old practices of hook-and-line trout fishing in Matlacha Pass, and trophy fishing for tarpon in Boca Grande, also continue in modern times. Newer fishery developments include the blossoming of guided backwater fishing from high-powered "flats" boats which sometimes damage fragile seagrass beds, and offshore party boat trips for the occasional angler and tourist.

A fishery borrowed from other coastal communities will soon flourish in the Harbor, in the form of clam culture. Hard clams are prized restaurant fare. Two commercial aquaculture operations presently operate in the lower Harbor. One cooperates with the Florida Sea Grant Program and Harbor Branch Oceanographic Institute to train displaced netters. Already, it harvests about 3 million clams from Charlotte Harbor, annually. In the next few years dozens of family-owned leases will support the culture and annual harvest of many millions more of clams from the Harbor, Gasparilla Sound, and Pine Island Sound. As this commercial fishery grows in economic importance, the value in protecting water quality will take on increased urgency.

*Closed for Business

Ironically, as clam culture prepares to flourish in Harbor waters, still other waters are off limits! for shell-fishing of any kind. A reliable measure of environmental health in estuaries is the ability to consume shellfish such as clams and oysters, because Florida's Department of Environmental Protection takes pain to ensure that shellfish are safe. Presently, 16,197 acres of waters, all in Pine Island Sound, are approved for shellfish harvest. Another 35,990 acres in Lemon Bay, Gasparilla Sound, and the Myakka River are conditionally approved. Unfortunately, the main body of Charlotte Harbor is not classified, which operationally means that shellfish harvesting is unapproved. Still worse are conditions causing the FDEP to prohibit shellfishing from 72,143 acres from Lemon Bay to Estero Bay. Estero Bay and Pine Island Sound have the largest areas of prohibited water, almost 80% of total prohibitions, as a result of measured or probable bacterial contamination. Overall, prohibited waters exceed approved plus conditionally approved waters by 38%, and the spread is expected to increase. Nothing signifies improved water quality more than an estuary's fitness for direct consumption of its shellfish, so it can only be hoped that efforts to map fugitive bacteria --such as an ongoing project in Charlotte County-- will aid in reversing the present trend.

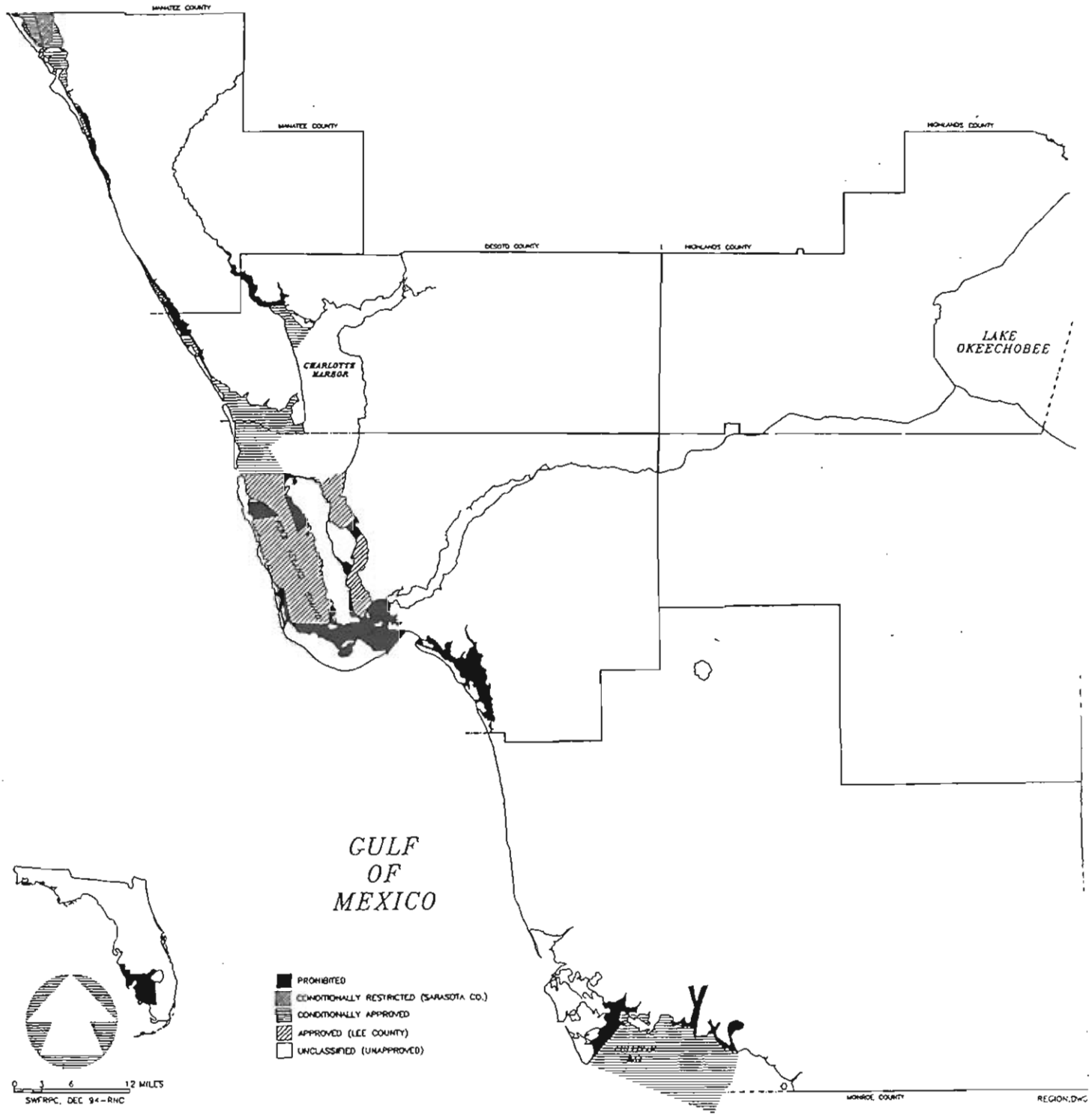


FIGURE 4 SHELLFISH HARVESTING AREAS SOUTHWEST FLORIDA REGION

*Red Tide

"Red tides", or blooms of toxic dinoflagellates, cause major coastal fish kills. In the Charlotte Harbor region, a major red tide has occurred on average once every 3 years since 1900, though the frequency of red tides along southwest Florida has increased during the past decade. Red tide blooms may be small and localized, or as large as the combined area of several counties. Red tides result from natural offshore processes but the persistence and intensity of red tides, once inshore, very well may be affected by point or nonpoint source discharges from the watershed. Red tide toxins and bloom-induced anoxia kill fishes and other estuarine biota. The smell of decaying fish, and aerosolized toxins, irritate human respiratory systems and lower occupancy rates of beach and waterfront tourist accommodations. In one particular year a rash of manatee deaths resulted from an explosive increase of tunicates (sea squirts) made toxic in manatee feeding grounds. In 1996, catastrophic manatee mortality resulted when red tide toxicity aggravated stress from sudden and severe cold fronts-- a total of 158 manatees resident to Charlotte Harbor perished. Scientific study concluded that a lifetime of low-level exposures to red tide toxins pushed adult manatee tolerances to fatal levels. Mechanisms controlling red tide are not well understood. If red tide persistence or severity can be linked to human activities the blooms may serve as indicators of success in managing nutrient or other forms of loading to the estuary.

*Species at Risk

In 1980, 42 species (then 40% of the state's total number of species at risk) that were listed as rare, endangered, or threatened, could be found in the Charlotte Harbor region. By 1990, that number had grown to 86 species (listed by FGFWFC, USFWS, CITES or FCREPA). In only one decade, the region's importance as refugia for listed species increased by more than 100%.

Today, nearly 20% of the region's faunal species other than insects and marine animals face some measure of peril. Many are our favorite wildlife-- species we associate with living in southwest Florida...

Endangered
Most sea turtles, wood storks, West Indian manatees, Florida panthers

Threatened
Loggerhead turtles, Eastern indigo snakes, brown pelicans, bald eagles, sandhill cranes, Florida scrub jays, red-cockaded woodpeckers

Special Concern
Gopher tortoises, alligators, roseate spoonbills, burrowing owls

...and many others. These species are environmental sentinels, informing us of emerging problems for wildlife in general. Individual actions, such as watching for manatees while boating, are as important as land development codes in protecting species at risk. From the standpoint of their long-term protection, our wisest collective action will be to provide for a regional system of preserves, managed lands, buffers, and corridors.

SPECIES OF THE CHARLOTTE HARBOR AREA
WHICH ARE CLASSIFIED BY THE FLORIDA GAME AND FRESH WATER FISH COMMMISSION
AS ENDANGERED, THREATENED, OR OF SPECIAL CONCERN

ENDANGERED

Reptiles

American crocodile	(*Crocodylus acutus*)
Atlantic green turtle	(*Chelonia mydas mydas*)
Atlantic hawksbill turtle	(*Eretmochelys imbricata imbricata*)
Atlantic Ridley turtle	(*Lepidochelys kempii*)
Atlantic leatherback turtle	(*Dermochelys coriacea*)

Birds

Wood stork	(*Mycteria americana*)
Florida everglade kite	(*Rostrhamus sociabilis plumbeus*)
Peregrine falcon	(*Falco peregrinus*)
Cuban snowy plover	(*Charadrius alexandrinus tenuirostris*)
Kirtland's warbler	(*Dendroica kirtlandii*)
Florida grasshopper sparrow	(*Ammodramus savannarum floridanus*)

Mammals

West Indian manatee	(*Trichechus manatus laitirostris*)
Florida panther	(*Felis concolor coryi*)

THREATENED

Reptiles

Atlantic loggerhead turtle	(*Caretta caretta caretta*)
Eastern indigo snake	(*Drymarchon corais couperi*)

Birds

Eastern brown pelican	(*Pelecanus occidentalis carolinensis*)
Southern bald eagle	(*Haliaeetus leucocephalus leucocephalus*)
Southeastern American kestrel	(*Falco sparverius paulus*)
Audubon's caracara	(*Caracara cheriway auduboni*)

Florida sandhill crane	(Grus canadensis pratensis)
Roseate tern	(Sterna dougallii dougallii)
Least tern	(Sterna albifrons)
Florida scrub jay	(Aphelocoma coerulescens coerulescens)
Red-cockaded woodpecker	(Picoides borealis)

Mammals

Mangrove fox squirrel	(Sciurus niger avicennia)
Florida mouse	(Peromyscus floridanus)
Florida black bear	(Ursus americanus floridanus)
Everglades mink	(Mustela vison evergladensis)

SPECIES OF SPECIAL CONCERN

Amphibians

Florida gopher frog	(Rana areolata aesopus)

Reptiles

Gopher tortoise	(Gopherus polyphemus)
American alligator	(Alligator mississippiensis)

Birds

Little blue heron	(Florida caerulea)
Snowy egret	(Egretta thula)
Louisiana heron	(Hydranassa tricolor)
Reddish egret	(Dichromanassa rufescens)
Roseate spoonbill	(Ajaia ajaja)
Limpkin	(Aramus guarauna pictus)
American oystercatcher	(Haematopus palliatus)
Florida burrowing owl	(Athena cunicularia floridana)
Marian's marsh wren	(Cistothorus palustris marianae)
Cuban yellow warbler	(Dendroica petechia gundlachi)

Mammals

Sherman's fox squirrel	(Sciurus niger shermani)

*Wildlife Refuges

Charlotte Harbor's own J.N. "Ding" Darling National Wildlife Refuge on Sanibel Island is a crown jewel. Established in 1945 and dedicated to Darling, an ardent conservationist, in 1978, the refuge is intended by Congress as "an inviolate sanctuary"...for migratory birds, and other management purposes. The Refuge protects more than 6,300 acres of unique subtropical ecosystems, in 8 tracts, of which 2,600 acres are wilderness areas. The Refuge also administers 1,120 acres of mangrove islands in 4 tracts within the Harbor and Pine Island Sound. Management tools include non-native species control, prescribed burning, excavation, water level controls, law enforcement, research, and education. The refuge is a recreational and educational resource for 1.5 million people annually, more than the entire present-day population of the NEP study area! Six endangered species occur in the Refuge, including the American crocodile. Three threatened species and ten species of special concern are regular Refuge inhabitants. It is hoped that NEP status for the Harbor can somehow work to give our Refuge much-needed federal assistance.

*Aquatic Preserves

The coastal estuaries and lagoons we think of as great waters of the Harbor region are synonymous with a contiguous set of aquatic preserves. At the state level, estuarine areas have been recognized and protected as eight conterminous aquatic preserves and buffers. Their total area is 323 square miles:

Aquatic Preserve Name	Date Established	Preserve Area, acres	Buffer Area, acres
Lemon Bay	1986	7,667	---
Cape Haze	1978	11,284	---
Gasparilla Sound/ Charlotte Harbor	1979	79,168	---
Matlacha Pass	1972	12,511	---
Pine Island Sound	1970	54,176	---
Estero Bay	1966/83	9,834	---
Combined Upland/ Wetland Buffers	var.	---	32,095

All face problems of declining seagrasses and mangroves, increasing nutrient loads, and changes in surface water hydrology. Lemon Bay faces watershed and shoreline development, and boat traffic impacts. Cape Haze preserve suffers from propeller damages to seagrass beds. Gasparilla Sound/Charlotte Harbor managers are concerned by freshwater flow reductions, and manatee safety. In Matlacha Pass and Pine Island Sound, boating impacts are a management issue; the latter preserve also faces shoreline alteration stresses. Increasing freshwater inflows and nutrient loads are management issues in the Estero Bay preserve, as well as habitat losses.

The aquatic preserve program matches resources to managers. It, and the Myakka Wild and Scenic River Program, put experienced specialists "in the field" for hands-on management. The program needs additional staff to accomplish its goals of accelerated land acquisition, habitat restoration, resource inventories, and management of boat-related impacts.

*The Tidal Caloosahatchee River

The lower reaches of the Caloosahatchee River-- the waters affected by tide-- wait quietly for the new century. The 20th Century has been hard on this river reach. Channels straightened, shorelines hardened, oyster reefs dredged: the river has been assaulted by raw sewage, storm runoff, great slugs of Lake Okeechobee overflow, pesticide spills, thermal effluent, and exotic nuisance species. Five times a week, 2 barges each carry 10,000 barrels of oil up the river to fuel the power plant near Interstate 75 (so far without a major accident since 1960-- but churning up mud with every trip). But the river persisted. Today, scientists marvel that seagrasses can still flourish when river conditions are suitable. Boaters delight upon seeing manatees. And fishermen privately speak of remarkable catches of snook or redfish from secret holes.

The tidal river's future will be an ecological and social renaissance. Base flows during the dry season will prevent salt water intrusion and its destruction of low salinity areas between Franklin Locks and Beautiful Island.

Later, watershed and Lake management schedules will lessen but prolong large-volume discharges during wet seasons, syncopating the river with coastal estuaries. Tidal oxbows will become ecological preserves and ecotourism destinations. Urban shorelines will be softened and made into productive refuge for juvenile fishes. Water quality will improve so as to not limit people from using the river beneficially. Fort Myers and Cape Coral will reshape their communities to maximize enjoyment and sustainable commercial uses of the river. How else the river may be in the new century one can only imagine, but the changes all will be for the better.

*Land Use

The land sales development that began in the 1950's dramatically and permanently changed the character and use of the land. Pastures and cropland were drained and cleared, coastal low-lands were dredged and filled to create developable homesites by the tens of thousands. The land was subdivided, canals were dug and streets were paved. however, in most of these developments very few houses were built. Even though some of this land was platted and sold twenty years ago, today a large percentage of it remains desolate, devoid of houses or people. The existing residential centers such as Fort Myers, Fort Myers Beach, Punta Gorda, Englewood and Sanibel have expanded and grown, but these areas are small compared to the near-empty land sales developments.

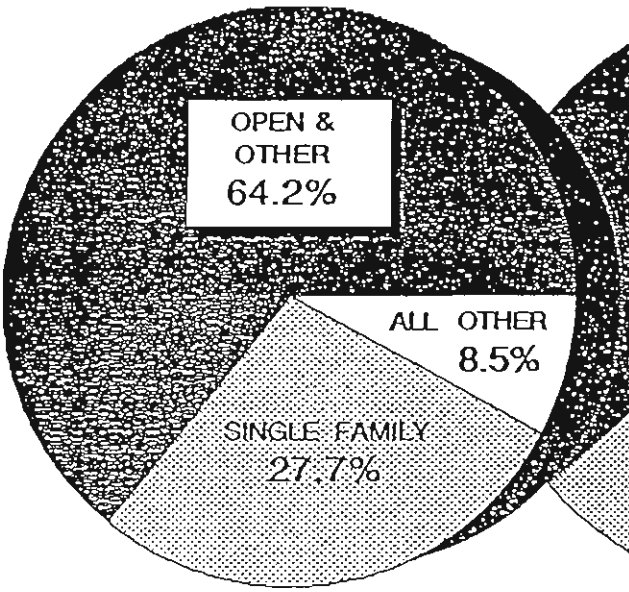
The thousands of acres of land subdivided in this manner have permanently cast the form of future development. Well into the next century, new development in the area will occur in the mold of the subdivision practices of the 1950's and 1960's.

The platting of these extensive tracts of land has removed thousands of acres from agricultural and other productive uses years in advance of when the land would actually be needed for housing. Agricultural land in under considerable development pressure near existing urban centers, particularly south and east of Fort Myers. There, flower and vegetable cropland is being rapidly displaced by urban land uses.

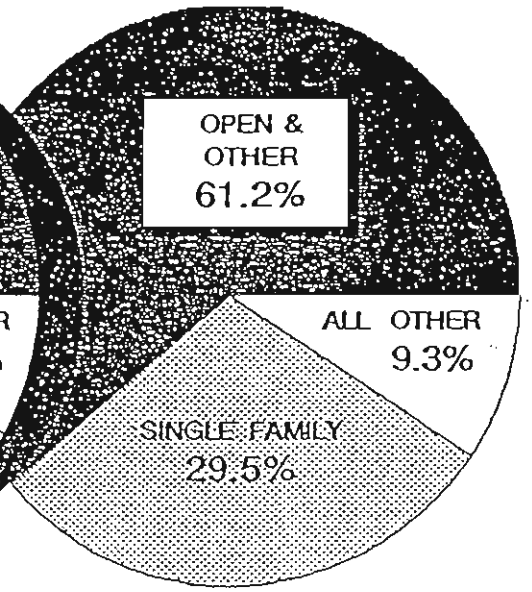
CHANGING LAND USE PATTERNS
1975 - 1987

FIGURE IV-1

URBAN LAND USE
1975



URBAN LAND USE
1980



URBAN LAND USE - 1987

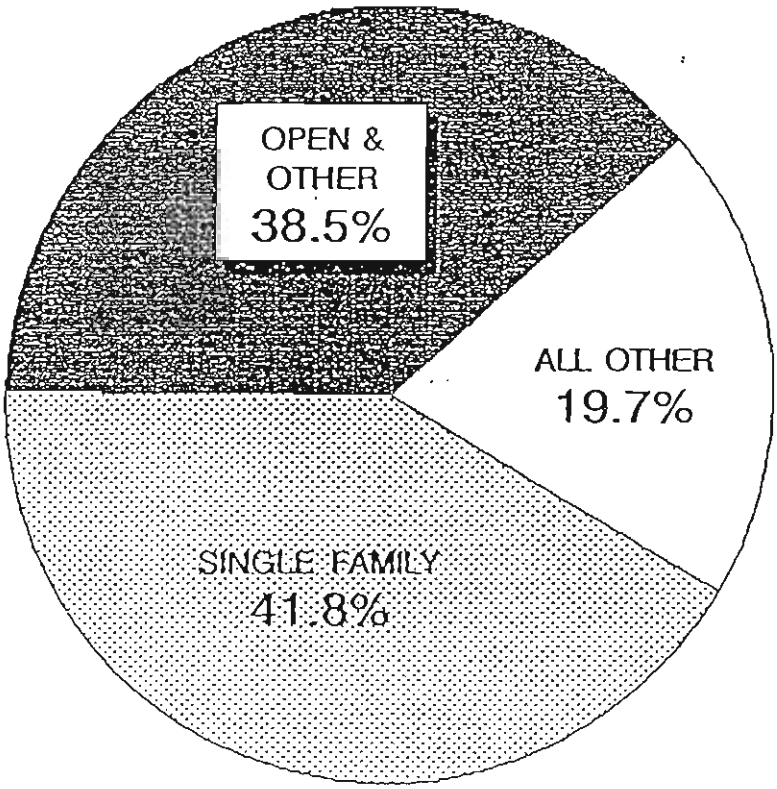


Table 2-1. 1990 land use in the Myakka River sub-watershed.

LAND USE TYPE	AREA (acres)	PERCENT TOTAL AREA
Single family res.	2,436	1.7
Medium dens. res.	92	<0.1
Multi-family res.	0	0.0
Commercial	19	<0.1
Industrial	0	0.0
Mining	416	0.3
Institutional	303	0.1
Non-forested open land	29,098	20.2
Barren land	518	0.4
Pasture	54,424	37.8
Citrus groves	2,598	1.8
Feet lot/dairy	282	0.2
Nursery	43	<0.1
Row crop	6,559	4.6
Upland forest	16,174	11.2
Fresh water	2,264	1.6
Salt water	0	0.0
Forested fresh-water wetland	16,626	11.6
Salt water wetland	2	<0.1
Non-forested fresh-water wetland	12,059	8.4
Tidal flat	0	0.0
TOTAL:	143,913	100.0

Table 2-2. 1990 land use in the Peace River sub-watershed.

LAND USE TYPE	AREA (acres)	PERCENT TOTAL AREA
Single family res.	19,804	1.5
Medium dens. res.	33,482	2.6
Multi-family res.	5,651	0.4
Commercial	9,662	0.8
Industrial	3,623	0.2
Mining	125,052	9.7
Institutional	9,141	0.7
Non-forested open land	155,791	12.0
Barren land	1,431	0.1
Pasture	405,451	31.3
Citrus groves	173,773	13.4
Feet lot/dairy	367	<0.1
Nursery	1,048	0.1
Row crop	2,521	0.2
Upland forest	111,087	8.6
Fresh water	39,539	3.1
Salt water	6	<0.1
Forested fresh- water wetland	111,788	8.7
Salt water wetland	0	0.0
Non-forested fresh-water wetland	84,175	6.5
Tidal flat	350	<0.1
TOTAL:	1,293,742	100.0

Table 2-3. 1990 land use in the Coastal sub-watershed.

LAND USE TYPE	AREA (acres)	PERCENT TOTAL AREA
Single family residential	20,246	2.8
Medium density residential	24,109	3.4
Multi-family res.	4,892	0.7
Commercial	3,030	0.4
Industrial	537	0.1
Mining	1,080	0.2
Institutional	6,602	0.9
Non-forested open land	160,553	22.5
Barren land	2,193	0.3
Pasture	71,673	10.0
Citrus groves	10,766	1.5
Feet lot/dairy	6	<0.1
Nursery	207	<0.1
Row crop	1,792	0.2
Upland forest	125,302	17.5
Fresh water	7,929	1.1
Salt water	134,455	18.8
Forested fresh- water wetland	43,336	6.1
Salt water wetland	32,161	4.5
Non-forested fresh-water wetland	63,262	8.8
Tidal flat	742	0.1
TOTAL:	714,873	100.0

*Population and Future Land Use

In 1950 Charlotte County had 4,300 residents. From 1950 until 1990 the county population doubled every 7 or 8 years, so that the 1995 population was 127,600 persons-- a 3000% increase. Lee County grew by 1600%. What phenomenal growth!

The NEP region as a whole grew as well, though not as precipitously as Charlotte or Lee counties. Between 1950 and today the SWFRPC estimates the region's NEP-adjusted population grew 550%, to nearly a million people. Not counting tourists, we are a million-fold community. Our community will swell by about half within the next 20 years according to business and population experts.

How will the region look, then? Future land use elements of local government comprehensive plans portray a region dominated by agriculture-- expected to cover 42% of land and non-tidal waters. Developed lands could account for 22% of the region, and rural estates, preserved lands, and mined-plus-industrial lands could each account for about 10% of the region.

Future Land Use of the Charlotte Harbor Basin

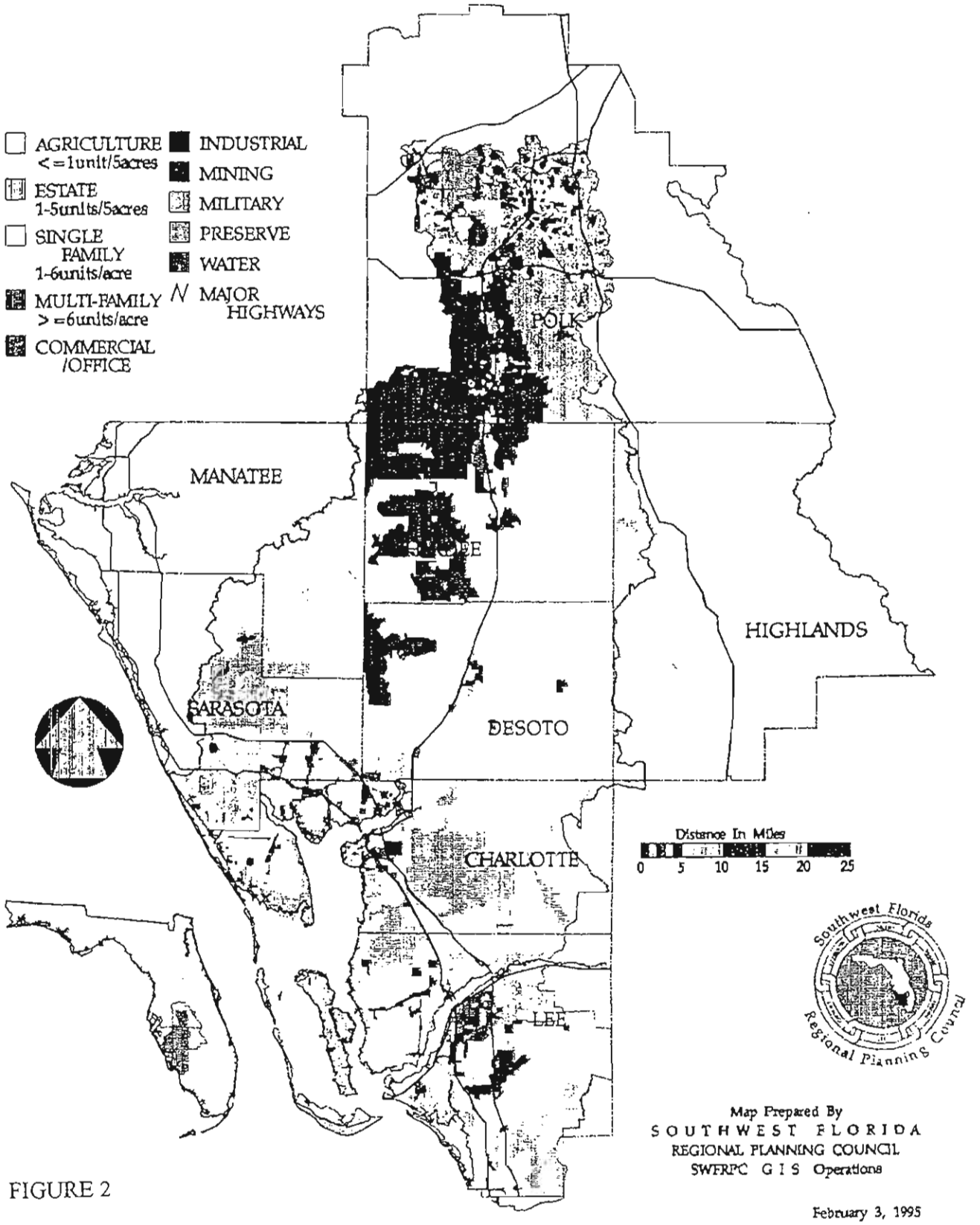


FIGURE 2

*Agriculture

Second only to tourism in Florida and the Charlotte Harbor region, agriculture is our economic anchor. Curiously, as Florida looses record levels of wetlands to farmland, Florida also leads the nation in farmland lost to development. Former ranches in coastal counties are especially vulnerable to wholesale transformation into bedroom communities. Citrus is our main agricultural product. Freezes in the 1980s accelerated grove starts in southwest Florida, notably Lee County. More than a dozen citrus varieties are grown, though most acreage goes into juice oranges. In 1995, a total of 283,000 acres of land in NEP counties was dedicated to citrus (not counting Highlands County)-- one-third of all Florida citrus acreage!

Beef cattle follow citrus in importance. Four NEP counties count among Florida's top ten beef counties: Polk, Hardee, De Soto, and Manatee. Together these counties produced 358,000 head of cattle. Ranches are mostly cow-calf operations, with calves sent to feed lots in corn-belt states. Hardee leads the region in dairy production, with 8,000 cows, in 1996, and Polk is Florida's second largest egg producer. Other crops are characteristic of the region. Hardee County is the self-named cucumber capital of America. Tomato acreage has grown rapidly in this decade, joining strawberries, watermelon, peppers, and tomatoes as dominant field crops.

Agriculture faces challenges on all fronts throughout our region. Land clearing, levelling, and drainage improvements wreck native habitats. Water demands of agriculture are Florida's greatest, but overpumping of aquifers has caused "big red holes" in maps of potentiometric surfaces (groundwater pressure). Ground water pumped to the surface for irrigation escapes fields, adding to stream flows and changing natural water chemistry of Myakka and Peace River tributaries. Fertilizers and pesticides find their way to surface and ground waters, creating calls for tighter farmland regulation. Federal code compels families to sell ranches in order to pay estate taxes. Despite green-belt exemptions, property taxes have escalated as nearby rural lands are developed. Citrus falls unpicked as crop prices fluctuate unpredictably. Preserving ranches and family farms while at the same time providing for the region's ecological sustainability is one of our greatest challenges, over-arching even the NEP's call for ecosystem management and wise stewardship of Charlotte Harbor. What will it take to meet the challenge?

*Commercial Values and Uses

The commercial value of Charlotte Harbor lies in its tourism, although commercial fishing and sports guide businesses are significant. The Harbor lacks the sort of manmade tourist attractions such as theme parks, universities or historic events that would significantly dilute the importance of tourist statistics as valid indicators for the Harbor. Consequently, those statistics are the best indicators of commercial values. Fish landings are another.

Charlotte Harbor Commercial Indicators, 1993

County	Tourists	Tourist Expenditures($)	1992 Fish Landings(lbs)
Charlotte	235,868	147,896,000	3,141,000
Lee	739,135	556,109,000	11,464,000
Sarasota	701,695	427,930,000	550,000
TOTALS:	1,676,698	1,131,935,000	15,155,000

*Recreational Uses and Features.

The Charlotte Harbor estuarine complex is one of Florida's least-spoiled systems, despite large population increases, primarily because its recreational values are recognized by its citizenry and have been largely protected from the obvious impacts of development. Recreational uses are best reflected in our preserved recreational sites. The following quantitative tables on parks and boating use provide indicators of the nature and value of Charlotte Harbor.

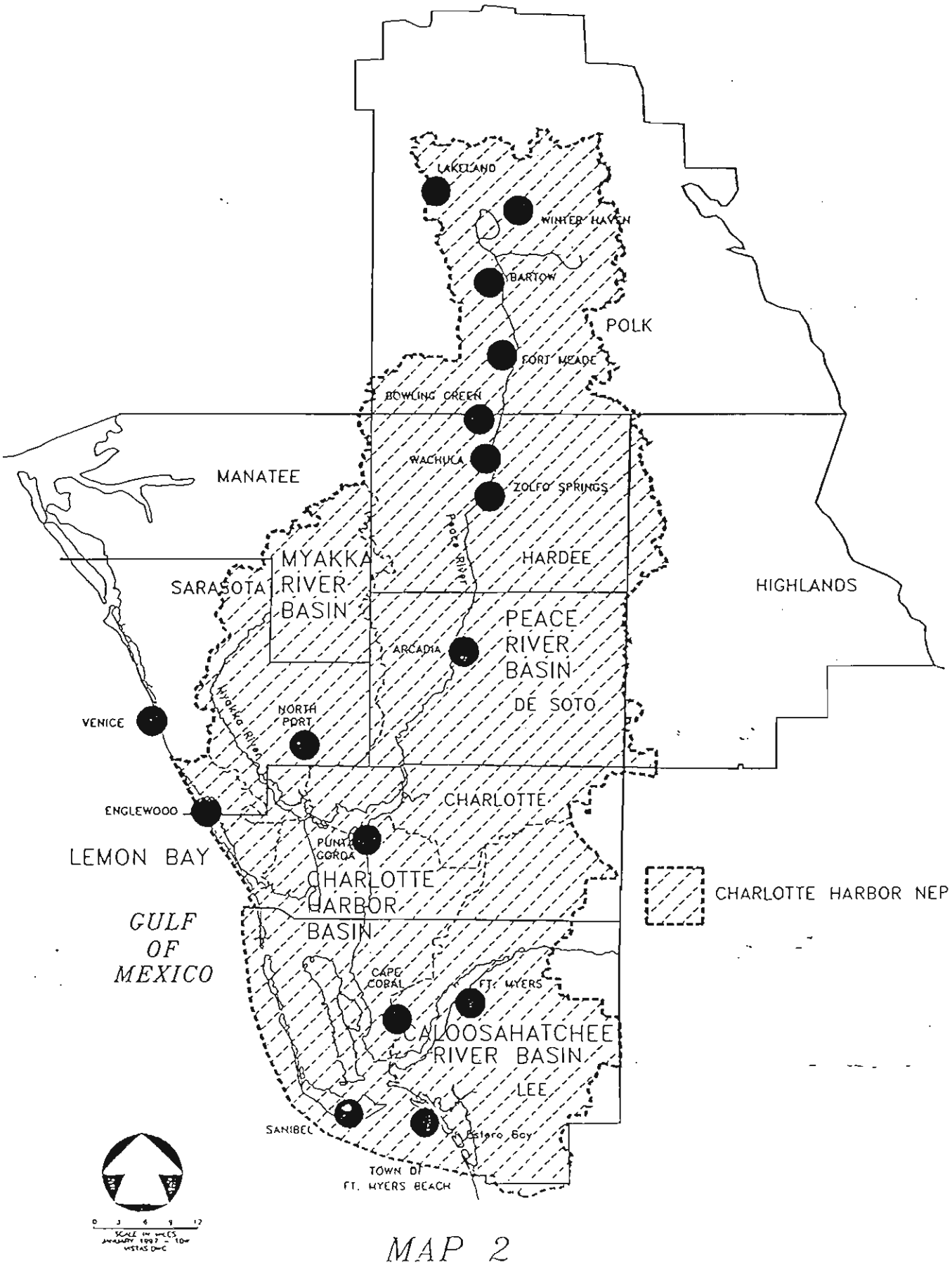
	Recreational		
County	Boats	Marinas	Boat Ramps
Charlotte	14,004	19	15
Lee	29,409	58	29
Sarasota	16,272	29	21
Polk, Hardee and DeSoto	----	4	18

Major recreational features of the Harbor complex are sports fishing, recreational boating, beach use, and pure scenic vistas, including glorious "flash of green" sunsets.

*Political Geography

The Charlotte Harbor NEP study area encompasses all or most of Lee, Charlotte, Sarasota, DeSoto, and Hardee Counties; almost half of Polk County; a third of Manatee County, and the narrow western edges of Highlands County. This eight county area would be enlarged by another county if lands between Lake Okeechobee and Fort Myers were included.

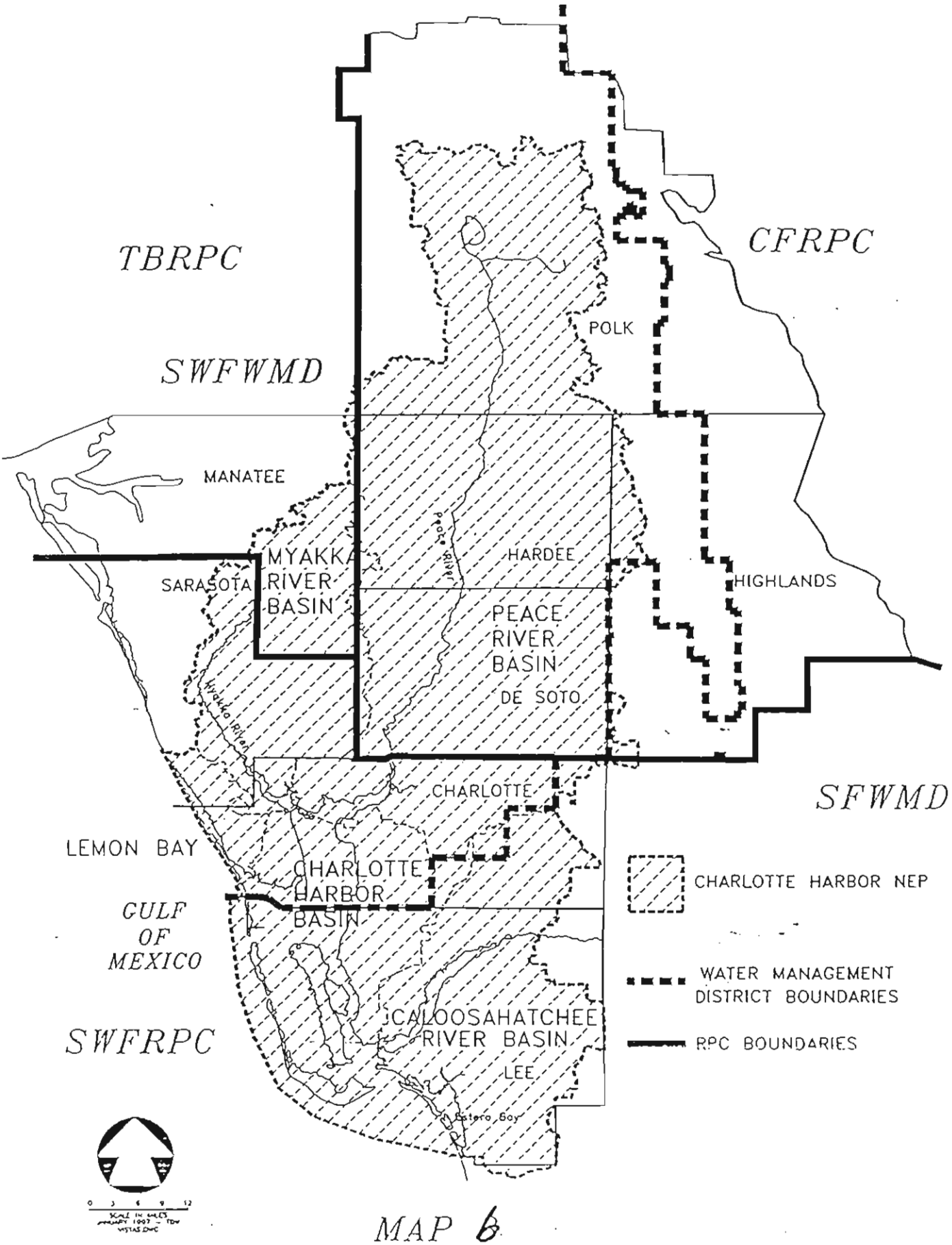
The study area includes parts of 3 regional planning councils --Tampa Bay, Central Florida, and Southwest Florida; 2 water management districts --South Florida and Southwest Florida, and numerous regional district divisions of other state agencies. The roles of these and federal agencies in governance of Charlotte Harbor are given in the "Base Programs Analysis" prepared for the NEP by the Southwest Florida Regional Planning Council.



MAP 2

CHARLOTTE HARBOR NEP

CITIES AND COUNTIES



MAP 6

CHARLOTTE HARBOR NEP
REGIONAL BOUNDARIES

*NEP County Almanac

Date Formed
Manatee (1855)
Polk (1861)
Lee (1887)
DeSoto (1887)
Hardee (1921)
Charlotte (1921)
Sarasota (1921)
Highlands (1921)

Area, square miles
Polk (2,048)
Highlands (1,119)
Lee (1,005)
Charlotte (832)
Manatee (772)
De Soto (721)
Hardee (630)
Sarasota (563)

1990 Population
Polk (405,382)
Lee (335,113)
Sarasota (277,776)
Manatee (211,707)
Charlotte (110,975)
Highlands (68,432)
De Soto (23,861)
Hardee (19,499)

1995 Median Age
Charlotte (54)
Highlands (52)
Sarasota (49)
Manatee (43)
Lee (42)
De Soto (37)
Polk (37)
Hardee (33)

1995 Per Capita Income
Sarasota ($28,761)
Manatee ($21,584)
Lee ($20,907)
Charlotte ($18,012)
Polk ($16,858)
Highlands ($16,541)
Hardee ($15,490)
De Soto ($15,043)

1995 Ad Valorem Millage Rate, mills
Hardee (20.65)
Manatee (18.11)
De Soto (17.86)
Highlands (17.81)
Polk (16.84)
Lee (15.61)
Sarasota (14.51)
Charlotte (14.20)

Labor Force, % Total Population
Hardee (50.3)
Lee (49.8)
Polk (49.2)
Manatee (47.4)
Sarasota (46.6)
Charlotte (40.3)
De Soto (39.9)
Highlands (38.6)

Retail Sales
Lee ($4.6 billion)
Polk ($4.2 billion)
Sarasota ($3.4 billion)
Manatee ($2.2 billion)
Charlotte ($1.1 billion)
Highlands ($571 million)
Hardee ($101 million)
De Soto ($ 8.8 million)

*National Estuary Programs

The United States Congress established the National Estuary Program to develop innovative tools for citizens' use in protecting estuaries. The NEP seeks to set examples in selected estuaries for use nation-wide. Designation of Charlotte Harbor to the NEP signifies national recognition of the region's unique resources and management issues.

Process and empowerment lie at the heart of an NEP. The process is consensus-building among committees. Actions to preserve or restore the estuary proceed if and only if there is a general agreement among all parts of society that such actions are warranted. Despite federal and state oversight (and funding) the NEP is not a "top-down" enterprise. Rather, needs and priorities flow up from technical and citizen committees to management and policy committees responsible for implementing the Harbor plan.

Citizens are empowered in this process by mediating the flow of interest and concern from the general public, to the management conference. Scientists, engineers, and resource managers are empowered by certifying the technical competence of information upon which critical decisions depend. Agency staff are empowered by focusing the resources of their respective institutions to bear on needed actions. And the Policy Committee, final arbiter of the conference, is empowered to codify and implement long-term recommendations by virtue of the strong base of participatory democracy from which they draw their mandate.

Nation-wide, some NEPs have been more successful than others but all have done significant work in identifying and remedying problems facing estuaries. The Charlotte Harbor NEP, despite having a shorter time period and smaller budget than prior programs, is well poised to accomplish much.
It has the experiences of nearby Sarasota and Tampa NEPs from which to draw; resources of numerous federal agencies; readiness on the part of state and local agencies; and willingness among industrial, commercial, and agricultural stake-holders. Best of all, the agenda for the Harbor NEP is largely one of preservation rather than restoration. Many restoration projects await in hydrology, water quality, and ecology, but the overall tone and direction of this NEP will be maintaining existing conditions and avoiding future problems.

*Goals of the Charlotte Harbor National Estuary Program

Program goals guide the management conference throughout the life of the program. Several of the goals require a long term commitment in order to be achieved. Goals developed for and by the management conference, particularly the Citizens' Advisory and Technical Advisory Committees, are:

1. Improve the environmental integrity of the Charlotte Harbor study area.

2. Preserve, restore and enhance seagrass beds, coastal wetlands, barrier beaches, and functionally related wetlands.

3. Reduce point and non-point sources of pollution to attain desired uses of the estuary.

4. Provide the proper freshwater inflow to the estuary to ensure a balanced and productive ecosystem.

5. Develop and implement a strategy for public participation and education.

6. Develop and implement a formal Charlotte Harbor management plan with a specified structure and process for achieving goals for the estuary.

7. Develop an accessible information system that integrates data on the Charlotte Harbor study area pertinent to Harbor and watershed management.

Importance of Harbor and Watershed Problem Areas to NEP Goals

Goal	Hydrological Alterations	Nutrient Enrichment	Habitat Loss	Incomplete Information*
Improve environmental integrity	High	High	High	Unknown
Preserve, restore and enhance habitats	Low	Medium	High	Low
Reduce point and non-point pollution sources	Medium	High	Low	Medium
Provide proper fresh water inflow to estuary	High	Low	Low	Low
Strategy for public participation and education	Low	Medium	Medium	High
Harbor and watershed management plan	High	High	High	Unknown
Accessible information management system for integrated data	High	High	High	Unknown

* On potential problem areas of pathogens, contaminants, and impacts of excessive human uses

*Grass Roots Governance

The National Estuary Program (NEP) was created by Congress, as Section 320 of the Water Quality Act of 1987. The EPA is authorized to form management conferences, actually a group of coordinated committees, to develop plans for the restoration or preservation of a given estuary. The plans are called Comprehensive Conservation and Management Plans, or CCMPs. Based on the experiences of other NEPs, the CCMP seems different than many plans that "sit on the shelf." Most importantly, the CCMP is the product of teamwork involving local communities, scientists and engineers, and citizen groups, including stakeholders-- people potentially affected by plans to help the estuary. Another distinction of CCMPs is the commitment made for their implementation, sometimes as long as 20 years. Coastal residents appreciate that estuarine damage accumulated for decades must take steady, persistent progress to undo. When a CCMP is adopted, federal, state, and local governments pledge their commitment to make needed changes over realistic time frames.

On July 6, 1995, EPA named Charlotte Harbor to the NEP and in October 1995 a cooperative agreement between the Southwest Florida Regional Planning Council and EPA allowed for the start-up of a Charlotte Harbor NEP. By early 1997, the NEP has so far:

-- Codified a "Management Conference Agreement" committing affected governments to cooperating in the NEP process;
-- Assembled the four committees of a management conference, a citizens advisory committee, technical advisory committee, management committee, and policy committee;
-- Established an office within the SWFRPC, staffed by a Program Director and Public Information Coordinator;
-- Selected consultants to produce key program documents such as the Harbor Characterization Report and Data Management Strategy;
-- Authorized several "early action projects" around the harbor and watershed to provide immediate responses to pressing issues, and
-- Produced this primer on the Harbor and the NEP for public information.

Drawing from the Harbor nomination document and meetings of the conference committees, the NEP has also established goals for the program, and identified priority problems for the Harbor:

Priority Problems

Hydrologic Alterations-- Adverse changes to amounts. locations, and timing of freshwater flows, the hydrologic function of floodplain systems, and natural river flows.

Base flows of the Upper Peace River have been declined by approximately one-third over the period of record, threatening the ecological productivity of middle river segments. Flow declines are attributable to extensive lowering of the potentiometric

surface, elimination of shallow water tables, increased retention of process and non-process waters by the phosphate industry, reductions in point source discharges, and fewer tropical storms. The Caloosahatchee River discharges excessive amounts of fresh water from Lake Okeechobee and watershed to the Harbor (although peak flows have declined somewhat due to changes in lake regulation). Interbasin diversions presently export water from the Myakka River to the Gulf of Mexico, and from south Florida to lower Charlotte Harbor. Peace River diversions will also export potable water to the Sarasota Bay NEP watershed.

Water Quality Degradation-- Including but not limited to pollution from agricultural and urban runoff, point source discharges, septic tank system loadings, atmospheric deposition, and groundwater.

Nutrient loads (and contaminants generally) from the phosphate industry have declined with improvements in water management, but wastewater from sewage treatment plants continue to enter the Peace and Caloosahatchee Rivers. Agricultural loads are increasing as native lands, planted forests, and pasture historically used for cattle ranching are converted to citrus groves, tomato fields, and other crops. Drainage systems created for flood control in urban areas transport nutrients to Harbor waters, and additional nutrients enter residential canal systems from improperly maintained septic tank systems. Nutrient enrichment poses a grave danger to SAV beds surrounding the Harbor. Surplus nutrients have the documented ability to promote phytoplankton blooms, epiphytic algae, and hypoxia. Throughout the Charlotte Harbor System, the volume of domestic wastewater discharged per day is projected to increase by 26 million gallons per day (mgd) in the year 2000 and by 44 mgd by the year 2020, with the vast majority of loads coming from the Peace River Basin. Loadings of total nitrogen are projected to increase by 1.35 tons per day by 2000 and 2.3 tons per day by 2020, as a result of increased wastewater production. However, these projections are based on two assumptions: that re-use of treated effluent does not occur on a large-scale basis, and that wastewater is only treated to secondary levels (i.e. 12-15 mg TN per liter). In West Central Florida, the combination of increased re-use of wastewater and nutrient removal technology has resulted in dramatic reductions in wastewater loads: 90 percent decline in Hillsborough Bay, 40 percent decline in northern Sarasota Bay, and 90-95 percent decline in central Sarasota Bay. An aggressive program to reduce wastewater effluent impacts, such as the re-routing of the City of Lakeland's discharge to industrial users and a wetlands system, can minimize the impact of future population growth on increased wastewater based nutrient loadings into Charlotte Harbor. Without such efforts, nutrient loads into Charlotte Harbor could potentially cause significant negative impacts.

Fish and Wildlife Habitat Loss-- Degradation and elimination of headwater streams and other habitats caused by development, conversion of natural shorelines, cumulative impacts of docks and boats, invasion of exotic species, and cumulative and future impacts.

Uplands, wetlands, and surface waters in the Peace River headwater area need restoration to compensate for past mining and reclamation practices, and urbanization. Hyper-eutrophic Lake Hancock offers a possible source of base-flow augmentation once algae problems are ameliorated. First order tributaries to the Peace River in Polk County need to be created to stabilize the trophic structure of the river ecosystem. Base flows will restore the fishery productivity of the upper river and enhance Harbor fisheries as well. In the lower Harbor, salinity regimes need to be optimized to guide reductions of Caloosahatchee River discharges. This action will rehabilitate SAV beds and stabilize habitats throughout the tidal river and estuary. Urban and residential canal shorelines require habitat restoration throughout the region. Wetlands make up an estimated 10 - 15% of the acreage in the Myakka and Peace River basins, and approximately 30% in the Coastal basin. Dredging and filling for residential and commercial purposes, construction of drainage ditches for agriculture and mosquito control, and construction of marinas and navigation channels have all resulted in the degradation and/or destruction of valuable wetland habitats. Approximately 51% of the existing salt marsh acreage appears to have been lost between 1945 and 1982, although mangrove forests and salt marshes continue to dominate the shoreline in non-urbanized areas. During this same time period, seagrass losses throughout Charlotte Harbor were estimated at 29 percent.

These issues can also be viewed as symptoms or consequences of more basic causal processes. Lands use and land use management, for examples, affect hydroperiods, nutrient concentrations, and habitat availability. Given the rate and scale of land use decisions in the region, a continuing Program effort will be needed in the general subject area of land use management. Also, the Program must address the problem of incomplete information on particular topics, alluded to in introductory sections of this report. Certain topics in certain geographic areas may be important but lack definitive data.

EXAMPLES OF PROBLEM AREAS
IN
GEOGRAPHIC SUBAREAS OF THE CHARLOTTE HARBOR NEP

	Hydrological Alterations	Nutrient Enrichment	Habitat Loss	Incomplete Information*
Myakka Basin	Flooding by drainage of Tatum Sawgrass	Oxygen stress in Lake Myakka	Channelization of Big Slough	Airboats upstream of Myakka City
Peace Basin	Declined flows in Peace River	Poor water quality in canals	Loss of streams in mined areas	Catfish mortality
Caloosahatchee Basin	Large discharges from Lake Okeechobee	Algae blooms and oxygen stress	Wetland conversion to agriculture	Closure of river to shellfishing
Coastal Areas**	Impoundment of Coral Creek	Loss of seagrasses	Loss of scallop fishery	Boat/manatee collisions

* On potential problem areas of pathogens, contaminants, and impacts of excessive human uses

** Estero, Lemon Bays; Pine Island, Gasparilla Sounds; Matlacha Pass

*Evaluation of Priority Problems

The Charlotte Harbor NEP is undertaking an evaluation of priority problems, in order to craft implementable actions for the Comprehensive Conservation and Management Plan. Evaluation criteria recommended by EPA, and a glimpse of their bearing on Harbor problem areas, are previewed, below.

	Hydrological Alterations	Water Quality	Habitat Decline
NEP consistency	High	High	High
Geographic extent	Large	Moderate	Moderate
Health impacts	Minor	Uncertain	Minor
Ecological impacts	Moderate	Moderate	Increasing
General welfare	Significant	Significant	Significant
Current information	Considerable	Some Gaps	Some Gaps
Causes known	Generally	Generally	Definitely
Remedies known	Yes	Yes	Mostly Yes
Available mgt. resources	Yes	Yes	Improving

ECOSYSTEM IMPACTS OF PROBLEM AREAS IN CHARLOTTE HARBOR NEP HABITATS

Habitats	Hydrological Alterations	Nutrient Enrichment	Habitat Loss	Incomplete Information*
Isolated wetlands	Succession	Cattail invasion	Species decline	Biomagnification
Lakes	Invasive species	Algae blooms	Species decline	Recreational losses
Rivers	Channel degradation	Algae Blooms	Species decline	Recreational losses
Tidal Rivers	Species decline	Hypoxia	Species decline	Need
Estuaries	Fishery effects	Seagrass loss	Species decline	Need
Lagoons	Sedimentation	Algae, hypoxia	Species decline	SAV propeller cuts
Islands/Beaches	Not applicable	Red tide enhancement?	Species decline	Recreational losses

* On potential problem areas of pathogens, contaminants, and impacts of excessive human uses

*Committee Roles in the Management Conference

Four committees comprise the management conference. Each serves a specialized role but all cooperate, for consensus is the criterion for conference action in meeting program goals. The largest conference committees involve citizens, and scientists:

Citizens Advisory Committee (CAC)

The CAC provides a mechanism for citizens' input to the NEP, as well as disseminating relevant information to the public. The CAC works closely with the public information coordinator to reinforce and maintain public support for the NEP, develop public participation strategies, provide input on public education programs, assist in public workshop development, provide a forum for public comment, and to direct public concerns to the Technical Advisory Committee and the Management Committee. The CAC chair is a voting member of the Management Committee.

Technical Advisory Committee (TAC)

The TAC provides technical support to program staff during the planning and interpretive stages of the program. Acting as the program's scientific voice, the TAC identifies problems facing Charlotte Harbor. The TAC helps develop work plans, develops requests for proposals, reviews proposals and reports, assists with information management, and coordinates agency research in the Harbor. The TAC chair is a voting member of the Management Committee.

Management Committee (MC)

The Management Committee serves as a bridge between the CAC and TAC, and Policy Committee. The MC also provides deep institutional support for the NEP, by staffing, funding, or otherwise facilitating projects of the management conference. The MC reviews work plans, contracts and proposals, work schedules, and products. It also ensures that program milestones and objectives are accomplished. Each member of the Policy Committee has one or more representatives on the Management Committee.

Policy Committee (PC)

The Policy Committee establishes general policy for the Harbor NEP and executes ultimate authority in program administration. The PC appoints members to other committees, and approves program budgets. The PC is the bridge between the management conference and local governments of the region... in fact, all but 4 of the 21 members of the Policy Committee represent cities, counties, or regional governments in southwest Florida, so it can truly be said that the Harbor NEP is "for the people, by the people."

Project Director and Staff

The Project Director is responsible for coordinating and managing the Charlotte Harbor Project, including:

- direction of staff support for the Policy, Management, Technical Advisory and Citizen Advisory Committees;
- coordination, management, and quality-control of contractor work;
- development and oversight of a data-management system;
- coordination of public participation and education initiatives;
- analysis and evaluation of technical and scientific reports;
- preparation of reports and documents;
- coordination of contractual, budgetary, audit, and personnel aspects of the Program;
- coordination with other relevant federal, state, and local agencies and projects;
- liaison with media, public, academic, and other interested parties.

The Project Office is staffed by the project director and a public affairs coordinator, and receives office/clerical support from the Southwest Florida Regional Planning Council.

ORGANIZATIONAL CHART

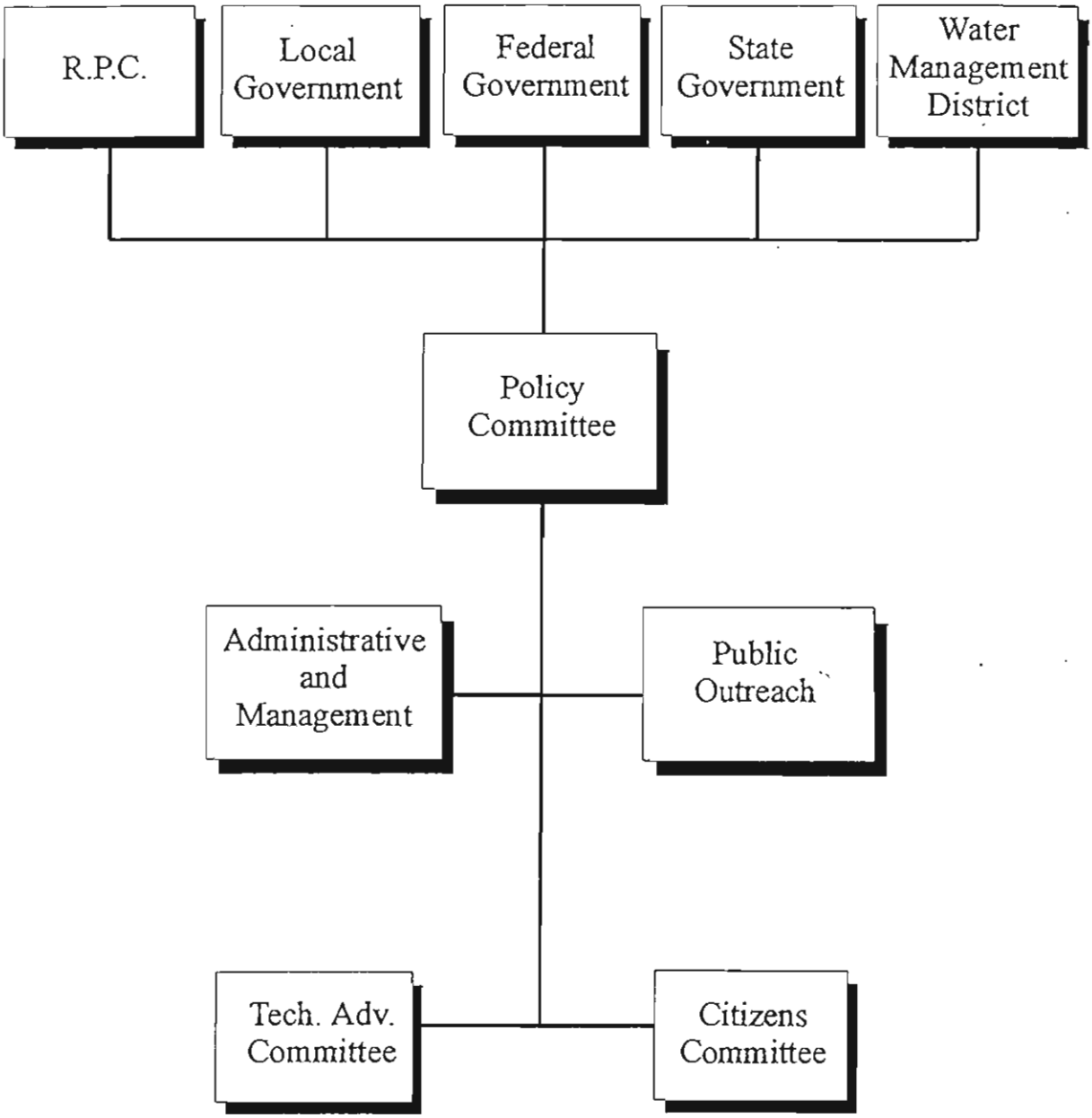


FIGURE 14

*Early Action and First-Year Work Plan Projects

(Add descriptions of final projects, once selected, here)

*Suggested Readings?

Lists of all Participants

Policy Committee

Management Committee

Citizen Advisory Committee

Technical Advisory Committee

*List of Acronyms

CBRA	Coastal Barriers Resources Act
CEP	Coastal Ecosystems Program
CFRPC	Central Florida Regional Planning Council
CHRPMTF	Charlotte Harbor Resource Planning and Management Task Force
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Floras
COE	Corps of Engineers, Army
CZM	Office of Coastal Zone Management
EPA	Environmental Protection Agency
EQL	Environmental Quality Laboratory, Inc.
ESP	Environmental Studies Program (New College, USF)
FCREPA	Florida Committee on Rare and Endangered Plants and Animals
FDACS	Florida Department of Agriculture and Consumer Services
FDCA	Florida Department of Community Affairs
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FGCU	Florida Gulf Coast University
FGFWFC	Florida Game and Fresh Water Fish Commission
FIPR	Florida Institute of Phosphate Research
FMRI	Florida Marine Research Institute
IFAS	Institute of Food and Agricultural Sciences
MML	Mote Marine Laboratory
NEP	National Estuary Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	Non-Point Discharge Elimination System
PRMRWSA	Peace River/Manasota Regional Water Supply Authority
SAV	Submerged Aquatic Vegetation
SBNEP	Sarasota Bay National Estuary Program
SFWMD	South Florida Water Management District
SWFRPC	Southwest Florida Regional Planning Council
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management
TBNEP	Tampa Bay National Estuary Program
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WLA	Waste load allocation