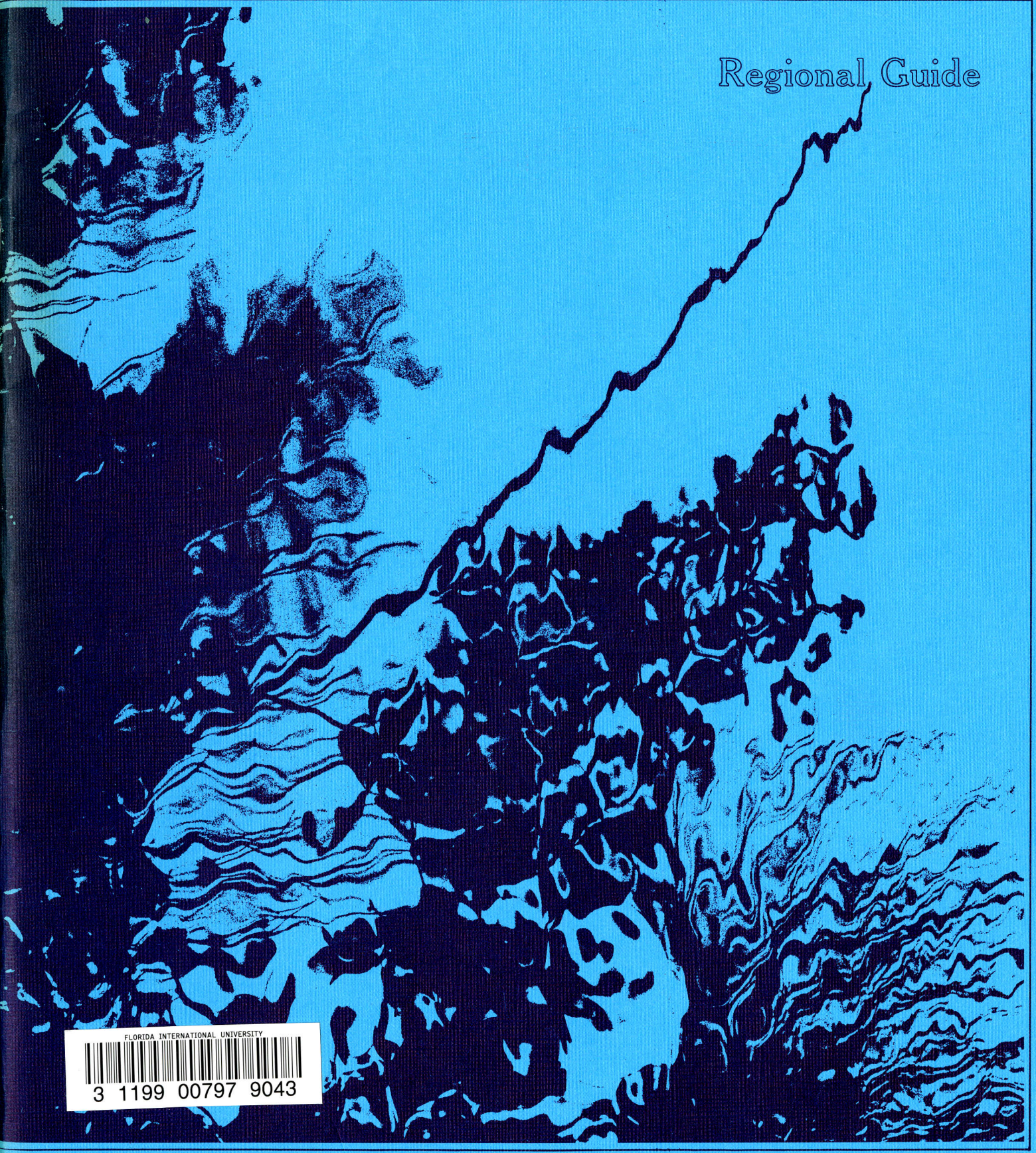
WATER MANAGEMENT CHAPTER

Regional Guide

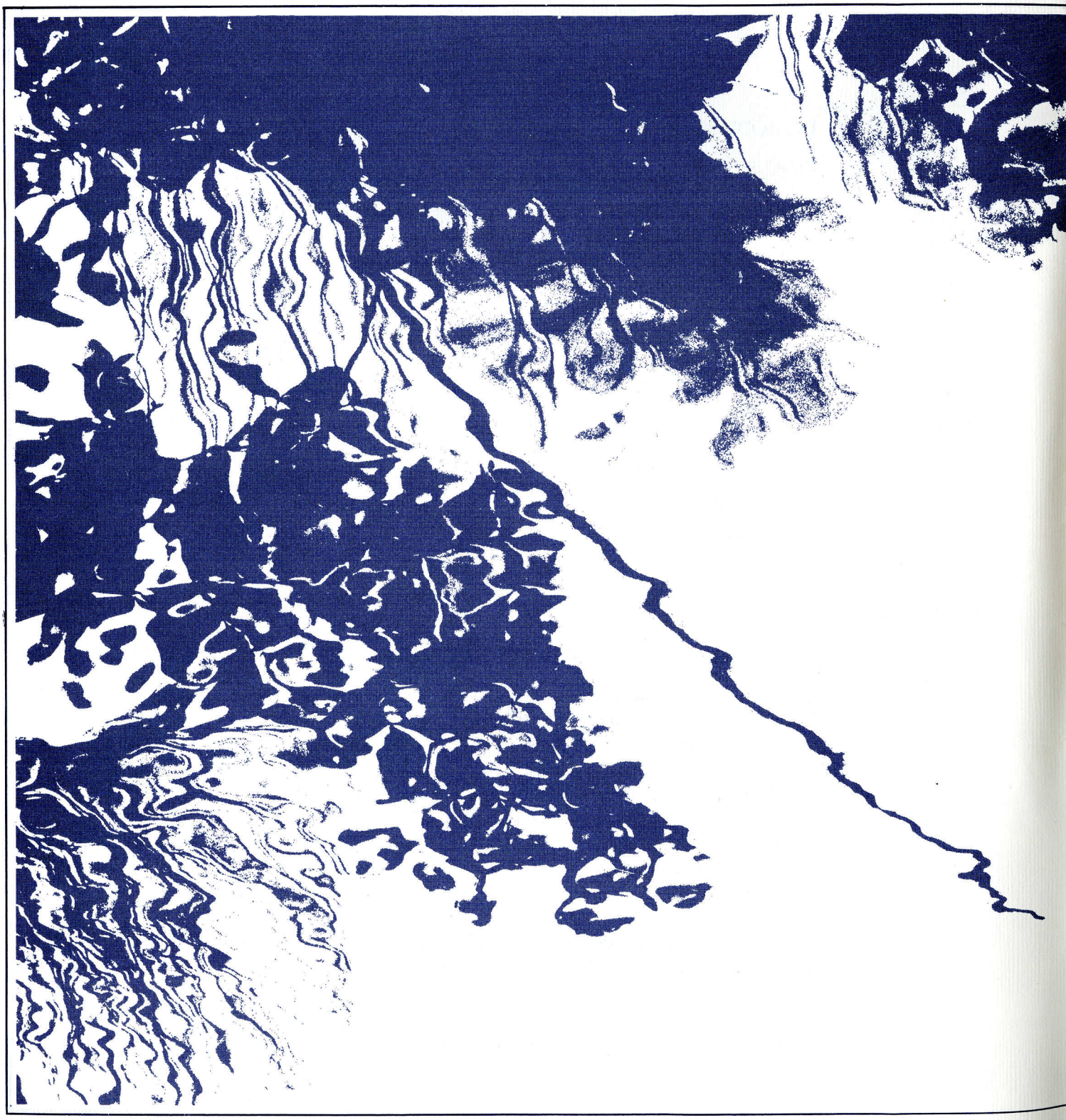


ADOPTED BY THE SOUTH FLORIDA REGIONAL PLANNING COUNCIL ON SEPTEMBER 10, 1973

WATER MANAGEMENT CHAPTER

Regional Guide

SOUTH FLORIDA
REGIONAL PLANNING COUNCIL



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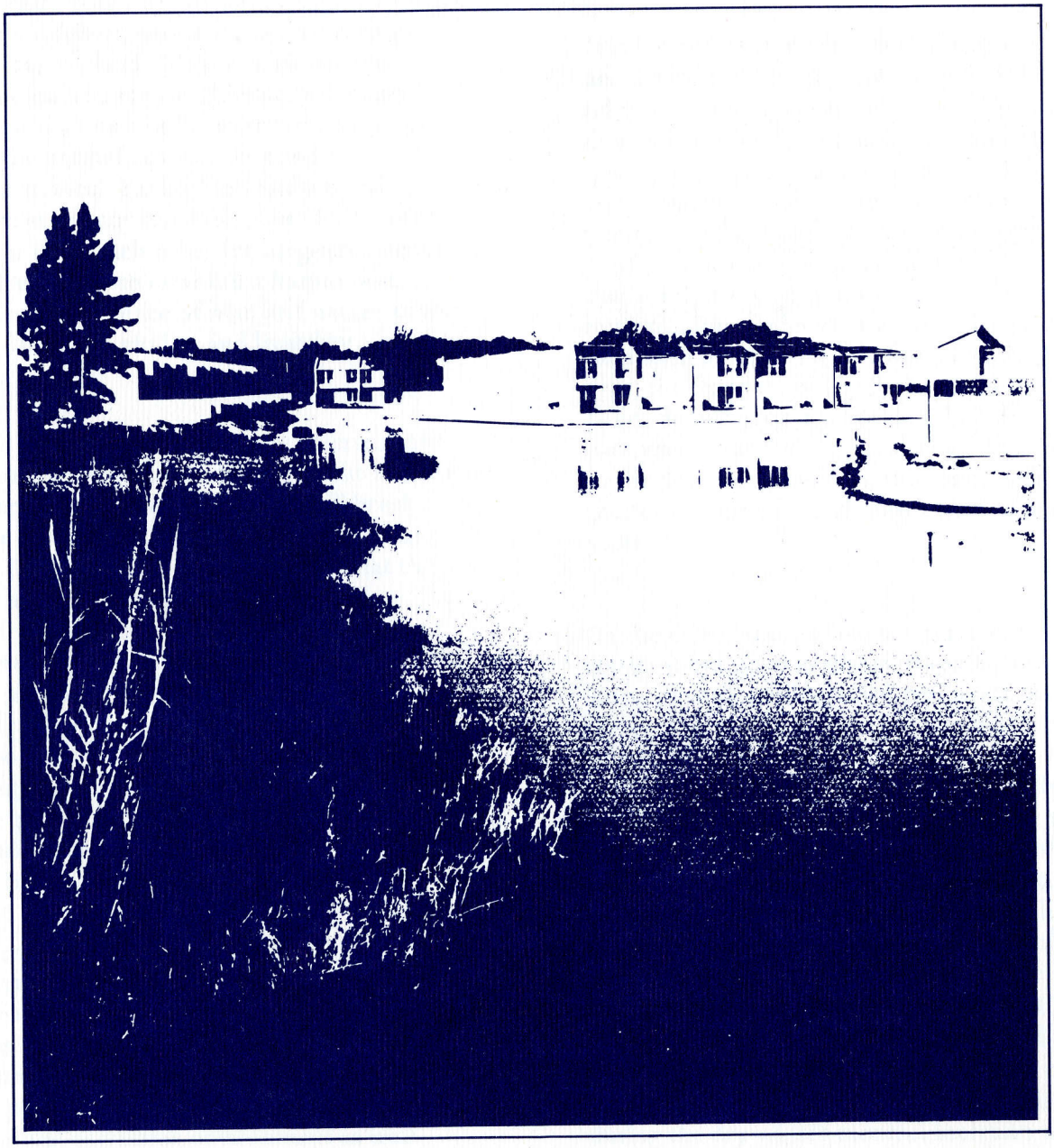
INTRODUCTION

This document, which presents goals, policies, and recommended programs for water management, is one chapter of the Council's initial Regional Guide. When completed, the Guide will contain the Council's policies for decision-making regarding regional-scale issues. This chapter provides an initial over-view of regional-scale water and water-related resources and issues. It is not intended to provide technical answers, but rather a series of policies to guide public and private decision-makers.

The water and water-related resources of the Region are both a complex technical issue and a major public issue. Not enough is known to provide exact answers to all questions and, since bad decisions have the potential for such major long-term damage, it is essential for conservative positions to be taken when information is limited or unavailable.

As the Council's planning program continues, this chapter will be updated to reflect new information or circumstances, including any new or revised policies established by the State Legislature.

Goals



Goals

Accounts of life in South Florida during the late 1800s describe the early settlers as fighting heavy rains, flooding, swamps, disease, mosquitos, and other elements of a sub-tropical environment. Little if anything was known of ecosystems or hydrologic cycles and, guided by a man-against-nature ethic, the settlers struggled to master the environment with a focus on clearing and draining the land. Today, after decades of environmental change and destruction, many realize that man cannot "master" or even exist without the natural environment and the work that it does. Rather man and natural environment are not separable, but vitally interdependent upon each other for long-term survival. Thus it is essential to establish a harmonious, productive co-existence of man and nature to secure the long-term vitality and livability of South Florida.

While the natural environment can tolerate varying degrees of stress, depending upon the sensitivity of each ecosystem, too much stress will break down the systems which support all life in the Region. Such breakdown would mean that the affected natural systems could no longer provide free work for man. The result would be a tremendous reduction in the quality of life due to a number of factors including: less water available for domestic use, loss of economic vitality in the tourist and the fishing industries, loss of water-based recreation, a poorer quality living environment, and increased social and economic costs of living or doing business in the Region.

The potential for highly negative consequences due to inaction requires government action to insure the long-term viability of remaining resources and to restore those essential resources whose functions have been disrupted. Only through positive action can the long-term survival of the natural and urban environment as well as the social and economic vitality of the Region be maintained. While it is clear that additional information is essential before balanced, long-term use becomes a reality, it is equally clear that in the meantime, decision-makers must act conservatively to prevent actions whose long-term effects cannot be shown to be without adverse impact.

It is important to recognize that natural, urban, and agricultural needs now compete for a relatively finite quantity of water. The natural demands are for the quantity of water at the quality necessary to support the natural environment of the Region, both plant and animal. Wetland and estuarine ecosystems depend on a seasonally varied flow of water that is relatively constant on an annual basis. For example, Everglades Park needs a dry-year minimum of 315,000 acre-feet of water per year, for that part of the Park east of Forty-mile Bend, delivered on a monthly schedule patterned after the historical flow. In addition to the dry-year minimum, the Park needs a greater volume of water during normal and wet years.

On the other hand, urban needs are not constant but grow in direct proportion to population growth and increased per capita use. Depending on the growth policies that are adopted and followed, the Region's current population of 2.5 million could grow to between 4.4 million and 8.5 million during the next 25 years. Increased urban growth not only requires more water for more people but, given present practices, covers more land which reduces aquifer recharge and increases pollution. At the same time, per capita water use is increasing from a 1966 range of 140 to 175 gallons per person per day to a projected 170 to 200 gallons by 2020. The problem is complicated by the fact that the influx of tourists during the dry winter months, increases the

need for water at the same time that other uses, such as lawn sprinkling, combine to exert the greatest demand for water when the supply is at its seasonal low.

Agricultural use affects the quantity of water in two major ways. First, large amounts of water are used to irrigate crops during the dry months. Some of this water is returned to underground aquifers but, according to the U. S. Geological Survey, over half is lost to the atmosphere. Secondly, the drainage needed to make the land accessable and to allow crop growth lowers the ground water level at the beginning of the dry season when planting must take place. This reduces the amount of water in storage for use later in the dry season.

In summary, the peak water demand for both urban and agricultural uses runs counter to the natural cycle, since the greatest demand occurs when the least is available. As water use approaches the maximum sustained capacity of water supply, major problems will appear during the dry season.

GOALS

1. **A BALANCED DISTRIBUTION OF WATER RESOURCES AMONG USES TO ENSURE A VIABLE, LONG-TERM EXISTENCE FOR BOTH MAN AND NATURE.**
2. **A HIGH LEVEL OF WATER QUALITY THROUGHOUT THE REGION TO INSURE BOTH A SUSTAINED YIELD OF WATER FOR URBAN AND AGRICULTURAL USE AND PERPETUATION OF THE NATURAL SYSTEMS THAT ARE ESSENTIAL TO THE SOCIAL AND ECONOMIC WELL-BEING OF ALL PEOPLE IN THE REGION.**

Policies

Policies

WATER MANAGEMENT PLANNING

Water is a limited resource whose use, as presently managed, appears to be reaching capacity. This is indicated by the drought of 1971, salt water intrusion, the many fish kills, the condition of many canals and coastal waters, and a growing list of endangered species. Perhaps the single most important event, in terms of focussing public and governmental attention on this problem and the need for better water management was the Governor's Conference on Water Management in South Florida that was held in September, 1971. The public is now aware, legislation has been passed, and bond issues have been approved to protect valuable and threatened resources. However, availability of adequate water resources alone will not insure a long-term, quality environment and over-emphasis on water may detract attention from the complex interrelationships among the many other factors involved in resolving regional problems. While it is essential that water be managed more effectively, it is also essential that it be done in the context of a comprehensive planning process that provides for the resolution of other regional problems.

Comprehensive regional planning is a process that deals with the interrelationships between and among appropriate elements of the physical, social, and economic environment in order to optimize regional growth and change. Optimizing regional growth requires that many elements such as transportation systems; utility systems; energy supplies; agriculture; recreation; and structures for commerce, industry, and housing as well as many others, including water, must all be appropriately interrelated in time and space if regional development is to be orderly and economic. Since financial and other resources are limited, trade-offs must be made that may, at times, sacrifice certain efficiencies or opportunities for one element to improve the overall vitality and quality of the Region. Trade-offs should be evaluated in terms of comprehensive goals, policies and objectives, such as those included in this chapter, that are established by elected decision-makers. Planning for the various functional elements, including water management, should be consistent with and guided by comprehensive regional policies and plans.

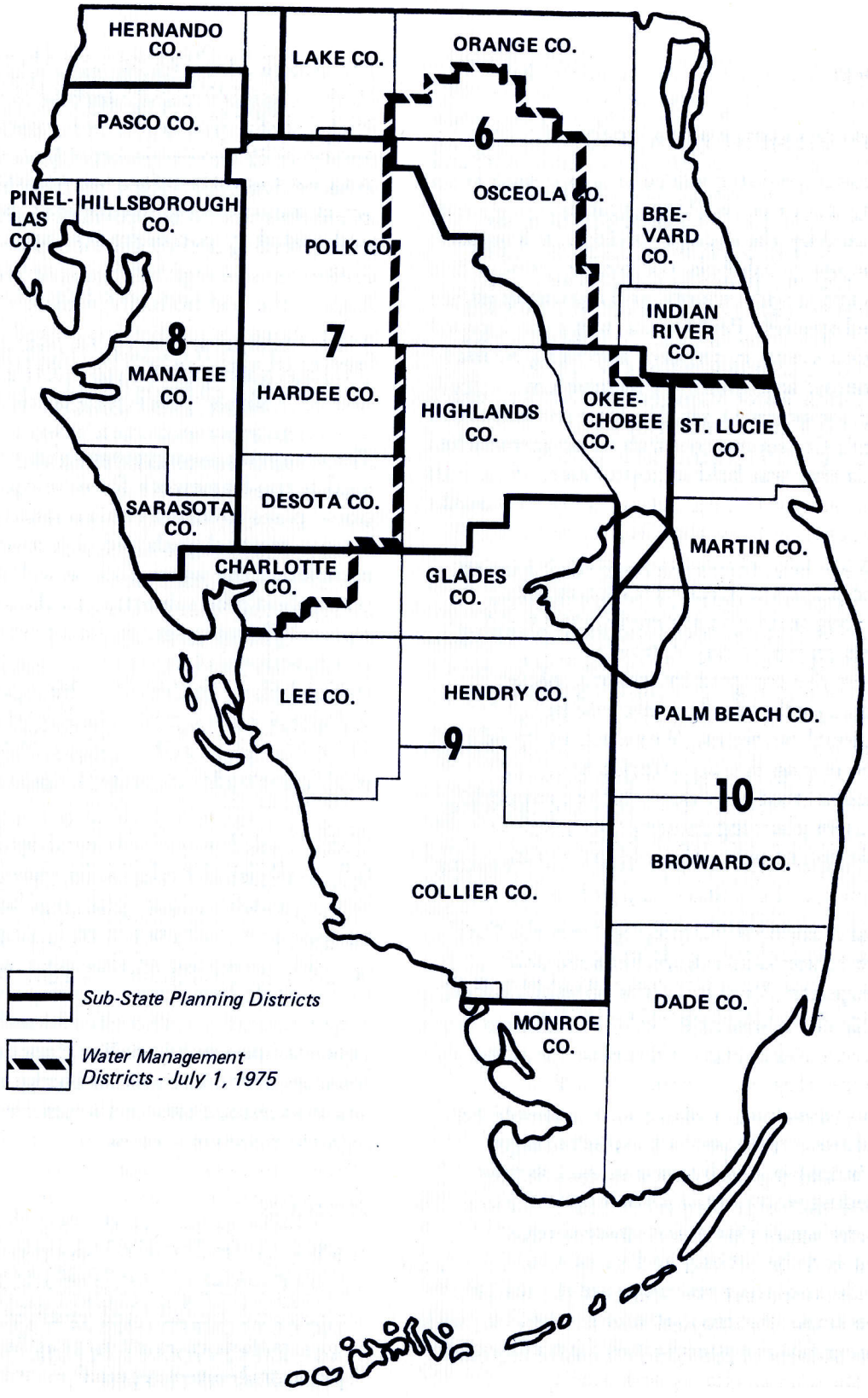
Water management has been fragmented: following different philosophies, using different criteria and approaches, proceeding with varying degrees of commitment and effectiveness. Recognizing the failure of this approach, the 1972 Legislature passed several laws to improve the management of both development and water throughout the State. The laws are the Water Resources Act, the Florida Environmental Land and Water Management Act, and the State Comprehensive Planning Act.

The Water Resources Act assigns responsibility for preparing a State water use plan to the Department of Natural Resources (DNR) and gives the Department authority to implement the plan and to delegate the responsibility for developing and implementing the water plan to five sub-state water management districts. The South Florida water district is essentially the Central and Southern Florida Flood Control District with a modified board of directors and changed boundaries, which include all South Florida. (Figure 1)

The Florida Environmental Land and Water Management Act is administered by the Department of Administration, Division of Planning. The Act provides for the definition of "Areas of Critical State Concern" and establishes procedures for the adoption of development controls to perpetuate the functioning of such areas. The Act also requires the establishment of criteria to define "Developments of Regional Impact" and specifies the process by which such developments must be reviewed by comprehensive regional planning agencies.

Figure 1

SUB-STATE PLANNING DISTRICTS AND
WATER MANAGEMENT DISTRICTS



The Comprehensive Planning Act requires the Division of State Planning to develop a comprehensive plan consisting of goals, objectives and polices to guide the orderly social, economic and physical growth of the State. As authorized by the Act, the Secretary of Administration has established ten sub-state planning districts. Since there are ten regional planning districts and only five water management districts, the two sets of districts are not coterminous. In South Florida, all or part of four planning regions lie within the South Florida Water Management District, with planning regions 9 and 10 covering some four-fifths of the water district as is shown in Figure 1.

The above three laws forms the basis for initiating, but do not completely define, a comprehensive planning process that includes functional planning for all appropriate elements, including water management. Water management is specified as a functional element of the overall comprehensive plan that is to be developed by the State Division of Planning. As with the relationship between the Department of Natural Resources and the water management districts, the regional planning agencies will apparently be responsible for preparing regional elements of the State comprehensive plan. However, the relationship between the water planning and comprehensive planning agencies in carrying out their respective responsibilities at the regional level has not been specified by the Legislature.

Development of the water plan element should be an iterative process that permits water management districts and regional planning agencies to systematically exchange plan-related information. The process should insure that the comprehensive plan is based upon a full understanding of water-related constraints and opportunities and that the water plan element is specifically designed to carry out water management aspects of the comprehensive regional plan.

The aspects of the functional element describing water resource capacities and capabilities, alternative methods of conservation and augmentation, and estimates of demand should be developed by water management districts. This information and its analysis should be provided to the appropriate regional planning agency for incorporation in the comprehensive regional planning process. In this Region, the additional information provided by the water management district, as well as other functional agencies, will be used to refine and expand this and other chapters of the Regional Guide.

The comprehensive regional plan or guide should be used as the framework for developing all functional plans to insure conformance with comprehensive regional goals and objectives. When completed, the water plan, as well as other functional plans, should be submitted to the appropriate regional planning agency for approval and adoption as a functional element of the comprehensive regional plan. In this way, the regional planning and water management agencies can develop mutually supportive plans and programs which each can implement under its State-designated responsibilities.

More detailed procedures must be defined to fully establish the relationship between comprehensive and functional planning, hence between water management districts and regional planning agencies. Adoption of standards and procedures by the State Legislature would provide desirable statewide uniformity. Where functional planning depends upon public policy, functional planning agencies, should be guided by the comprehensive regional plan or the policies of the appropriate regional planning agency.

POLICIES

1. ENCOURAGE THE STATE LEGISLATURE TO DEFINE THE ROLES AND RELATIONSHIPS BETWEEN REGIONAL AGENCIES CARRYING OUT COMPREHENSIVE PLANNING AND AGENCIES INVOLVED IN FUNCTIONAL PLANNING FOR WATER.

2. **ENCOURAGE THE STATE LEGISLATURE TO INSURE THAT THE COMPREHENSIVE REGIONAL PLAN AND PLANNING PROCESS IS THE FRAMEWORK FOR THE DEVELOPMENT, REFINEMENT, AND INTERPRETATION OF THE WATER MANAGEMENT ELEMENT TO INSURE THAT REGIONAL DEVELOPMENT IS GUIDED FROM A COMPREHENSIVE PERSPECTIVE THAT OPTIMIZES THE OVERALL QUALITY OF LIFE IN AN ORDERLY AND ECONOMIC FASHION.**

3. **ENCOURAGE THE STATE LEGISLATURE TO REQUIRE THAT FUNCTIONAL PLANS, INCLUDING THOSE FOR WATER MANAGEMENT, BE REVIEWED FOR APPROVAL AND ADOPTION AS PART OF COMPREHENSIVE REGIONAL PLANS.**

SOURCES OF WATER

The water resources of the Region are limited since only so much rain falls annually and only so much can be stored above ground or in ground aquifers. No one has determined the safe sustained yield of water in the Region and measurement will be difficult because of the many variables involved. For example, a great deal of water returns to the atmosphere and to the sea, some of which might be intercepted for use if the environmental consequences are favorable. Reuse of wastewater now discharged to the sea would add the equivalent of about three inches of rain per year and other means of conserving or recycling could further raise the total amount of usable water. The important point is that the limit of available water may be expressed as a range, depending upon reuse or conservation practices, rather than as one specific quantity.

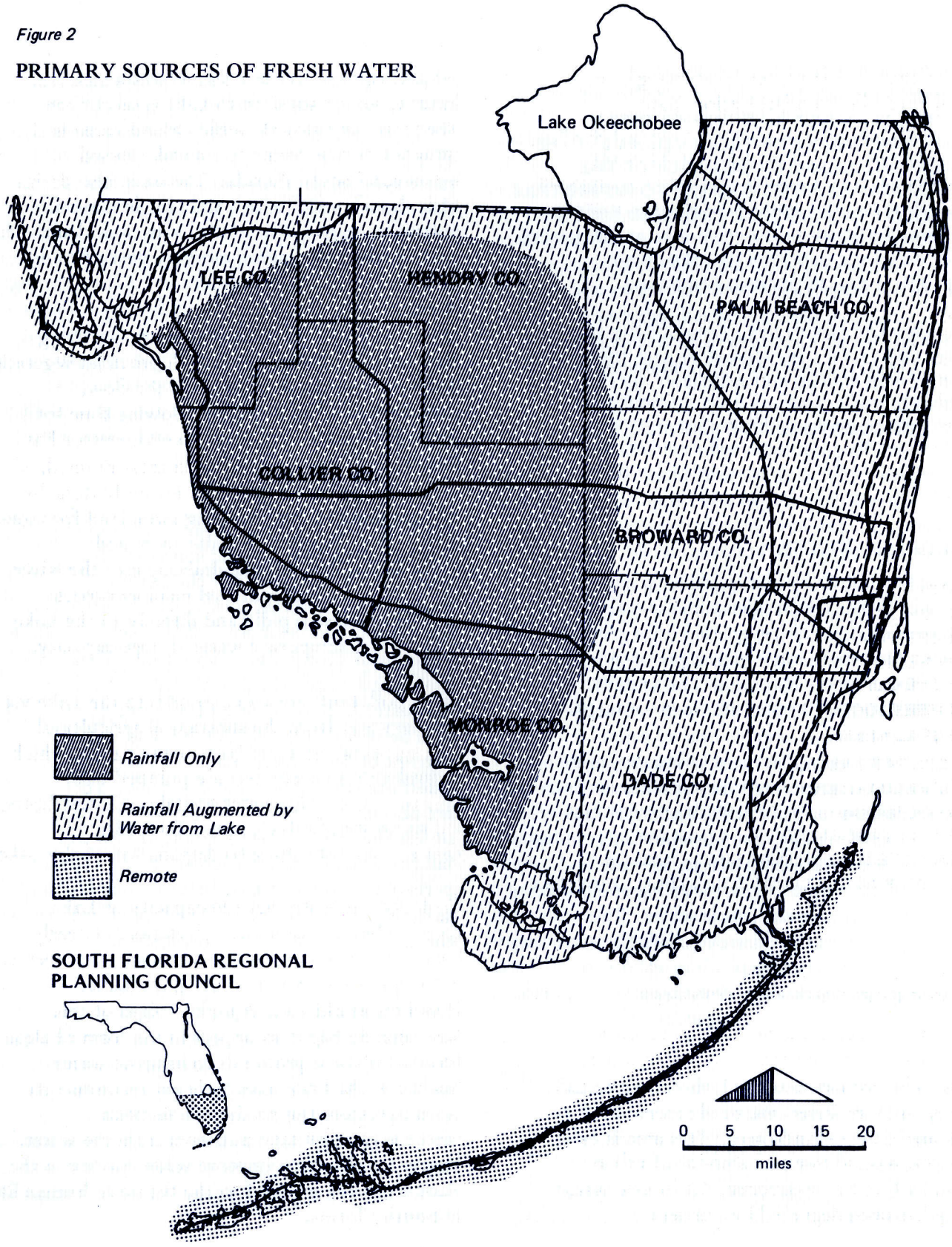
The amount of usable water is directly related to quality since, if water quality is too poor for a specific use, it can hardly be considered as usable without the application of money and technology to bring the water up to an adequate quality. In fact, the quality of water and the costs of purification may prove to be more of a limiting factor than total quantity. How much more water can be made available for use by more prudent management? An answer today would be more speculation than fact. What is fact is that there is only limited time to get the information necessary to establish a balance between demand and supply. Studies are urgently needed to determine the feasibility and desirability of: backpumping; forward pumping; deep aquifer injection and recovery of storm water and treated sanitary sewage; the purfication capacity of aquatic and wetland systems; increasing the level of Lake Okeechobee; use and conversion of saline water; and the amount and timing of agricultural, natural, and urban water needs.

Because of its location on the Florida peninsula, the only present economic source of fresh water for the south half of the State is rain. The 1 in 2-year average rainfall over the southern half of the State ranges from 48 inches near Orlando, to 51 inches near Clewiston, to about 62 inches along the coastal ridge between West Palm Beach and Homestead. Since nearly 60 percent of the total rain falls between June and October and only 10 percent between December and February, there is a definite, annual wet and dry cycle. There are also multi-year wet and dry periods where more or less than the average amount of rain will fall for several years in succession. In addition, experts have estimated that between one-half and seven-eighths of the rainfall returns to the atmosphere through evaporation or transpiration.

Even though east coast underground water supplies are augmented by water from Lake Okeechobee, rainfall is still essential to recharge the underground aquifers. Rainfall also plays a major role in supplying water to Everglades National Park and the Conservation Areas. It is the *only* source of water for the Big Cypress and for southern Lee County, most of Hendry County, and all of Collier County.

Figure 2

PRIMARY SOURCES OF FRESH WATER



Little is known of the effect that changes in ground cover due to urbanization have on the quantity and location of rainfall. For unknown reasons, the east coast, which has the most urban and agricultural development, appears to be getting less rain and the west coast more over the last ten years.

Among many proposals to conserve or store water on the surface, one recent proposal suggests a film to cover water surfaces to reduce evaporation. Such proposals must be evaluated, not only in terms of their impact on evaporation, but also in terms of side effects like the effect of such a film itself on water quality, fish, wildlife, and possible changes in the pattern or intensity of rainfall due to reduced evaporation.

POLICIES

4. **ENCOURAGE ALL LEVELS OF GOVERNMENT TO CONCENTRATE EFFORT ON RESEARCH TO DETERMINE THE REAL LIMITS OF THE REGION'S WATER RESOURCES IN TERMS OF THE QUANTITY AND QUALITY NEEDED TO MEET SOCIAL, ECONOMIC, AND ENVIRONMENTAL NEEDS.**
5. **ENCOURAGE ALL LEVELS OF GOVERNMENT TO EVALUATE LAND DEVELOPMENT AND WATER MANAGEMENT PROPOSALS IN TERMS OF THEIR PROBABLE EFFECT ON THE COMPLETE HYDROLOGIC CYCLE AND ON ORDERLY AND ECONOMIC REGIONAL GROWTH.**

THE ROLE OF LAKE OKEECHOBEE

Lake Okeechobee is the heart of an extensive surface water network including water control canals. The primary source of water for the Lake is the Kissimmee River, the headwaters of which are in the Orlando area. This area is experiencing a rapid rate and amount of urban growth and, as a consequence, Kissimmee water quality has been degraded by nutrients, sewage, silt, and other urban wastes which are, in turn, being passed on to Lake Okeechobee. The increasing growth in the Orlando area is also using water that formerly flowed, unused by man, to South Florida. The basin also drains agricultural runoff which includes fertilizers, nutrients, insecticides, animal wastes, and silt. This further degrades water quality in the River and ultimately the Lake.

Historically, the Kissimmee was a meandering river with marsh areas that both provided vegetation to remove nutrients and slowed the flow, providing water storage, and allowing time for natural cleansing. However, the Kissimmee has been channelized and its marsh areas drained, which not only eliminated the work formerly done by the marshes but, by providing more land for more intensive agricultural use, also increased the amount of pollutants draining into the River. In addition, the straightened channel carries pollutants more rapidly and directly to the Lake and reduces temporary water storage capacity.

Some pollutants are also carried into the Lake via surface water from the substantial agricultural area surrounding it and from many canals, which normally drain away, but are pumped back into the Lake. This water contains silt, fertilizers, animal wastes, herbicides and insectides, that further contribute to degradation of the Lake.

Ecologists indicate that the capacity of Lake Okeechobee to assimilate pollutants has nearly been reached and, without significant improvement in the quality of water entering the Lake, it will die as did Lake Apopka. Signs of this have already begun to appear in the form of algae blooms. Recent proposals to improve water quality in the Lake have included recommendations to restore the Kissimmee marshes whose vegetation take nutrients from the water. The success of efforts to improve water quality in the Kissimmee is important to the future of human life in South Florida.

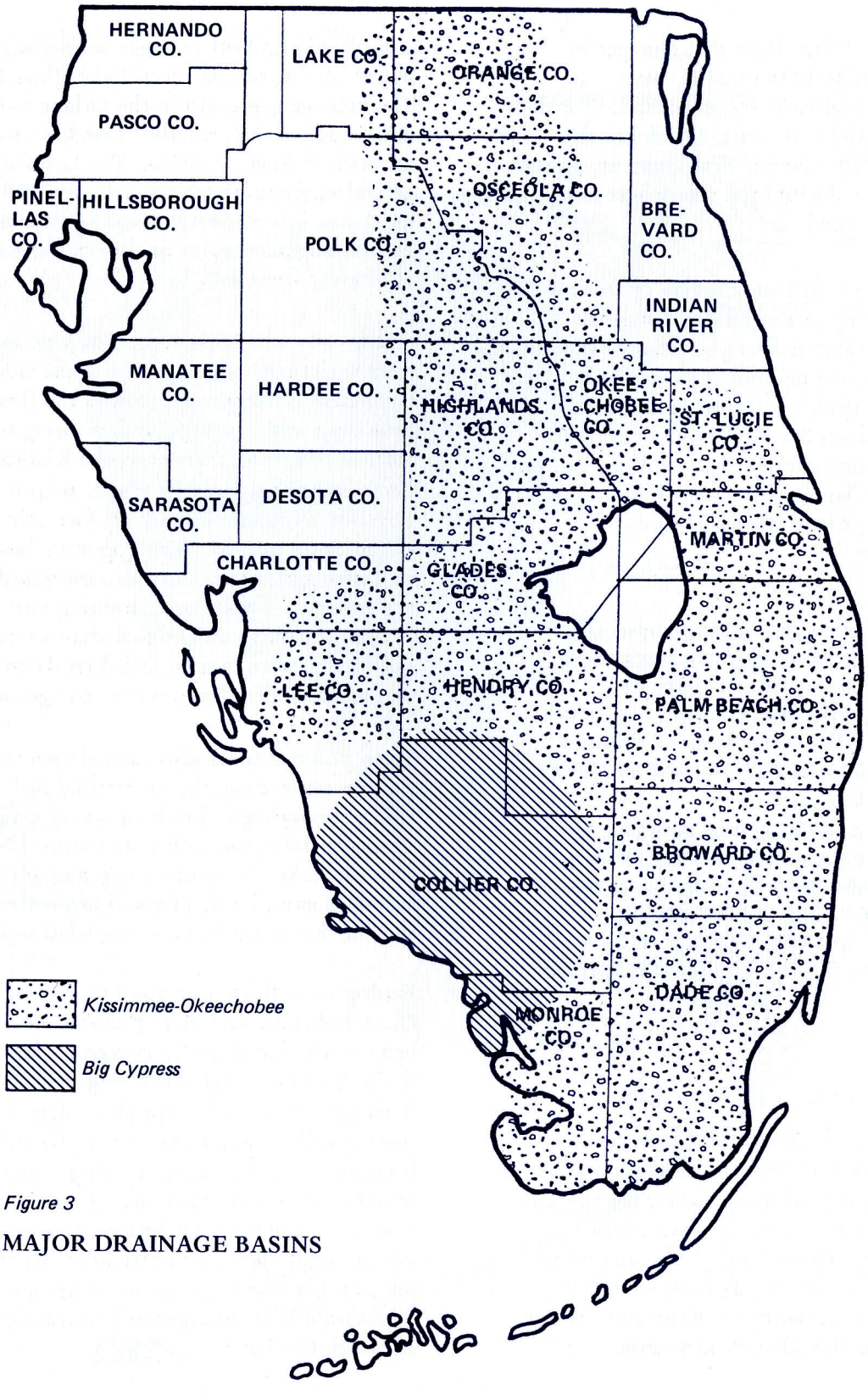


Figure 3

MAJOR DRAINAGE BASINS

The Lake is completely enclosed with dikes to provide management control as well as to prevent flooding of low-lying areas. There are areas inside the dikes where shallow water provides habitat for marsh vegetation that takes in nutrients, removing some pollution from Lake waters. The marshes also perform a valuable fisheries/hatchery function that assists in maintaining the ecological balance, aiding the regional economy and providing a valuable recreation resource.

Because of the wet and dry cycle, ability to store excess water during the wet period for later use during the dry period is essential to the continued existence and functioning of man and nature in South Florida. The Lake is the major storage facility in this scheme. At present, it is maintained at a maximum stage of approximately 15½ feet, although it has not reached this level for several years. Raising the stage level to 17½ feet has been authorized and there is discussion of going even higher to 21½ feet. Studies of the Lake indicate that by raising the level properly, it could probably withstand the stress of a change to approximately 17½ feet. However, indications are that raising the level higher would destroy the marsh areas, releasing their nutrients with a devastating stress on the Lake.

Since the Lake is a source of municipal water, the quality of the water coming into it from the Kissimmee, as well as other sources, is of prime concern. Insecticides, heavy metals and other urban and agricultural wastes threaten the continued functioning of the Lake, both as an ecosystem and as a source of water for South Florida. Government action must focus on the protection of Lake Okeechobee as both a major environmental resource and as a key source of domestic water.

POLICIES

6. SUPPORT CHANGED MANAGEMENT PRACTICES, INCLUDING DECHANNELIZATION, IN THE KISSIMMEE BASIN TO IMPROVE AND PROTECT THE WATER QUALITY OF THE KISSIMMEE RIVER AND LAKE OKEECHOBEE.

7. ENCOURAGE BACKPUMPING THAT WILL IMPROVE THE QUALITY OF WATER IN LAKE OKEECHOBEE.

SURFACE WATERS

Early residents of South Florida felt that there was such an over-abundance of shallow surface water that they proceeded to drain it off to the sea as quickly as possible. There is less water now and it is neither nuisance nor luxury, but essential to life in South Florida. The ecosystems in which these surface water resources play a major role are very complex, very sensitive and threatened with disruption on a wide scale.

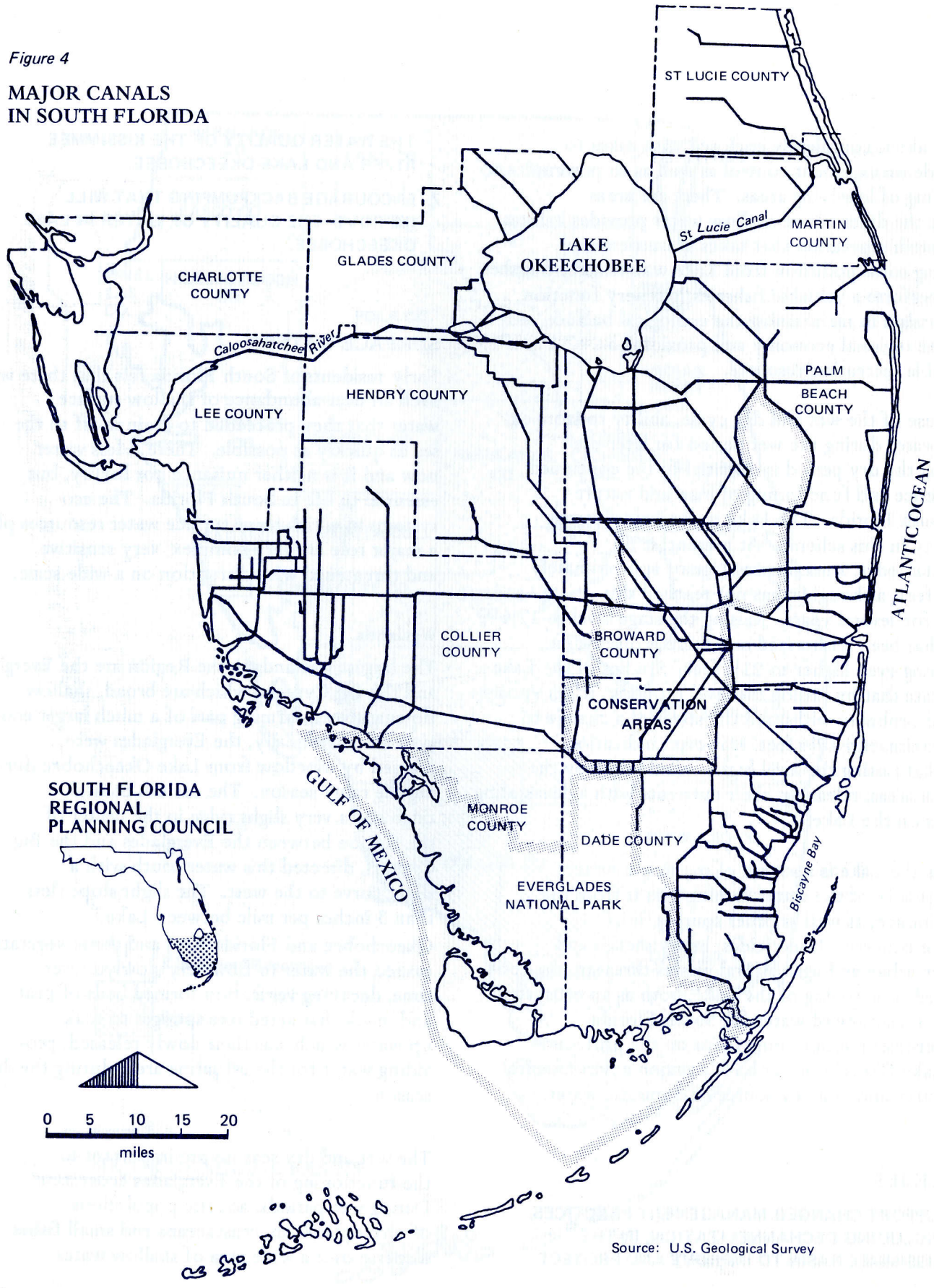
Wetlands

The largest wetlands in the Region are the Everglades and the Big Cypress, which are broad, shallow flowing rivers, forming part of a much larger ecosystem. Historically, the Everglades were formed by overflow from Lake Okeechobee during the rainy season. The eastern coastal ridge and a very slight ridge in the center of the Region between the Everglades and the Big Cypress, directed this water south with a slight curve to the west. The slight slope (less than 3 inches per mile between Lake Okeechobee and Florida Bay) and dense vegetation caused the water to flow very slowly. Over time, decaying vegetation formed beds of peat and muck that acted like sponges to soak up water which was then slowly released, providing water for the estuarine areas during the dry season.

The wet and dry seasons are important to the functioning of the Everglades ecosystem. During wet periods, aquatic populations of phytoplankton, crustaceans and small fishes disperse over a wide area of shallow water

Figure 4

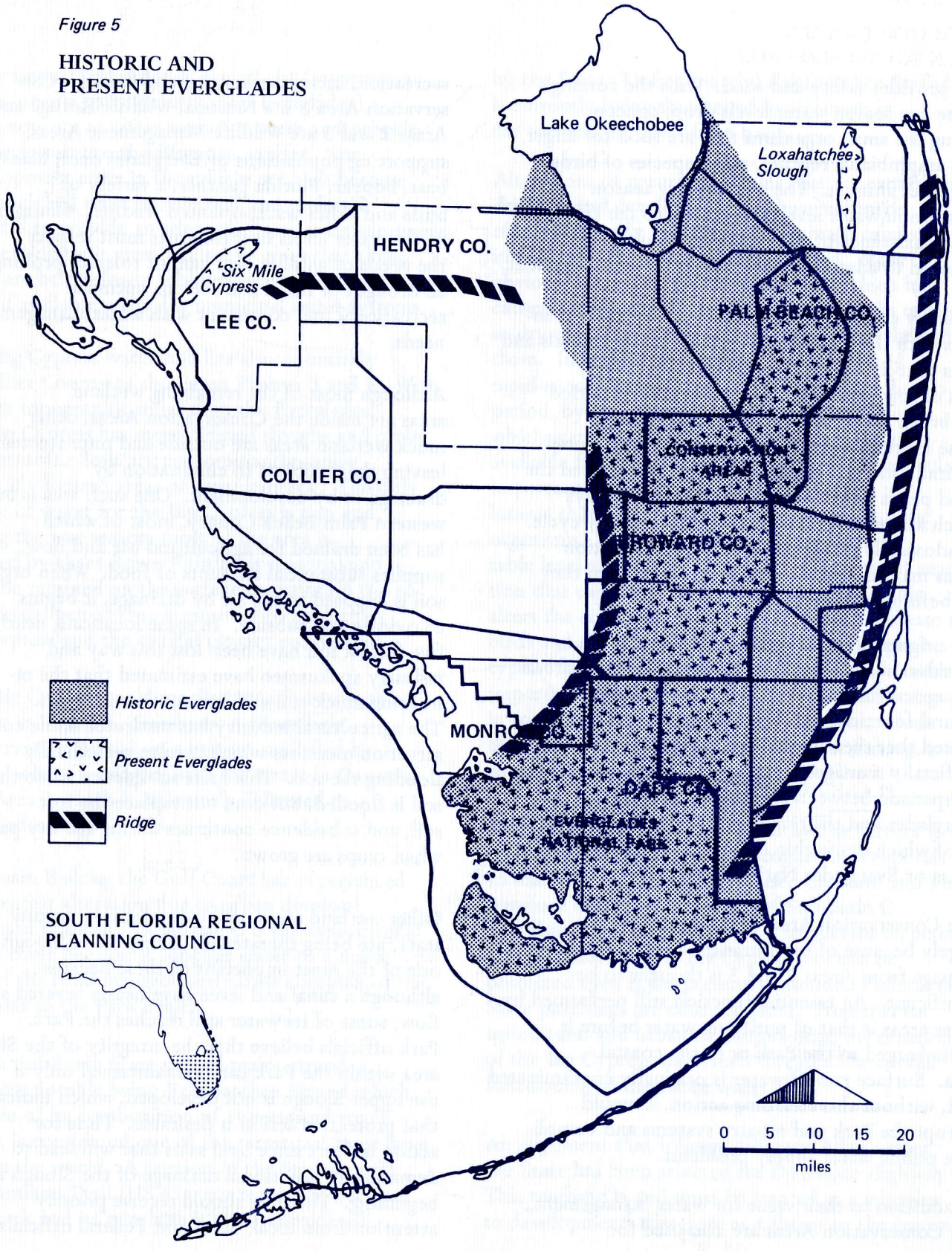
MAJOR CANALS IN SOUTH FLORIDA



Source: U.S. Geological Survey

Figure 5

HISTORIC AND PRESENT EVERGLADES



that provides safety and food. With the coming of the dry season water levels drop, concentrating the small organisms that are food for larger fish, amphibians, reptiles, many species of birds, and other animals. The wet and dry season variation in water level is also basic to the continued existence of the plants that have managed to adapt to the South Florida environment.

Logically enough, the seasonal wet-dry cycle coincides with the reproductive cycles of the animals and birds that live in the Everglades. Excessively high or low water for too long or short a period can break a link in the cycle, which can cause reproductive failure. Such events occured naturally in the past, but drainage has lowered the flood peaks and deepened the drought valleys which accentuates the effect of the wet-dry cycle. Paradoxically, some parts of the Conservation Areas may remain flooded longer now than they did before drainage began.

The original Everglades have been modified considerably as a result of drainage for both urban and agricultural development. In fact, the natural functioning of the Everglades has been so altered that the remaining functions are largely artificially managed. Figure 5 shows a comparison between the historic area of the Everglades and the remaining wetland area, almost all of which lies within either the Conservation Areas or Everglades National Park.

The Conservation Areas store water poorly, largely because of evapotranspiration, although seepage from Areas 2 and 3 is thought to be significant. An essential function still performed by these areas is that of purifying water before it is discharged to the Park or to the coastal area. Surface runoff water is originally contaminated and, without this cleansing action, it would disrupt the Park and estuary systems and complicate public water supply problems.

In addition to their value for water management, the Conservation Areas are also used for recreation, including hunting and fishing. Conservation Area 1 is a National Wildlife Refuge and Areas 2 and 3 are Wildlife Management Areas, supporting populations of Everglades deer, black bear, bobcat, Florida panther, a variety of birds and other water-oriented wildlife. Management of the water levels in these areas must respect the needs of wildlife that cannot tolerate prolonged drought or flood and seek to optimize recreational use, consistent with water management needs.

Although most of the remaining wetland areas are inside the Conservation Areas, other muck wetland areas are outside and unprotected, leaving them subject to elimination by drainage or by development. One such area is in western Palm Beach County, most of which has been drained for agricultural use and now supplies substantial amounts of food. When organic soil is exposed to the air by drainage, it begins to oxidize and subside. In some locations, nearly five feet of soil have been lost this way and industry spokesmen have estimated that the remaining muck soil will last another 25 years. The agricultural industry has instituted some conservation measures which involve periodically flooding the soil. This halts subsidence while the soil is flooded, but does not replace the lost soil, and subsidence continues during the dry period when crops are grown.

Other wetland areas, still in a relatively natural state, are being threatened. Shark River Slough is one of the most important of these because, although a canal and levee have nearly severed sheet flow, some of its water still reaches the Park. Park officials believe that the integrity of the Slough area within the Park can be maintained only if the upper Slough is not developed, which indicates that protective action is desirable. Time for action is short since land sales that will lead to demands for additional drainage of the Slough are beginning. This area should receive priority attention from local, State and Federal officials.

Other important wetlands east of the Conservation Areas, once a part of the natural Everglades flow, now act as water retention areas and provide recharge water to the Biscayne aquifer. Site development costs in these areas are high because the muck soil must be removed and replaced with fill to provide an adequate base for development, yet development pressures are so great that these areas are being slowly nibbled away with resultant loss of available water for municipal water systems.

The Big Cypress watershed lies almost entirely in Collier County as shown on Figures 3 and 6. With greater topographic relief than the Everglades, the Big Cypress has more defined sloughs and drainage patterns. Soils are predominantly sandy with only limited areas of organic muck. The only source of water for the Big Cypress is rain and, during the wet season, most of the area is covered by sheet flow. Rainfall is seasonal and must be retained on the surface to maintain the natural hydroperiod that is essential to both the Big Cypress and the coastal estuary ecosystems.

The Big Cypress has three distinct sub-basins as is shown in Figure 6. Sub-basin A flows into Conservation Area 3, in a pattern modified by canals, where it mingles with the water in Conservation Area 3 which is ultimately delivered to Everglades Park.

Sub-basin B along the Gulf Coast has experienced the greatest alteration due to urban development and drainage. Sub-basin C is the most critical of the three because it supplies water to a major part of the total mangrove-estuarine complex of the Park and to the Park itself.

Within Sub-basin C are several major strands, the most notable being Fakahatchee Strand which, because of its combination of cypress and royal palms, is considered one of the rarest and most beautiful in the world. A portion of the Strand, near the Tamiami Trail (US 41), is a registered national landmark and its purchase is being considered by the State. Unfortunately, Fakahatchee Strand is currently being threatened by drainage in the western portion of the basin.

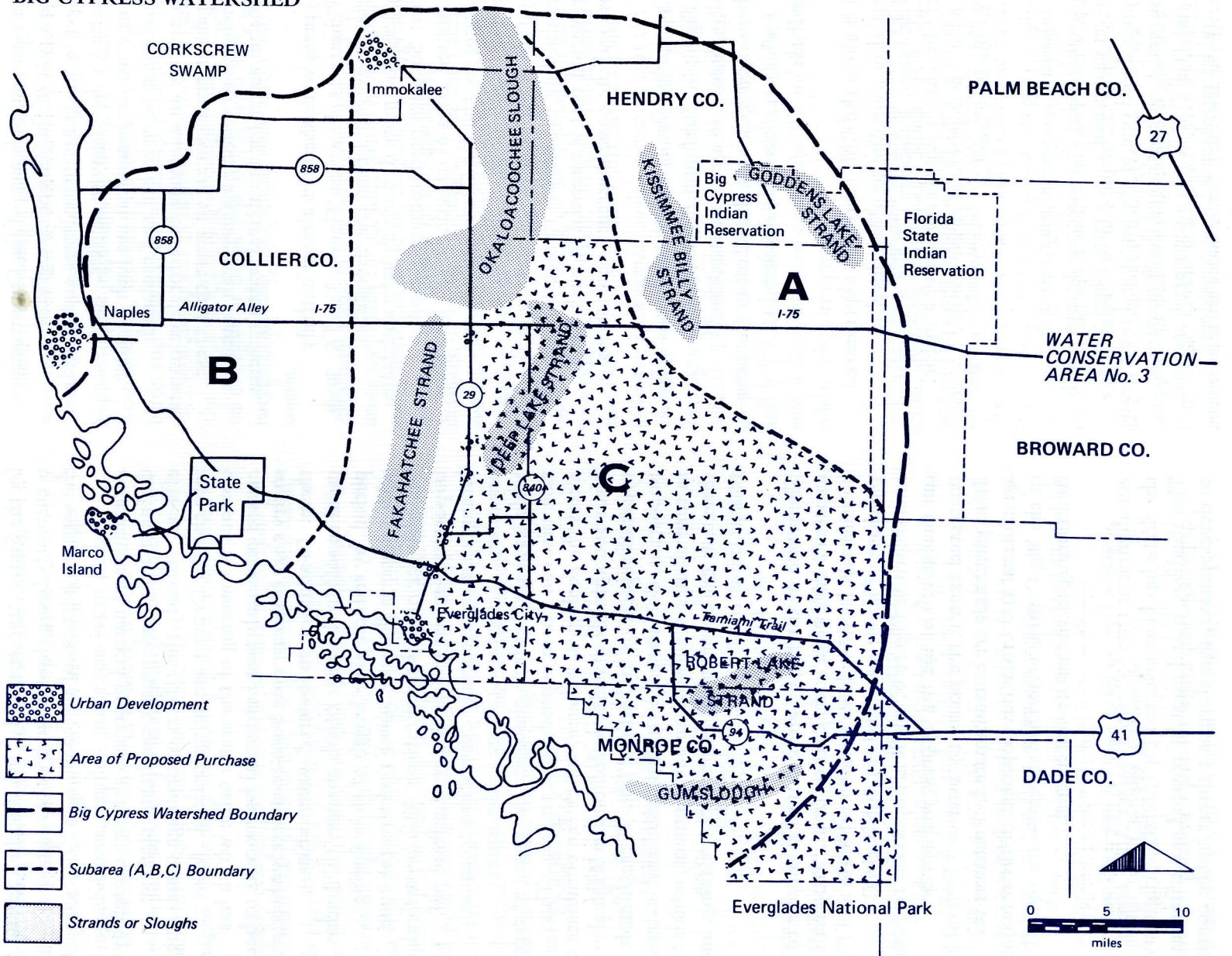
Alterations of natural processes that are caused by drainage and development can have extensive effects. Already the effects of drainage canals dug into the Big Cypress are being noticed. Most obvious is lowering of the water table which has caused previously wet hardwood hammocks to become so dry that fires can now burn completely through them. In addition to lowered water tables, rapid runoff in drainage canals changes the hydroperiod, by reducing the length of time during which water is flowing, which shortens the time available for natural purification. This is particularly important because canals also concentrate pollutants that are especially destructive to aquatic organisms. Long-term change in the water table level also leads to change in the types of vegetation that can live or reproduce in an area. This alters the ecological balance, which can eliminate the birds and animals that depended on the original types of vegetation and animal life. Perhaps most important, the changes in hydroperiod and water quality in turn change the estuarine environment, which threatens the commerical fishing, sport fishing, and tourist industries.

The worth of the Big Cypress as well as threats to its existence have been widely recognized. Proposals to maintain its value have focused on State and Federal purchase of about two-thirds of Sub-basin C as is shown in Figure 6, but it is important to point out that much of the Big Cypress will not be protected even if the presently intended Federal and State purchases are consummated. Pressures for agricultural and urban development in the remainder of the Big Cypress watershed threaten the overall functioning of the entire water shed.

An alignment that follows Alligator Alley across the State has been selected for Interstate Highway I-75. This roadway is and must be treated as a stimulus to development, therefore as a threat to the continued

Figure 6

BIG CYPRESS WATERSHED



Source: *The Big Cypress Watershed,* Everglades-Jetport Advisory Board, April 19, 1971, p.5.

functioning of the Big Cypress and its dependent estuaries. Federal purchase of a portion of Sub-basin C will protect only a small part of the I-75 right-of-way, leaving the remainder still vulnerable.

One endangered area outside the purchase boundary is the Corkscrew Swamp Wildlife Sanctuary in the northwestern part of the Big Cypress, which is owned and managed by the National Audubon Society. Water for the Sanctuary comes from a small drainage basin to the north and east where agricultural development is threatening to cut off the water supply for the Sanctuary. Downstream, drainage canals have been dug close to its southern boundary which siphon water from the Sanctuary, threatening its continued existence by reducing the duration of the wet period and lowering the water table.

Maintaining the productivity of the Big Cypress and associated natural systems requires more than the purchase of land, which will take years to complete. Since the federal government indicated intent to buy the land, the State Legislature has both provided $40 million in funding and designated the Big Cypress as an Area of Critical State Concern. Local governments should, in cooperation, institute moritoria on development and rezoning, not only to protect the resources but to prevent unwarranted increases in land costs. In areas outside the purchase boundaries, land development regulations should be adopted to minimize environmental disruption in the watershed. Other sensitive and unique natural areas such as the Corkscrew Swamp should be designated as endangered areas or as areas of critical State concern to insure their perpetuation.

Loxahatchee Slough, in northeast Palm Beach County, forms the headwaters of the Loxahatchee River which enters the Atlantic Ocean at Jupiter. The Slough and River form one of the remaining relatively large scenic areas along the east coast of the Region. The uppermost headwaters of the Slough have been completely enclosed with dikes to form a water catchment area which drains to the Clear Lake Reservoir, serving as one source of water for West Palm Beach. No longer connected hydrologically with the Slough itself, the Reservoir is important as a source of domestic water.

The remaining portion of the Slough is still vulnerable and is already threatened by signs of development and pressure for urban development is growing. Subdivision lots are being sold inside the Slough and development to the west threatens to reduce the quality of the water entering it. Proposals have been made and consideration is being given to purchase of part of the area.

POLICIES

8. **ENCOURAGE STATE, LOCAL, AND FEDERAL GOVERNMENTS TO ACT TO INSURE THAT THE PART OF SHARK RIVER SLOUGH, WHICH LIES OUTSIDE EVERGLADES NATIONAL PARK, IS NOT DEVELOPED.**
9. **PROMOTE WATER MANAGEMENT IN THE CONSERVATION AREAS THAT MEETS THE NEEDS OF WILDLIFE COMMUNITIES, AND ENCOURAGE EFFECTIVE WILDLIFE MANAGEMENT PRACTICES TO INSURE DESIRABLE WILDLIFE POPULATIONS AND OPTIMUM RECREATIONAL OPPORTUNITIES, WHILE MEETING OTHER IMPORTANT NEEDS FOR WATER.**
10. **DISCOURAGE WATER MANAGEMENT OR DEVELOPMENT PROJECTS THAT THREATEN TO AGGRAVATE THE NATURAL WET AND DRY CYCLE OR CAUSE DISRUPTION OF IMPORTANT WETLANDS.**
11. **ENCOURAGE THE STATE AND FEDERAL GOVERNMENTS TO CONDUCT OR SUPPORT THE STUDIES NECESSARY TO DETERMINE THE QUALITY OF WATER NECESSARY TO ALLOW BACKPUMPING TO WETLANDS WITHOUT DAMAGING THEIR NATURAL PRODUCTIVITY.**

12. ENCOURAGE PROMPT STATE AND FEDERAL PURCHASE OF THE BIG CYPRESS TO AID IN MAINTAINING THE PRODUCTIVITY OF THE NATURAL ENVIRONMENT AND TO INSURE A CONTINUED SUPPLY OF QUALITY WATER TO EVERGLADES NATIONAL PARK AND TO THE COASTAL ESTUARIES.

13. URGE THE STATE TO DESIGNATE ALL OF THE FAKAHATCHEE STRAND AS AN AREA OF CRITICAL STATE CONCERN TO PRESERVE THIS UNIQUE AREA AND TO AID IN PROVIDING THE FRESH WATER NEEDED TO MAINTAIN THE PRODUCTIVITY OF COASTAL ESTUARIES.

14. ENCOURAGE LOCAL GOVERNMENTS TO STRICTLY MANAGE DEVELOPMENT THROUGHOUT THE ENTIRE BIG CYPRESS AREA IN ORDER TO PREVENT ENVIRONMENTAL DESTRUCTION OR DISTORTION THAT WOULD ELIMINATE THE WORK DONE BY THE NATURAL ENVIRONMENT.

15. SUPPORT DRAINAGE MANAGEMENT IN THE BIG CYPRESS WATERSHED THAT PERPETUATES BOTH SURFACE AND GROUND WATER SYSTEMS.

16. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO ACT TO REDUCE THE DEVELOPMENT PRESSURES THAT WILL BE STIMULATED BY CONSTRUCTION OF I-75 ACROSS THE EVERGLADES AND THE BIG CYPRESS.

17. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO ACT TO MAINTAIN THE WATER SUPPLY FOR CORKSCREW SWAMP WILDLIFE SANCTUARY.

18. ENCOURAGE LOCAL GOVERNMENTS TO IMPOSE BUILDING AND ZONING MORITORIA IN THE AREAS OF THE BIG CYPRESS THAT ARE SCHEDULED FOR STATE OR FEDERAL PURCHASE.

19. ENCOURAGE THE PURCHASE OF THOSE AREAS OF LOXAHATCHEE SLOUGH THAT ARE NECESSARY TO PRESERVE ITS CHARACTER AND FUNCTION.

20. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO TAKE THE MEASURES NECESSARY TO PROTECT THE LOXAHATCHEE AND OTHER IMPORTANT WETLANDS FROM ENVIRONMENTAL DEGRADATION.

Coastal Zone Waters

The coastal zone waters are the most sensitive, the most threatened, and at the same time, do the greatest amount of work for man by supporting the recreation, tourism, and fishing industries. They are also prime ingredients in the national and international image of South Florida.

ESTUARIES

Estuaries are areas where salt and fresh water mix. It is here that productivity is up to eleven times greater than on prime farm land and it is here, in the mangroves, salt marshes, and dunes, that the brunt of storms and hurricanes is borne. The mangroves also provide the protected environment for the marine organisms that are essential to the economy of the Region. In the past, mangrove areas have been thought of as undesirable, useless scrub that bred mosquitos and separated man from the water, but research has shown that the mangrove is vital to estuarine ecology.

The Everglades Jetport Advisory Board, in *Big Cypress Watershed, Florida,* reported that "the mangroves as an energy source are important, not only within the mangrove zone, but well into adjacent bays and coastal areas" and "the mangrove-estuarine zone . . . is vital to the continued existence of (sport and commerical) fisheries."

Of the remaining mangrove estuaries in the Region, the largest area is in Everglades National Park. These are protected from direct destruction by development, but the mangrove estuaries outside the Park are not, except when State-owned, in which case State policy prohibits the wholesale removal of mangroves. In other areas, local governments should manage development to insure that mangrove

Complete Listing of Policies

WATER MANAGEMENT PLANNING

1. Encourage the State Legislature to define the roles and relationships between regional agencies carrying out comprehensive planning and agencies involved in functional planning for water.

2. Encourage the State Legislature to insure that the comprehensive regional plan and planning process is the framework for the development, refinement, and interpretation of the water management element to insure that regional development is guided from a comprehensive perspective that optimizes the overall quality of life in an orderly and economic fashion.

3. Encourage the State Legislature to require that functional plans, including those for water management, be reviewed for approval and adoption as part of comprehensive regional plans.

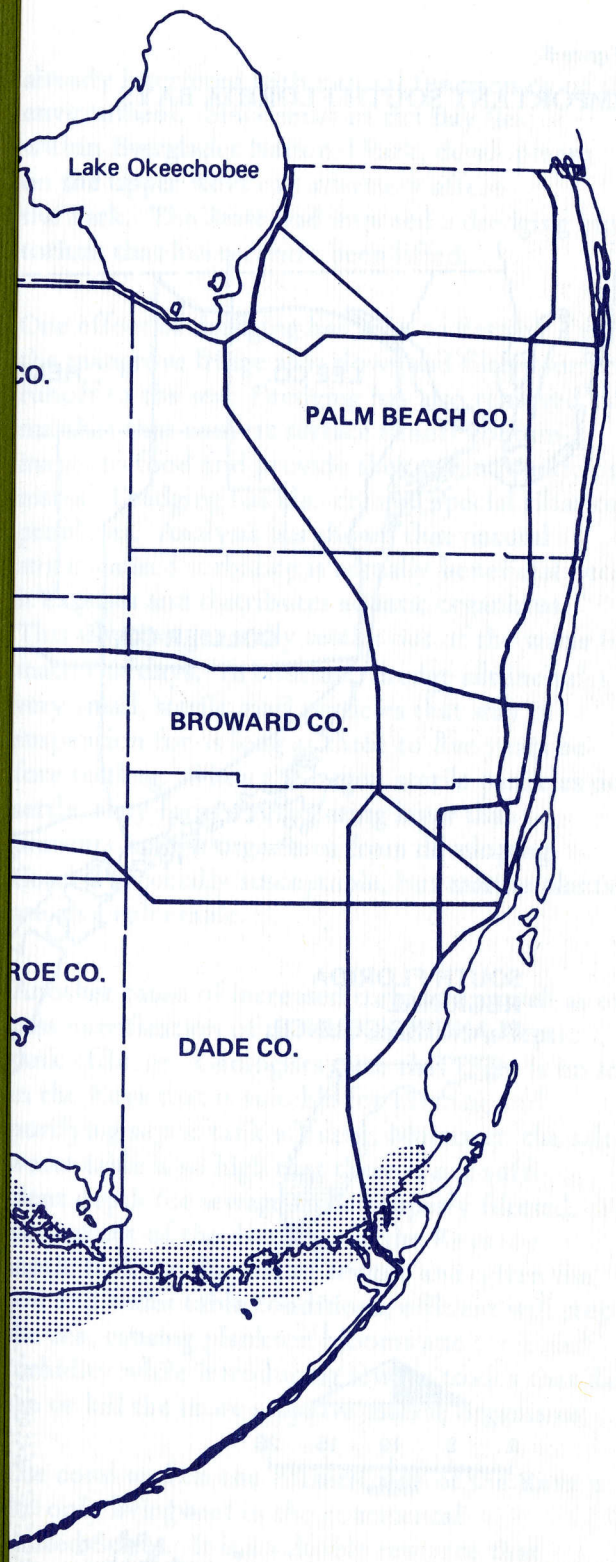
SOURCES OF WATER

4. Encourage all levels of government to concentrate effort on research to determine the real limits of the Region's water resources in terms of the quantity and quality needed to meet social, economic, and environmental needs.

5. Encourage all levels of government to evaluate land development and water management proposals in terms of their probable effect on the complete hydrologic cycle and on orderly and economic regional growth.

THE ROLE OF LAKE OKEECHOBEE

6. Support changed management practices, including dechannelization, in the Kis-



simmee Basin to improve and protect the water quality of the Kissimmee River and Lake Okeechobee.

7. Encourage backpumping that will improve the quality of water in Lake Okeechobee.

SURFACE WATERS

8. Encourage State, local, and Federal governments to act to insure that the part of Shark River Slough which lies outside Everglades National Park is not developed.

9. Promote water management in the Conservation Areas that meets the needs of wildlife communities, and encourage effective wildlife management practices to insure desirable wildlife populations and optimum recreational opportunities, while meeting other important needs for water.

10. Discourage water management or development projects that threaten to aggravate the natural wet and dry cycle or cause disruption of important wetlands.

11. Encourage the State and Federal governments to conduct or support the studies necessary to determine the quality of water necessary to allow backpumping to wetlands without damaging their natural productivity.

12. Encourage prompt State and Federal purchase of the Big Cypress to aid in maintaining the productivity of the natural environment and to insure a continued supply of quality water to Everglades National Park and to the coastal estuaries.

13. Urge the State to designate all of the Fakahatchee Strand as an Area of Critical

State Concern to preserve this unique area and to aid in providing the fresh water needed to maintain the productivity of coastal estuaries.

14. Encourage local governments to strictly manage development throughout the entire Big Cypress area in order to prevent environmental destruction or distortion that would eliminate the work done by the natural environment.

15. Support drainage management in the Big Cypress Watershed that perpetuates both surface and ground water systems.

16. Encourage the State and local governments to act to reduce the development pressures that will be stimulated by construction of I-75 across the Everglades and the Big Cypress.

17. Encourage the State and local governments to act to maintain the water supply for Corkscrew Swamp Wildlife Sanctuary.

18. Encourage local governments to impose building and zoning moritoria in the areas of the Big Cypress that are scheduled for State or Federal purchase.

19. Encourage the purchase of those areas of Loxahatchee Slough that are necessary to preserve its character and function.

20. Encourage the State and local governments to take the measures necessary to protect the Loxahatchee and other important wetlands from environmental degradation.

COASTAL ZONE WATERS

21. Encourage the State and local governments to adopt regulations that protect

mangrove estuaries and salt marshes to insure the continued functioning of coastal ecosystems.

22. Encourage local governments to reject proposals for development in the coastal zone that threaten to degrade the quality or hamper the productivity of estuarine and bay environments.

23. Encourage the State to take appropriate steps to prevent coral reef destruction due to harvesting of coral.

24. Encourage the State to reinstate the dredging ban in the Keys until a comprehensive development plan is adopted, including appropriate regulations to insure continued environmental productivity.

25. Encourage State purchase or regulation of sensitive coastal areas that are threatened with loss of natural functioning or productivity that is of Regional or State importance.

26. Encourage the development and enforcement of State and local regulations that require central sewers for urban development in coastal areas where improperly treated wastes would degrade estuarine or bay environments.

MAN-MADE WATERS

27. Encourage the State and local governments to establish and enforce design standards for all new canals, lakes, and borrow pits in existing or planned residential areas to encourage beneficial aquatic environments that will aid in maintaining a quality residential environment.

28. Encourage the State and local governments to establish and enforce design

standards for canals, man-made lakes, and borrow pits in nonresidential areas to encourage the development of beneficial aquatic environments, with due consideration for flood control and water conservation needs.

29. Encourage feasible redevelopment of existing residential lakes and canals to provide an aquatic environment suitable for improving water quality and enhancing the human environment.

30. Encourage the State and local governments to develop and adopt drainage criteria and subdivision regulations that require maximum feasible on-site retention of storm water to aid in improving surface water quality, to insure the percolation of more rain into ground water systems, and to reduce demands on the primary drainage canals.

31. Encourage controlled experiments with new techniques to remove or control nuisance aquatic weeds from canals and other water bodies without degrading water quality.

32. Discourage the construction of canals that would provide avenues for salt water intrusion.

GROUND WATER AQUIFERS

33. Encourage the establishment of urban growth and development regulations that protect the natural recharge of aquifers by rainfall.

34. Encourage the State and local governments to establish development management criteria and regulations that protect the ground water supply from pollution by either urban or agricultural runoff.

35. Encourage the State and local governments to prohibit drainage or development projects that are not either part of or consistent with a comprehensive water management program.

36. Encourage the development and implementation of well drilling and operating regulations that prevent further contamination of fresh water supplies.

37. Encourage the State to undertake effective action to halt contamination of fresh water supplies by deteriorating or uncapped wells.

38. Encourage all appropriate units of government to compile more specific, usable information on the quantity and usability of the ground water resources of the Region and the measures necessary to properly manage them for sustained use.

39. Encourage the prohibition of development in areas identified as specific recharge areas critical to the protection of ground water supplies unless it is proven that the development will not adversely affect aquifer recharge.

WATER POLLUTION

40. Encourage State and Federal government study to determine the feasibility of regulating the application of fertilizer and insecticides in both urban and rural areas, consistent with food production needs, in order to reduce water pollution from these sources to as low a level as is feasible.

41. Encourage the maintenance, restoration, or creation, if necessary, of wetland areas to provide natural cleansing of surface runoff water and to aid in aquifer recharge.

42. Encourage local governments to adopt subdivision regulations that require the retention of most storm water runoff on-site to trap the majority of pollutants, to insure the percolation of more rain into the ground water system, and to reduce demands on the primary drainage canals.

43. Encourage the State and local governments to adequately staff and fund water pollution abatement programs and to require prompt conformance to water quality standards.

44. Encourage industries and other individual sources to recycle water whenever feasible and to discharge wastes to public systems, after any necessary pretreatment.

45. Encourage the State to maintain its ban on tap-ins to sewage works that do not meet established performance standards.

46. Encourage the State to require advanced waste treatment in areas where less-treated sewage effluent would reduce water quality below appropriate levels.

47. Encourage all levels of government to require that, whenever possible, sewage treatment facilities be designed to allow for future reuse of water and located to minimize adverse effect on aquifers.

48. Encourage all levels of government to use optimization of the long-term use of natural and economic resources as primary criteria in making decisions regarding reuse and treatment level of waste water.

49. Until research establishes the level of treatment necessary to protect wetland ecology and functions, discourage the discharge of other than completely compatible water to wetlands.

50. Encourage all levels of government to require that no incompatible waters be discharged to the inland canals of the Region and that all existing incompatible discharges be removed from canals as soon as possible.

51. The Council will require local governments to maintain existing ocean outfalls as emergency safety valves once reuse of sanitary and storm sewage is accomplished.

52. Encourage the State and local governments to expedite the provision of central sewage works to allow package or interim sewage treatment plants and septic tanks to be phased out of use, with priority attention to areas of aquifer recharge and to areas where there is threatened or actual pollution of surface waters or public water supplies.

53. Encourage the State and local governments to prohibit the installation of septic tanks in areas identified as specific aquifer recharge areas, where there is a threat of polluting surface waters, or where there is a threat of polluting public water supplies.

54. Encourage State and local governments to fully enforce regulations regarding the installation of septic tanks and establish penalties for the unauthorized alteration of such systems.

Figure 7

MAJOR ESTUARIES

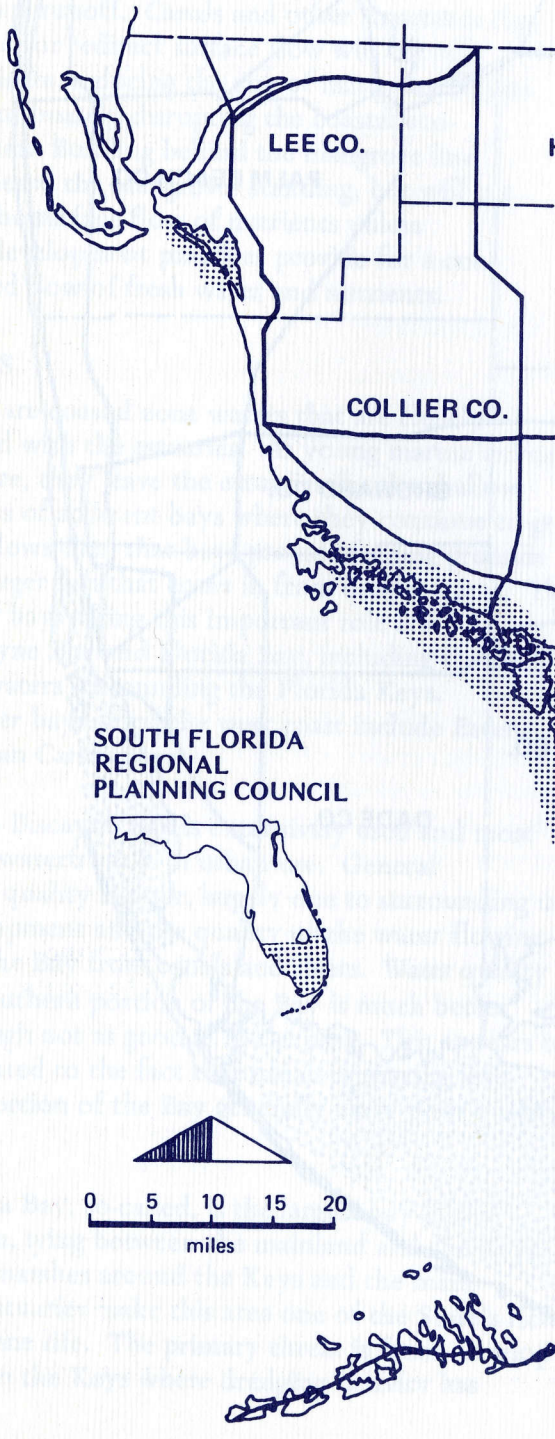


Figure 7

MAJOR ESTUARIES

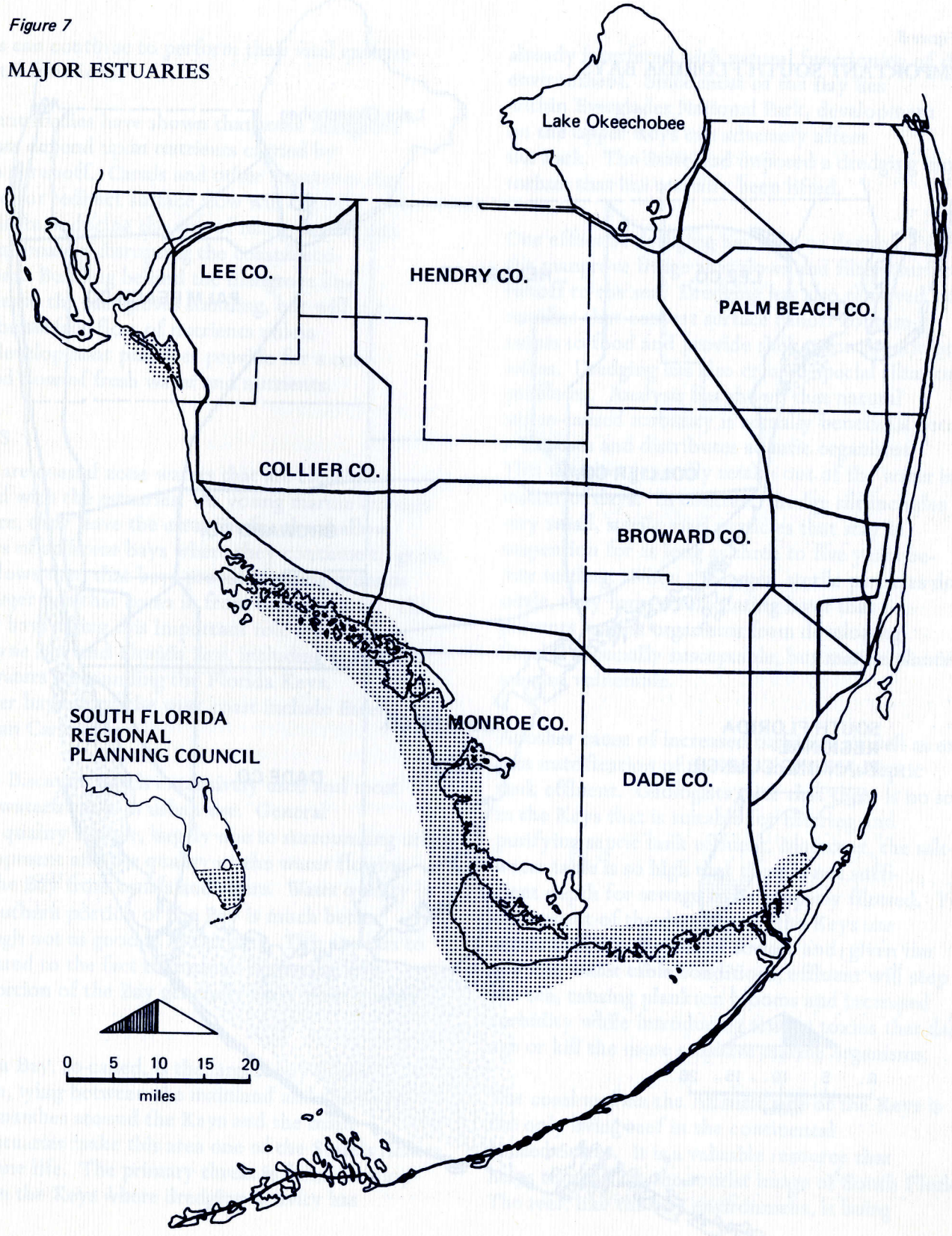
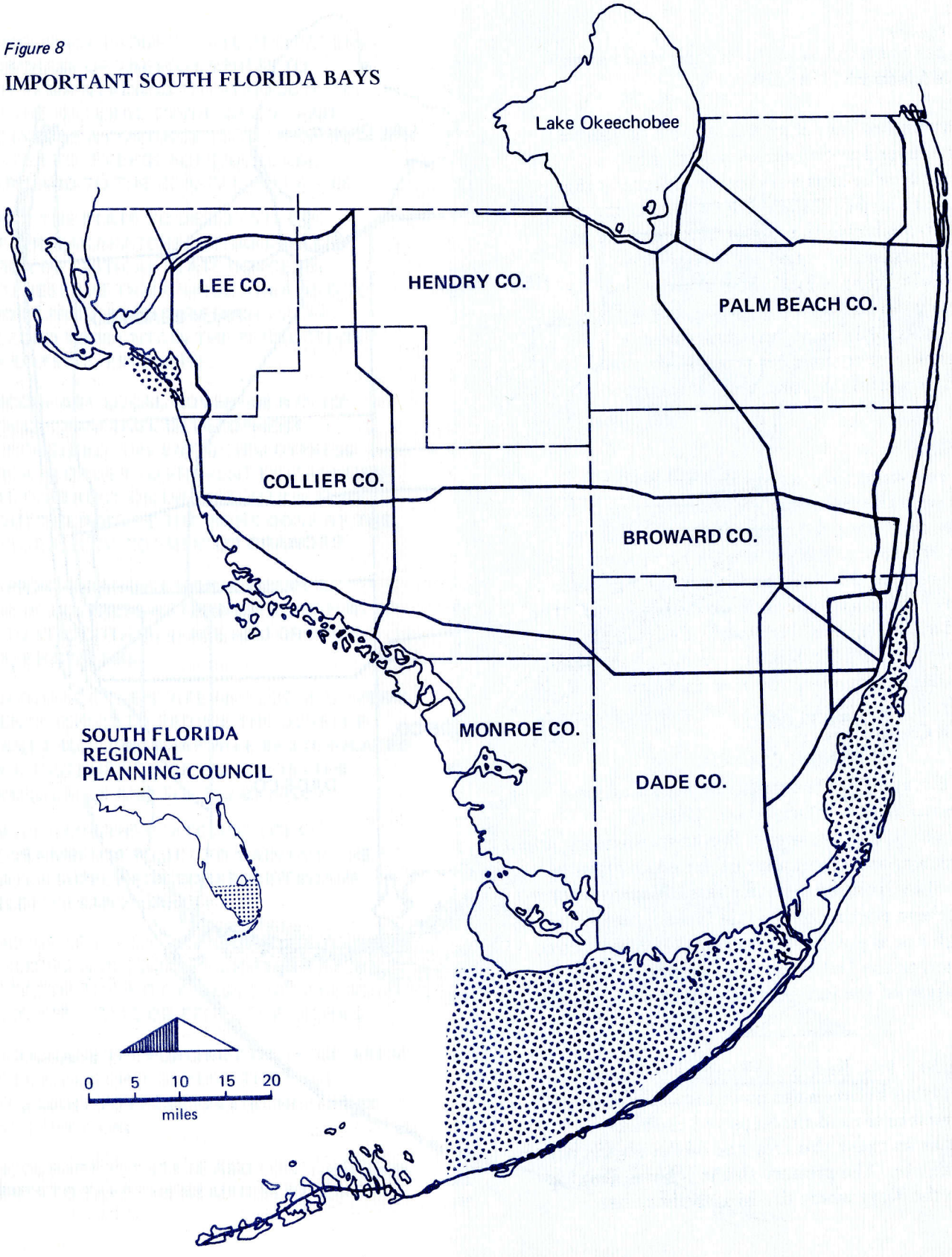


Figure 8

IMPORTANT SOUTH FLORIDA BAYS



areas can continue to perform their vital environmental functions.

Recent studies have shown that some mangrove forests depend upon nutrients carried by surface runoff. Canals and other structures that reduce or redirect surface flow will cut off nutrients, reducing the size of mangrove forests and ultimately disrupting the coastal ecosystem. Building behind the mangrove line will leave the mangroves standing, but will cut off the surface flow of nutrients unless site development practices provide for a continued flow of fresh water and nutrients.

BAYS

Bays are coastal zone waters that are closely linked with the estuaries. As young marine animals mature, they leave the estuaries for the shallow waters of adjacent bays where they continue to grow. It follows then that bays provide feeding grounds for larger fish that come in from deeper water. The larger bays filling this important role are Biscayne Bay and Florida Bay, including the shallow waters surrounding the Florida Keys. Smaller bays along the west coast include Estero and San Carlos bays.

North Biscayne Bay is extensively used and most of its waterfront is in urban use. General water quality is poor, largely due to surrounding urban development and the quality of the water flowing into the Bay from canals and rivers. Water quality in the southern portion of the Bay is much better although not as good as in the past. This appears to be related to the fact that canals emptying into this portion of the Bay generally carry poor quality water.

Florida Bay, so-called, is the largest bay in the Region, lying between the mainland and the Keys. Tidal marshes around the Keys and the mainland estuaries make this area one of the State's richest in marine life. The primary threat is from development in the Keys where dredging activity has already interfered with natural functioning of the environment. Since most of the Bay lies within Everglades National Park, development on the upper Keys can adversely affect the Park. The State had imposed a dredging moratorium that has recently been lifted.

One effect of dredging has been to destroy a part of the mangrove fringe that slows and filters surface runoff to the sea. Dredging has also removed tidal marshes that convert surface runoff contaminants to food and provide shelter for aquatic organisms. Dredging has also created special siltation problems. Analysis has shown that natural storm-caused turbidity is actually beneficial because it exposes and distributes aquatic organisms. This siltation generally settles out of the water in a matter of days. In contrast, dredge silt includes very small, sterile marl particles that stay in suspension for as long as three to five years before settling. When the larger, sterile particles do settle, they form a suffocating layer that prevents marine organisms from developing. Coral is especially susceptable, but marine plants are also vulnerable.

Another cause of increased turbidity as well as excess nutrification of the Bay shallows is septic tank effluent. Geologists state that there is no soil in the Keys that is suitable for filtering and purifying septic tank effluent. Moreover, the saltwater table is so high that there is not sufficient depth for sewage to be properly filtered. Yet 80 percent of the dwellings in the Keys use septic tanks to dispose of sewage and, given the soil and water table conditions, effluent will seep to the sea, causing plankton blooms and increased turbidity while introducing sewage toxins that damage or kill the more sensitive marine organisms.

The coral reef on the Atlantic side of the Keys is the only living reef in the continental United States. It is a valuable resource that helps to establish the tourist image of South Florida. The reef, like the bay environment, is being

threatened by sewage effluent, dredge silt, and human abuse. The human abuse consists primarily of the collecting of coral, both by individuals and for commerical sale. This destruction, particularly in the Key West area, dissipates a rare and valuable resource for little purpose.

Estero Bay, southwest of Ft. Myers, is considered the second most important area of high marine productivity in the State. This Bay receives surface water runoff from a small drainage area in western Lee County, a major feature of which is the Six Mile Cypress Strand, just south and east of Ft. Myers. Development in this basin and accompanying pollution threatens the continued performance of the Bay's environmental functions. Development proposals for this basin have been bitterly contested by those concerned over the future of the Bay.

POLICIES

21. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO ADOPT REGULATIONS THAT PROTECT MANGROVE ESTUARIES AND SALT MARSHES TO INSURE THE CONTINUED FUNCTIONING OF COASTAL ECOSYSTEMS.

22. ENCOURAGE LOCAL GOVERNMENTS TO REJECT PROPOSALS FOR DEVELOPMENT IN THE COASTAL ZONE THAT THREATEN TO DEGRADE THE QUALITY OR HAMPER THE PRODUCTIVITY OF ESTUARINE AND BAY ENVIRONMENTS.

23. ENCOURAGE THE STATE TO TAKE APPROPRIATE STEPS TO PREVENT CORAL REEF DESTRUCTION DUE TO HARVESTING OF CORAL.

24. ENCOURAGE THE STATE TO REINSTATE THE DREDGING BAN IN THE KEYS UNTIL A COMPREHENSIVE DEVELOPMENT PLAN IS ADOPTED, INCLUDING APPROPRIATE REGULATIONS TO INSURE CONTINUED ENVIRONMENTAL PRODUCTIVITY.

25. ENCOURAGE STATE PURCHASE OR REGULATION OF SENSITIVE COASTAL AREAS THAT ARE THREATENED WITH LOSS OF NATURAL FUNCTIONING OR PRODUCTIVITY THAT IS OF REGIONAL OR STATE IMPORTANCE.

26. ENCOURAGE THE DEVELOPMENT AND ENFORCEMENT OF STATE AND LOCAL REGULATIONS THAT REQUIRE CENTRAL SEWERS FOR URBAN DEVELOPMENT IN COASTAL AREAS WHERE IMPROPERLY TREATED WASTES WOULD DEGRADE ESTUARINE OR BAY ENVIRONMENTS.

Man-Made Waters

Canals and residential lakes provide a majority of the inland surface water in the Region. Since they are the result of either dredge and fill or drainage operations, their common origin and relative location, with respect to urban or agricultural development, means that they have similar problems.

Residential canals and lakes are considered by nearby residents as environmental assets and by others as resources for fishing, swimming, and boating. In spite of their being viewed by residents as recreation or amenity assets, the canals in the Region were usually sources of fill or were designed for drainage, not active human use, and are considered to have, at best, marginal water quality. One water quality study refers to Dade County canals as being grossly polluted, with quality in some being so bad that body contact is a health hazard. Canals receive many wastes, domestic as well as industrial, plus surface runoff from urban and agricultural areas and seepage from malfunctioning septic tanks. Studies show that water quality in most canals is so poor that even slight increases in contaminants will exceed general water quality standards. Over-prolific growth of aquatic plants is one indication of poor quality canal water. These plants often completely cover the water surface, shutting out all sunlight, reducing oxygen in the water to the

level where fish die or they concentrate toxins, leading to waterfowl kills. During wet periods and following heavy rains, aquatic weeds are also washed to the bays in great quantities where, killed by the salt water, they decompose, polluting the bays.

Herbicide sprays are presently the most feasible control for aquatic weeds, but they are only temporary and frequently have adverse effect on animals, fish and useful aquatic plants. The other current control is mechanical harvesting, however, its use is limited because it is expensive and many canals are inaccessable. Some research is being done to find natural enemies of specific aquatic weeds.

Pollution of canal waters is more than just an aesthetic problem. In South Florida the canals penetrate the top surface of the aquifers so that canal and ground waters interchange and, although many larger contaminants are filtered out as the water moves through the aquifer, viruses or toxins may remain in solution. The recent typhoid epidemic in South Dade was traced to just such a cause where the water supply had been contaminated by sewage effluent that apparently moved laterally in the ground water.

Their original design as storm sewers or borrow pits contributes to poor water quality in many residential lakes and canals, primarily due to excessive depth which, combined with water turbidity, prevents sunlight from reaching the bottom. Without light, aquatic plants essential to a healthy body of water cannot live and, since dissolved oxygen also generally decreases with increased depth, fish and other aquatic organisms cannot live or reproduce in such zones. Too little surface area in relation to depth also reduces the circulation of oxygen in a water body and since most canals and many residential lakes are too deep for their surface area, there is little or no oxygen at the bottom. Either reducing the depth or increasing the surface area would aid in improving water quality. The typical steep canal and lake banks also prevent the growth of desirable aquatic plants that remove nutrients from the water, provide dissolved oxygen, and food and shelter for aquatic organisms. Steep banks are also a safety hazard to children. The Trustees of the Internal Improvement Trust Fund, in Resolution 73-5, have recommended that shoreline developments use naturally sloping, vegetated shorelines or sloped riprap rather than vertical seawalls.

Some efforts are being made to regulate the design of man-made water bodies to insure useful, biologically workable environments. However, more emphasis should go to the development of standards that insure, at a minimum, proper design of all new residential canals and lakes. Methods should be developed to rehabilitate existing canals and lakes in order to provide healthy biological environments and effective drainage systems.

Surface drainage carrying urban and agricultural contaminants, is typically sent directly into canals or residential lakes. It would be relatively easy, during original construction, to provide shallow holding areas to retain as much runoff water as possible on-site where, after natural filtration, the water would enter the ground water system and later nearby lakes or canals. This would keep much of the silt and organic waste out of lakes and canals. Reducing the pollution of residential canals and lakes in the Region will require regulations for new developments that hold water on-site, which is, in fact, already being done by a number of developers in the Region. Restoring acceptable quality in residential lakes and canals may require reconstruction to retain as much storm water on the land as possible in order to reduce pollution loads. In this way public funds can be concentrated on meeting sanitary sewage treatment needs without costly diversions for treating storm waters.

In the past, developers of coastal property dredged canals for fill and to provide access to open water. These canals usually dead end and their sides are usually bulkheaded, making the development of desirable aquatic environments unlikely since bottoms are typically anerobic and water quality is poor. When flushed by rains, tides or storms, the canal water is carried to bay, river or sea, degrading water quality. In addition, such canals provide ready avenues for salt water intrusion. Future development of waterfront canals should be consistent with the following principles:

- Canals should not dead end or create areas where sediment or debris will accumulate.
- Canals should not provide routes for additional salt water intrusion.
- Canal depth should be consistent with the ability of sunlight to reach the bottom and the need for thorough circulation of oxygen.
- Bulkheads and banks should be sloped to encourage the growth of desirable aquatic vegetation and to reduce scour and destruction of bulkheads themselves.

POLICIES

27. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO ESTABLISH AND ENFORCE DESIGN STANDARDS FOR ALL NEW CANALS, LAKES, AND BORROW PITS IN EXISTING OR PLANNED RESIDENTIAL AREAS TO ENCOURAGE BENEFICIAL AQUATIC ENVIRONMENTS THAT WILL AID IN MAINTAINING A QUALITY RESIDENTIAL ENVIRONMENT.

28. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO ESTABLISH AND ENFORCE DESIGN STANDARDS FOR CANALS, MAN-MADE LAKES, AND BORROW PITS IN NONRESIDENTIAL AREAS TO ENCOURAGE THE DEVELOPMENT OF BENEFICIAL AQUATIC ENVIRONMENTS, WITH DUE CONSIDERATION FOR FLOOD CONTROL AND WATER CONSERVATION NEEDS.

29. ENCOURAGE FEASIBLE REDEVELOPMENT OF EXISTING RESIDENTIAL LAKES AND CANALS TO PROVIDE AN AQUATIC ENVIRONMENT SUITABLE FOR IMPROVING WATER QUALITY AND ENHANCING THE HUMAN ENVIRONMENT.

30. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO DEVELOP AND ADOPT DRAINAGE CRITERIA AND SUBDIVISION REGULATIONS THAT REQUIRE MAXIMUM FEASIBLE ON-SITE RETENTION OF STORM WATER TO AID IN IMPROVING SURFACE WATER QUALITY, TO INSURE THE PERCOLATION OF MORE RAIN INTO GROUND WATER SYSTEMS, AND TO REDUCE DEMANDS ON THE PRIMARY DRAINAGE CANALS.

31. ENCOURAGE CONTROLLED EXPERIMENTS WITH NEW TECHNIQUES TO REMOVE OR CONTROL NUISANCE AQUATIC WEEDS FROM CANALS AND OTHER WATER BODIES WITHOUT DEGRADING WATER QUALITY.

32. DISCOURAGE THE CONSTRUCTION OF CANALS THAT WOULD PROVIDE AVENUES FOR SALT WATER INTRUSION.

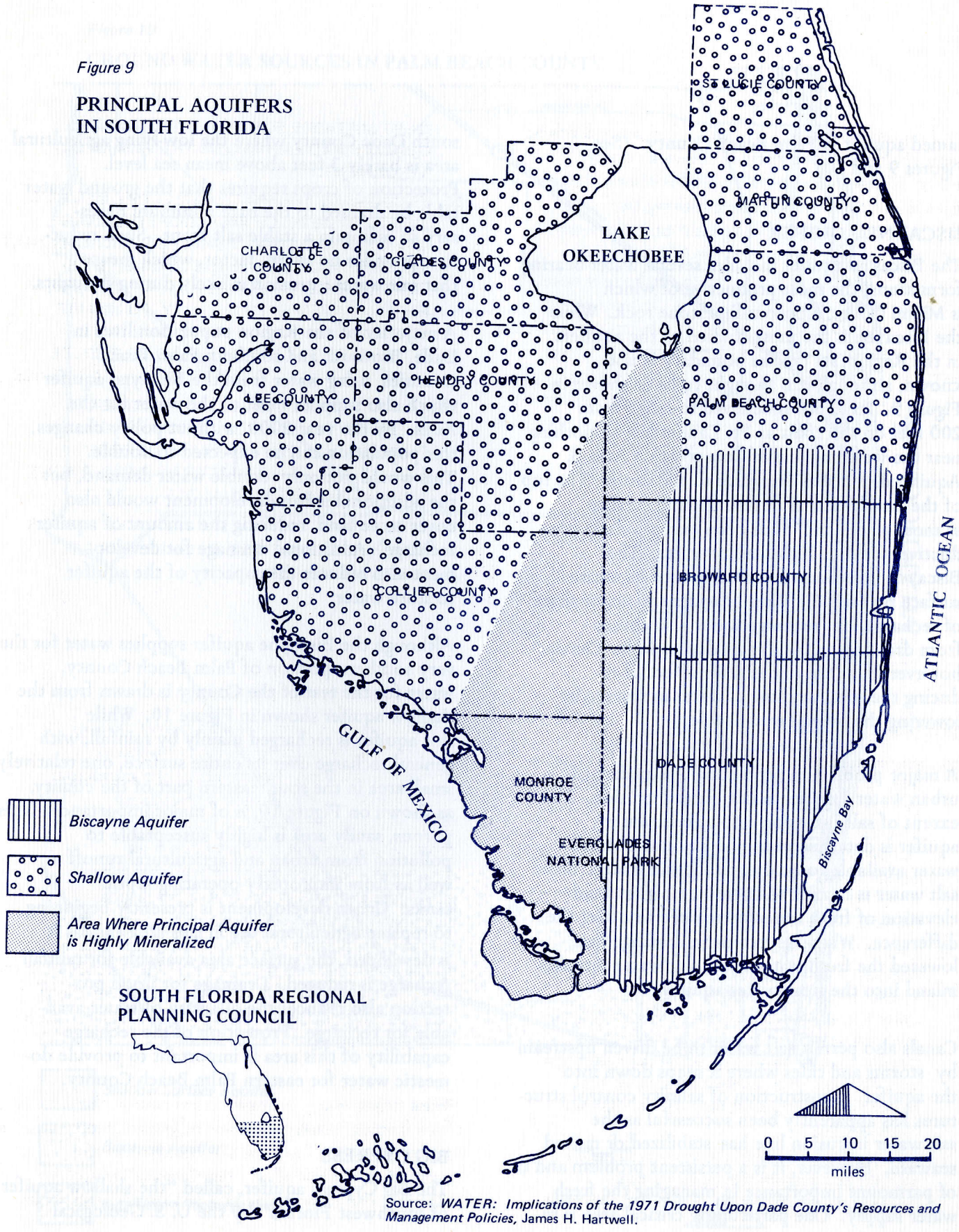
GROUND WATER AQUIFERS

Ground water is stored in and moves through porous, underground geologic formations known as aquifers. Nearly all of the municipal water supply in the Region comes from these underground water systems, forming the most direct, critical link between man and water. Ground water is available almost anywhere in the Region at shallow depth, frequently in substantial quantities, and often, but not always, of high quality. Like other elements in the environment, it is part of a large ecosystem that must be managed for long-term, sustained use if the cost and quality of living in the Region is to be reasonably good.

Most urban water is drawn from one of the four known, relatively shallow, ground water aquifers in the Region. They are the Biscayne in the southeast, the so-called "Big Cypress" in Collier County, the Hawthorne in Lee County, and an un-

Figure 9

PRINCIPAL AQUIFERS IN SOUTH FLORIDA



Source: *WATER: Implications of the 1971 Drought Upon Dade County's Resources and Management Policies,* James H. Hartwell.

named aquifer in Palm Beach County. (See Figures 9 and 10).

BISCAYNE AQUIFER

The Biscayne aquifer includes several water-bearing formations, the most productive of which is Miami Oolite, a porous limestone rock. While the Biscayne is the most studied of the aquifers in the Region, its precise boundary is not known, although it is thought to be as shown in Figure 9. Its depth is believed to range from 200 feet on the coast at Ft. Lauderdale to nothing near the western edge of Conservation Area 3. Aquifer depth also decreases to the south. The top of the Biscayne is at or near ground surface in most places and it has been exceptionally productive, yielding high quality water. The Biscayne is recharged vertically over its entire surface by rainfall. Rain provides the major share of recharge, but recharge water also comes from drainage canals during dry periods. Canals, however, have the undesirable effect of reducing the total amount of water in storage by lowering the overall water table.

A major problem in protecting the quality of urban water supplies is salt water intrusion. The extent of salt intrusion into a fresh water aquifer is determined by the amount of fresh water available to hold back the salt water. Since salt water is heavier than fresh, a higher head elevation of fresh water is required to offset the difference. Wherever extensive drainage has lowered the fresh water head, salt water intrudes inland into the fresh water aquifer.

Canals also permit salt water to be driven upstream by storms and tides where it seeps down into the aquifer. Construction of salinity control structures has apparently been successful as the salt water intrusion line has stabilized or moved seaward. However, it is a persistent problem and is of parmount importance in managing the fresh water supply. One particularly critical area is in south Dade County where the low-lying agricultural area is barely 3 feet above mean sea level. Protection of crops requires that the ground water table be drained to the bare minimum necessary to maintain a stable salt front. Such reduction provides no safety factor, which means that salt water intrusion is likely during droughts.

A majority of the Region population lives in Dade, Broward, and southern Palm Beach Counties, using water from the Biscayne aquifer which also supplies most of the water for the Keys. By the year 2000, without policy changes, this population can be expected to double. This would not only double water demand, but the additional urban development would also cover more land, reducing the amount of aquifer recharge. Additional drainage for development also reduces the capacity of the aquifer to store water.

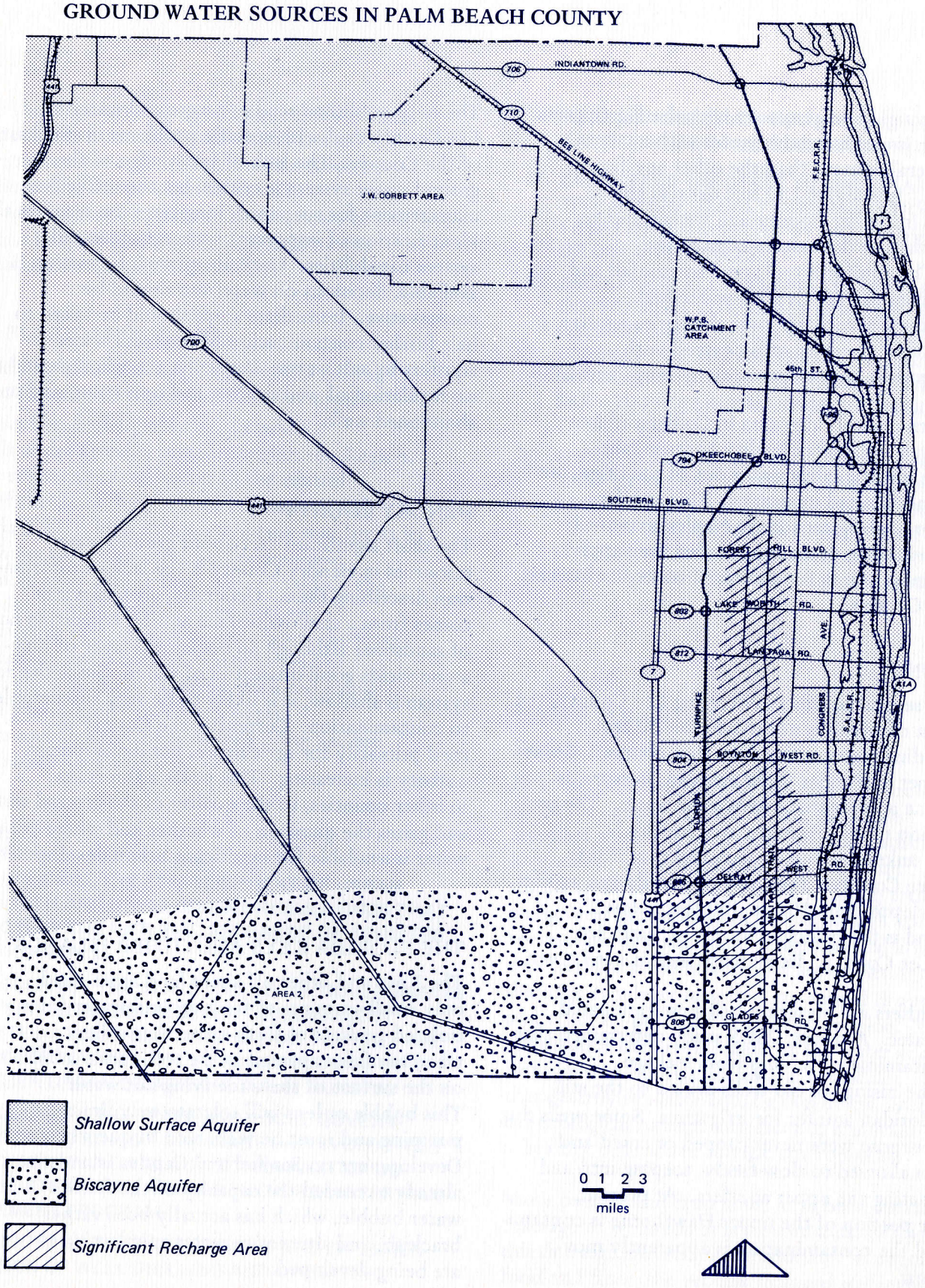
Although the Biscayne aquifer supplies water for the very southern portion of Palm Beach County, water for the rest of the County is drawn from the shallow aquifer shown in Figure 10. While this aquifer is recharged mainly by rainfall, with general recharge over its entire surface, one relatively small area in the southeastern part of the county, as shown on Figure 10, is of major importance. This porous, sandy area is highly susceptable to pollution from urban and agricultural runoff as well as from improperly operating septic tanks. Urban development is presently beginning to replace agricultural use in this area and, as it is developed, the surface area available for rainfall recharge is reduced. Drainage for flood protection also reduces the quantity of water available for recharge. Protection of the recharge capability of this area is important to provide domestic water for eastern Palm Beach County.

BIG CYPRESS

The Big Cypress aquifer, called "the shallow aquifer of southwest Florida" by the U. S. Geological

Figure 10

GROUND WATER SOURCES IN PALM BEACH COUNTY



Survey, is roughly coterminous with the Big Cypress watershed. It yields potable water with a higher mineral content than the other aquifers in the Region. It is about 130 feet deep at the Gulf Coast in Collier County and wedges out to ground surface at the eastern edge of the County. The aquifer is recharged by rainfall and by water from the Big Cypress watershed. Although there is recharge over the entire aquifer, areas with thicker sandy soils covered with pine and cypress have the greatest recharge capability.

The western coastal ridge area in Collier and Lee provides water of higher quality because rainfall flushes lower quality water out of the ridge, but it yields only limited quantities. This aquifer provided enough water for the Naples area until recently, when the demand exceeded the supply, necessitating a search for additonal water further east in the Big Cypress.

LEE COUNTY

There are several aquifers underlying Lee County, the uppermost of which is not more than 30 feet deep, yielding water with a high iron content. Somewhat deeper and under slight artesian pressure, is a sandstone aquifer that yields good water. The precise location of the recharge area for this aquifer is unknown, but experts feel that it is in eastern Lee County. The third or Hawthorne aquifer ranges in depth from 100 to 300 feet below ground and is the principle source of water for western Lee County. Its recharge area is not known.

These aquifers are presently being contaminated by salt water. A recent USGS study determined that some contamination comes from leakage around the casings of old wells drilled to the still deeper Floridan aquifer for irrigation. Some wells dug for this purpose were never capped or cased and have been allowed to flow freely, seeping into and contaminating the upper aquifers. At present, the lower portion of the upper Hawthorne is contaminated and the contamination is apparently moving upward.

The only published studies on ground water in Lee County deal with specific problems in small areas of the County. The lack of knowledge of the ground water system is critical because effective management for sustained, long-term use requires the identification of important recharge areas and system capabilities. Until adequate information is available, decisions on water use should be conservative. Immediate steps should be taken to halt further contamination of the fresh water aquifers by salt water. Particular attention should focus on regulation of well drilling and operation, and on abandoned wells.

HENDRY COUNTY

The most significant fact about ground water resources in Hendry County is the lack of information describing them. Generally, ground water comes from a shallow surface aquifer consisting largely of sandstone although an occasional layer of limestone yields good quantities of water. Since the aquifer system is shallow, it is likely to be very susceptable to contamination. Currently, the County is used primarily for agriculture, but development activity is increasing. This poses a threat, as in other counties, to the quality of the ground water and raises the question of whether and where enough water is available for significant urban development.

THE FLORIDA KEYS AND OTHER ISLANDS

The Keys and other off-shore land areas yield only small amounts of fresh ground water from isolated pockets of fresh water that collect when rainfall, captured in the soil, forms a bubble on the surface of the underlying salt water. This bubble or lens will tolerate only limited pumping and must be recharged frequently. Development on Sanibel and Captiva islands has already exceeded the capacity of the fresh water bubble, which has actually been rather brackish, and alternative water supplies are being developed.

Since the Keys have no significant supply of fresh ground water it must be pumped from the Biscayne aquifer and delivered to the Keys by pipeline. The use of water in the Keys has begun to reach or exceed the capacity of the pipeline in spite of the water supplied by the desalinization facility in Key West.

THE FLORIDAN AQUIFER

Underlying all of the Region at depths ranging from 700 to 1600 feet is the Floridan aquifer. This aquifer, recharged in the Orlando area, is under artesian pressure within the Region. While it provides fresh water in the central part of the State, by the time it gets to South Florida it has a high chloride content that limits its usefulness, although some golf courses use the water after adding fresh water to dilute the chloride. It has been suggested that air conditioning systems and power plants, if properly designed, could use this water instead of fresh water. Although limited, such use could relieve pressure on other fresh water sources and should be considered if the net use of resources would be less.

POLICIES

33. ENCOURAGE THE ESTABLISHMENT OF URBAN GROWTH AND DEVELOPMENT REGULATIONS THAT PROTECT THE NATURAL RECHARGE OF AQUIFERS BY RAINFALL.

34. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO ESTABLISH DEVELOPMENT MANAGEMENT CRITERIA AND REGULATIONS THAT PROTECT THE GROUND WATER SUPPLY FROM POLLUTION BY EITHER URBAN OR AGRICULTURAL RUNOFF.

35. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO PROHIBIT DRAINAGE OR DEVELOPMENT PROJECTS THAT ARE NOT EITHER PART OF OR CONSISTENT WITH A COMPREHENSIVE WATER MANAGEMENT PROGRAM.

36. ENCOURAGE THE DEVELOPMENT AND IMPLEMENTATION OF WELL DRILLING AND OPERATING REGULATIONS THAT PREVENT FURTHER CONTAMINATION OF FRESH WATER SUPPLIES.

37. ENCOURAGE THE STATE TO UNDERTAKE EFFECTIVE ACTION TO HALT CONTAMINATION OF FRESH WATER SUPPLIES BY DETERIORATING OR UNCAPPED WELLS.

38. ENCOURAGE ALL APPROPRIATE UNITS OF GOVERNMENT TO COMPILE MORE SPECIFIC, USABLE INFORMATION ON THE QUANTITY AND USABILITY OF THE GROUND WATER RESOURCES OF THE REGION AND THE MEASURES NECESSARY TO PROPERLY MANAGE THEM FOR SUSTAINED USE.

39. ENCOURAGE THE PROHIBITION OF DEVELOPMENT IN AREAS IDENTIFIED AS SPECIFIC RECHARGE AREAS CRITICAL TO THE PROTECTION OF GROUND WATER SUPPLIES UNLESS IT IS PROVEN THAT THE DEVELOPMENT WILL NOT ADVERSELY AFFECT AQUIFER RECHARGE.

WATER POLLUTION

Surface Runoff

Nutrients are necessary to maintain the food chain for aquatic organisms, but excessive amounts upset the ecological balance, causing accelerated eutrophication. Surface water runoff from both agricultural and urban areas is now recognized as a significant source of high concentrations of pollutants. In agricultural areas, excess fertilizers and insecticides are carried into drainage canals by runoff as are animal droppings and other by-products of livestock raising. The net result is over-enrichment of the water and the introduction of insecticides and herbicides that destroy sensitive aquatic organisms, breaking the ecological balance necessary to maintain a healthy productive aquatic environment.

Many pasture and crop lands have been created by drainage of wetlands or semi-wetlands. While this drainage allowed the production of necessary food and fiber, the process replaced wetlands,

which reduce pollutants, with agricultural uses that increase pollution. One way of reducing the adverse effects without giving up significant benefits would be to retain wetland buffer areas, wherever feasible, to purify runoff before it enters waterways. In fact, consideration should be given to creating or recreating buffer or treatment areas for filtration and nutrient uptake by natural processes.

There is wide-spread and necessary use of fertilizers and insecticides in the agricultural areas of the Region. Since excessive amounts will be washed off or leached out of the land by rains, it is important that the application of fertilizer and insecticides be properly controlled, both to minimize the runoff to water courses and to avoid unnecessary cost to farmers. The State and Federal governments should act to determine application rates that insure effective agricultural productivity while minimizing water pollution.

Surface runoff from urban areas is as much, if not more of a problem, than that from agricultural lands. In addition to fertilizers, insecticides, herbicides, and organic materials, such as animal wastes and vegetative debris, urban runoff also contains grease, oil and other street washings, plus litter and silt. In urban areas, runoff enters a water course either directly or through storm sewers. Where surface water is directed to the canals or lakes by drainage swails, it will be somewhat filtered by ground cover if any exists, but where storm sewers are used to remove runoff, there is no reduction in its strength and little settling of silt and sediment.

Studies in other parts of the country have shown that the quality of urban runoff is generally the same as sanitary sewage after secondary treatment, although the first flush of runoff is generally of poorer quality. Such studies should be done for South Florida to determine if the storm water quality problem is as severe here as in other areas. Historically, storm sewer effluent has not been treated because it was not thought of as a pollution source but, given the current knowledge of its poor quality, action to improve its quality may be necessary. In developing areas, regulations should require retention of as much surface water as possible on-site to allow both for filtration and settling of contaminants, nutrient uptake by vegetation, and percolation of more rainfall into the ground water system. In already developed areas, rapid or direct disposal of runoff to surface waters should be discouraged. To the extent possible, all water entering drainage canals, residential lakes or other surface waters should first be filtered by vegetation, by percolation into the soil or both through the use of drainage swails and retention areas.

Industrial Wastes

The primary industry of South Florida is tourism, which is a relatively clean industry; however, there are some industrial operations in the Region that contribute to the water quality problem. Some industries discharge liquid wastes to public sewage systems while others discharge to public waterways or use other means, some of which are acceptable and some are not. This discussion focuses on industries that do not discharge to public sewage systems. Industrial waste is generally very different from domestic sewage, being typically much stronger and frequently containing unusual elements that are not compatible with conventional sewage treatment processes. Trace metals, cleaning solvents and acids are examples of the elements in some industrial wastes that can impair or disrupt the biological treatment processes in a normal sewage treatment plant. Generally, industrial wastes should be collected after pretreatment, if necessary, for compatibility with central treatment plant operation and then discharged to central systems where the quality of final treatment can be closely controlled.

Domestic Waste

The volume of domestic waste is estimated at 150 gallons per person per day although only 60 percent is actually generated in residential areas while the balance comes from industries and infiltration. Infiltration is simply ground water seeping into sewers that are not water-tight, which is a particular problem in South Florida because of the generally high water table. Infiltration increases the volume of sewage to be treated thereby raising the cost and, in some areas of the Region, the infiltration contains salt water that also interfers with the biological treatment process.

Domestic wastes are a major pollutant of water in the Region. Decomposition of organic matter in the treated sewage depletes the supply of dissolved oxygen in the receiving waters and adds nutrients, stressing the fish populations and plant communities. Nutrients, such as phosphates and nitrates, stimulate undesirable plant growth and the toxins and viruses that are present in sewage may endanger human health.

Primary treatment of domestic sewage involves screening and settling of larger materials. Secondary treatment is generally accomplished by bacterial action that breaks down organic matter into inactive components. Tertiary or advanced waste treatment (AWT) uses various means to either remove more organic matter or take out nutrients. Disinfection to destroy harmful bacteria can accompany any level of treatment.

Most public or private agencies that collect sewage treat it to some level before disposal. However, a few jurisdictions such as Miami Beach and Key West, to mention two, discharge untreated sewage into the ocean. The emphasis on environmental quality has led to treatment requirements that will end this unacceptable practice although the State and Federal governments will need to assign high priority to funding such projects.

The Florida Department of Pollution Control recently ordered that all sewage be treated to a level that removes 90 percent of the biochemical oxygen demand (BOD). Most sewage treatment plants in the State did not meet this standard and were forced to either improve their operations or curtail additional hook ups. Such actions are essential to catch up with current water pollution and to insure that it does not grow faster than it can be dealt with effectively.

Ninety percent treatment should not be viewed as the ultimate end. Some conditions will require advanced waste treatment (AWT) to remove nutrients or BOD that secondary treatment cannot remove. At the same time, requiring AWT where it is not necessary would waste money that could be used to improve other parts of the system. The intensity of sewage treatment should depend upon where the effluent is to go and the quality that must be maintained in the receiving area to prevent its deterioration. A determination should be made of those conditions under which AWT is essential and this determination should be the basis for State rules on AWT.

There is little disagreement on the need to have systems that allow greater reuse of water. The question is what reuse will be made of the water and when. Reuse does not necessarily mean drinking water supply but perhaps pumping to interior wetlands for dry season needs or recharging the ground water supply. It could also mean underground storage to maintain salt water barriers or the use of treated effluent to irrigate crop or pasture lands. Different uses of treated waste will most likely require different treatment approaches and degrees of treatment. In the past, decisions like this have been based on identified financial costs. Costs, although still an important consideration, can no longer be the primary factor. Rather, management of waste water must focus on optimizing the use of resources, including energy and money.

There is insufficient data on most reuse alternatives. Several studies and demonstration programs are being conducted to determine the levels of treatment necessary to avoid adverse environmental impacts. At least two such studies focus on the environmental effects of discharging treated waste water to the Everglades. The current Flood Control District position is conservative in that the District will not issue permits for discharge of treated sewage into the Conservation Areas, regardless of the degree of treatment. Until adequate research determines the probable effects, discharge of other than completely purified effluent to other wetland systems also appears to involve undesirable risk. The necessary studies and research should be done as soon as possible.

Other reuse possibilities include storage of either storm water runoff or treated waste water in the salt water boulder zone by deep well injection. Because of the density difference, it is thought that the injected fresh water will form a bubble where it can be withdrawn later if necessary. One advantage of this method is thought to be that the level of treatment required is not as high as for disposal to wetland areas, although the long-term environmental consequences are unknown. In spite of this, the Environmental Protection Agency has ruled that sewage treatment plants in south Dade and Palm Beach counties must use deep well injection rather than ocean outfalls. Additional study should be conducted as rapidly as possible to determine the long-term viability of this practice.

Inland canals have long been used as convenient recepticles for sewage disposal and they also carry contaminated surface runoff from both rural and urban areas which limits their potential for other uses. Where the quality of the inland canals is such that the stress due to treated waste discharge is destructive these discharges should be removed or, if other alternatives are not possible, advanced waste treatment should be required.

Along the east coast, ocean outfalls are an alternative to disposal in either inland canals or deep wells. Water quality plans developed by Dade, Broward, and Palm Beach counties all incorporate some ocean outfalls as interim measures until more precise reuse criteria are developed. After conversion, these ocean outfalls should be retained to serve as emergency safety valves if problems occur, to allow discharge of effluent that would otherwise jeopardize fresh water supplies. To the extent possible, all sewerage works should be constructed to avoid hampering the eventual reuse of water.

Package or Interim Treatment Plants

Developers of residential areas remote from central sewage systems often install portable package plants or interim plants as do many shopping centers and office buildings. These plants use a treatment process similar to that in regular treatment plants. Many producers of package plants claim a high degree of treatment efficiency, with the effluent being discharged to the ground water system via seepage pits.

One advantage of package or interim plants is that they can return water to the ground water system. A disadvantage is that their successful operation requires technical skill which their small size does not justify and, even with warning systems, malfunctions occur and continue for some time if they are not watched closely. The high water table in South Florida and the use of shallow surface aquifers for public water limits the desirability of package plants and indicates that their location in relation to public water supply is critical. Package plants should only be considered as interim measures until central facilities are available. Permission to install package or interim plants should be contingent on compatability with a comprehensive plan for central sewage collection and treatment.

Septic Tanks

In South Florida, the septic tank is a widely used means of disposing of domestic waste. In many older urban areas the septic tanks that were installed before central sewers were built are still in use; and they are also being used in new residential areas where central sewers are not available. At the time of the 1970 Census it was reported that 334,000 septic tanks were in use in the Region.

Effective septic tanks are capable of removing 40 to 75 percent of suspended solids and from 25 to 65 percent of the BOD. After initial settling and decomposition, the effluent is piped to a drainfield where it filters through the soil and undergoes additional decomposition by micro-organisms. Under ideal conditions, where the system has been properly built, where the soil is biologically active, where there is good percolation, and where the drainfield is far enough above the water table, the septic tank can provide a reasonable level of treatment while returning water to the ground. The problem is that in most parts of the Region the wet season water table is higher than the three feet below ground necessary for effective functioning of septic tanks. Consequently, septic tanks have been installed in high water table areas where effluent mingles immediately with the ground water without being filtered or decomposed.

Septic tank effluent has been the subject of study by the U. S. Geological Survey. Preliminary findings indicated that most of the nitrates, phosphates and bacteria remain above the 30-foot depth. This finding should be viewed with caution since, in other parts of the country, wells have drawn these pollutants down, mixing them with and returning them in well water. Even though contaminants may not extend below 30 feet, they do pollute this zone and tend to travel horizontally for some distance without diminishing significantly in quantity. Therefore, where the water table meets the ground surface within the area of contamination, these contaminants can enter canals, lakes or other waters. An Environmental Protection Agency report entitled "An Environmental Impact Statement-Ocean Outfalls and Other Methods of Treated Wastewater Disposal in Southeast Florida" states that septic tanks should be only a temporary means of disposal. Homeowner negligence in maintenance and illegal alterations by the homeowner to the system, when it fails to function properly, are the main reasons for short-term use of this type of disposal. Illegal alterations by homeowners include direct connection to canals when the filter field clogs and the puncturing of septic tanks to prevent them from being forced or floated out of the ground by the high water table.

In general, the use of septic tanks in areas that are or will be developed to urban density should be prohibited as they would mean a needless double cost for sewage when the central system is installed. Also, septic tanks should not be allowed in areas where public water supplies are drawn from shallow aquifers or in areas where they would be likely to pollute lakes or canals. In addition, septic tanks should be closely inspected to insure that they are installed and operated according to the established regulations.

POLICIES

40. ENCOURAGE STATE AND FEDERAL GOVERNMENT STUDY TO DETERMINE THE FEASIBILITY OF REGULATING THE APPLICATION OF FERTILIZER AND INSECTICIDES IN BOTH URBAN AND RURAL AREAS, CONSISTENT WITH FOOD PRODUCTION NEEDS, IN ORDER TO REDUCE WATER POLLUTION FROM THESE SOURCES TO AS LOW A LEVEL AS IS FEASIBLE.

41. ENCOURAGE THE MAINTENANCE, RESTORATION, OR CREATION, IF NECESSARY, OF WETLAND

AREAS TO PROVIDE NATURAL CLEANSING OF SURFACE RUNOFF WATER AND TO AID IN AQUIFER RECHARGE.

42. ENCOURAGE LOCAL GOVERNMENTS TO ADOPT SUBDIVISION REGULATIONS THAT REQUIRE THE RETENTION OF MOST STORM WATER RUN-OFF ON-SITE TO TRAP THE MAJORITY OF POLLUTANTS, TO INSURE THE PERCOLATION OF MORE RAIN INTO THE GROUND WATER SYSTEM, AND TO REDUCE DEMANDS ON THE PRIMARY DRAINAGE CANALS.

43. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO ADEQUATELY STAFF AND FUND WATER POLLUTION ABATEMENT PROGRAMS AND TO REQUIRE PROMPT CONFORMANCE TO WATER QUALITY STANDARDS.

44. ENCOURAGE INDUSTRIES AND OTHER INDIVIDUAL SOURCES TO RECYCLE WATER WHENEVER FEASIBLE AND TO DISCHARGE WASTES TO PUBLIC SYSTEMS, AFTER ANY NECESSARY PRETREATMENT.

45. ENCOURAGE THE STATE TO MAINTAIN ITS BAN ON TAP-INS TO SEWAGE WORKS THAT DO NOT MEET ESTABLISHED PERFORMANCE STANDARDS.

46. ENCOURAGE THE STATE TO REQUIRE ADVANCED WASTE TREATMENT IN AREAS WHERE LESS-TREATED SEWAGE EFFLUENT WOULD REDUCE WATER QUALITY BELOW APPROPRIATE LEVELS.

47. ENCOURAGE ALL LEVELS OF GOVERNMENT TO REQUIRE THAT, WHENEVER POSSIBLE, SEWAGE TREATMENT FACILITIES BE DESIGNED TO ALLOW FOR FUTURE REUSE OF WASTE WATER AND LOCATED TO MINIMIZE ADVERSE EFFECT ON AQUIFERS.

48. ENCOURAGE ALL LEVELS OF GOVERNMENT TO USE OPTIMIZATION OF THE LONG-TERM USE OF NATURAL AND ECONOMIC RESOURCES AS PRIMARY CRITERIA IN MAKING DECISIONS REGARDING REUSE AND TREATMENT LEVEL OF WASTE WATER.

49. UNTIL RESEARCH ESTABLISHES THE LEVEL OF TREATMENT NECESSARY TO PROTECT WETLAND ECOLOGY AND FUNCTIONS, DISCOURAGE THE DISCHARGE OF OTHER THAN COMPLETELY COMPATIBLE WATER TO WETLANDS.

50. ENCOURAGE ALL LEVELS OF GOVERNMENT TO REQUIRE THAT NO INCOMPATIBLE WATERS BE DISCHARGED TO THE INLAND CANALS OF THE REGION AND THAT ALL EXISTING INCOMPATIBLE DISCHARGES BE REMOVED FROM CANALS AS SOON AS POSSIBLE.

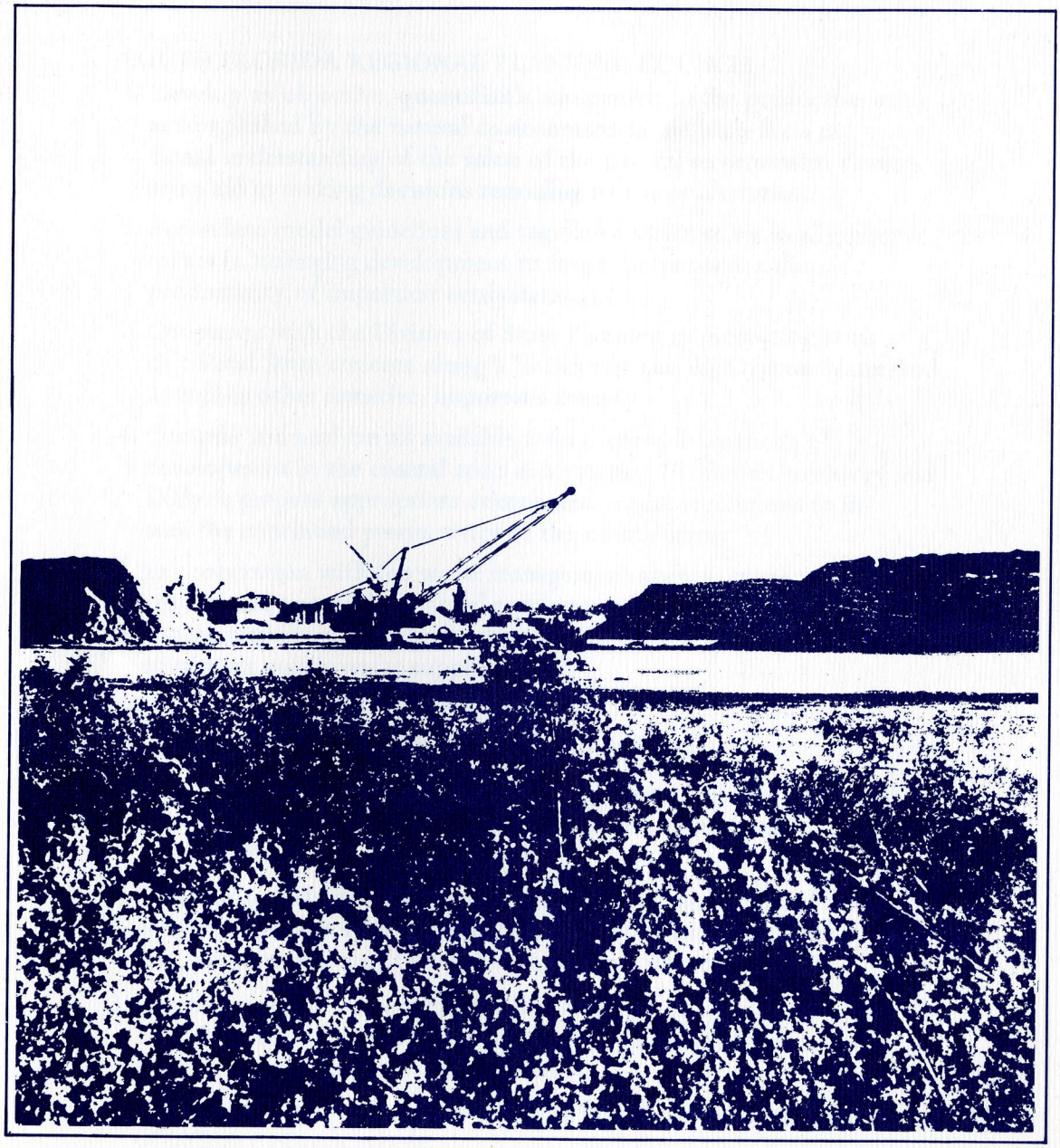
51. THE COUNCIL WILL REQUIRE LOCAL GOVERNMENTS TO MAINTAIN EXISTING OCEAN OUTFALLS AS EMERGENCY SAFETY VALVES ONCE REUSE OF SANITARY AND STORM SEWAGE IS ACCOMPLISHED.

52. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO EXPEDITE THE PROVISION OF CENTRAL SEWAGE WORKS TO ALLOW PACKAGE OR INTERIM SEWAGE TREATMENT PLANTS AND SEPTIC TANKS TO BE PHASED OUT OF USE, WITH PRIORITY ATTENTION TO AREAS OF AQUIFER RECHARGE AND TO AREAS WHERE THERE IS THREATENED OR ACTUAL POLLUTION OF SURFACE WATERS OR PUBLIC WATER SUPPLIES.

53. ENCOURAGE THE STATE AND LOCAL GOVERNMENTS TO PROHIBIT THE INSTALLATION OF SEPTIC TANKS IN AREAS IDENTIFIED AS SPECIFIC AQUIFER RECHARGE AREAS, WHERE THERE IS A THREAT OF POLLUTING SURFACE WATERS, OR WHERE THERE IS A THREAT OF POLLUTING PUBLIC WATER SUPPLIES.

54. ENCOURAGE STATE AND LOCAL GOVERNMENTS TO FULLY ENFORCE REGULATIONS REGARDING THE INSTALLATION OF SEPTIC TANKS AND ESTABLISH PENALTIES FOR THE UNAUTHORIZED ALTERATION OF SUCH SYSTEMS.

Programs



Programs

The following outlines some initial tasks necessary to implement the water management policies outlined in this chapter. The complexity of the water resource issue requires that many agencies be involved in the solution; therefore, this program includes recommended tasks that should be carried out, not only by the Council, but also by various other governmental agencies.

SOUTH FLORIDA REGIONAL PLANNING COUNCIL

1. Develop an objective, quantifiable assessment of the productive work accomplished by the natural environment as the basis for a rational understanding of the value of the natural environment to man as an aid in making decisions regarding its use or alteration.
2. Formulate model guidelines and regulations for use by local governments in managing development to insure perpetuating the productivity of important ecosystems.
3. Cooperate with the Division of State Planning in protecting areas of critical State concern along I-75 through the Big Cypress Watershed as well as other sensitive, important areas.
4. Compile and analyze all available information on methods of development in the coastal zone ecosystems. From this inventory and analysis prepare appropriate criteria and model regulations to insure the continued productivity of the coastal zone.
5. In cooperation with the water management agency, prepare design criteria and appropriate model regulations to aid local governments in managing development in aquifer recharge areas to protect public water supplies.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

1. Develop and implement the water management plan as a functional element of and within the framework of the comprehensive regional plan.
2. Conduct an extensive analysis of the impact of agricultural development and practices on water quality in South Florida and formulate recommendations to reduce any adverse impacts.
3. Conduct a study of the possible alterations in the spatial and temporal characteristics of rainfall from the changes in ground cover as a result of urbanization or other alterations.
4. Conduct research and experimentation into the removal and control of nuisance aquatic weeds.

5. Develop, as rapidly as possible, the water resources information needed for the west Coast to effectively evaluate and manage additional drainage.
6. Investigate possible use of saline water from the Floridan aquifer as a means of reducing demand on the fresh water aquifer, including an evaluation of the economic, energy, and environmental costs.
7. Outline various alternatives for disposal of storm water runoff from urban areas and determine the desirability and feasibility of each.
8. Undertake studies to determine specific design criteria for canals and other similar water bodies that will permit the development of self-sustaining natural environments.
9. Develop techniques for redesigning existing canals and residential lakes to foster self-sustaining natural environments.

COUNTIES AND MUNICIPALITIES

1. Adopt land use plans and development regulations that reflect regional policies for water management as well as the functional plan for water management.

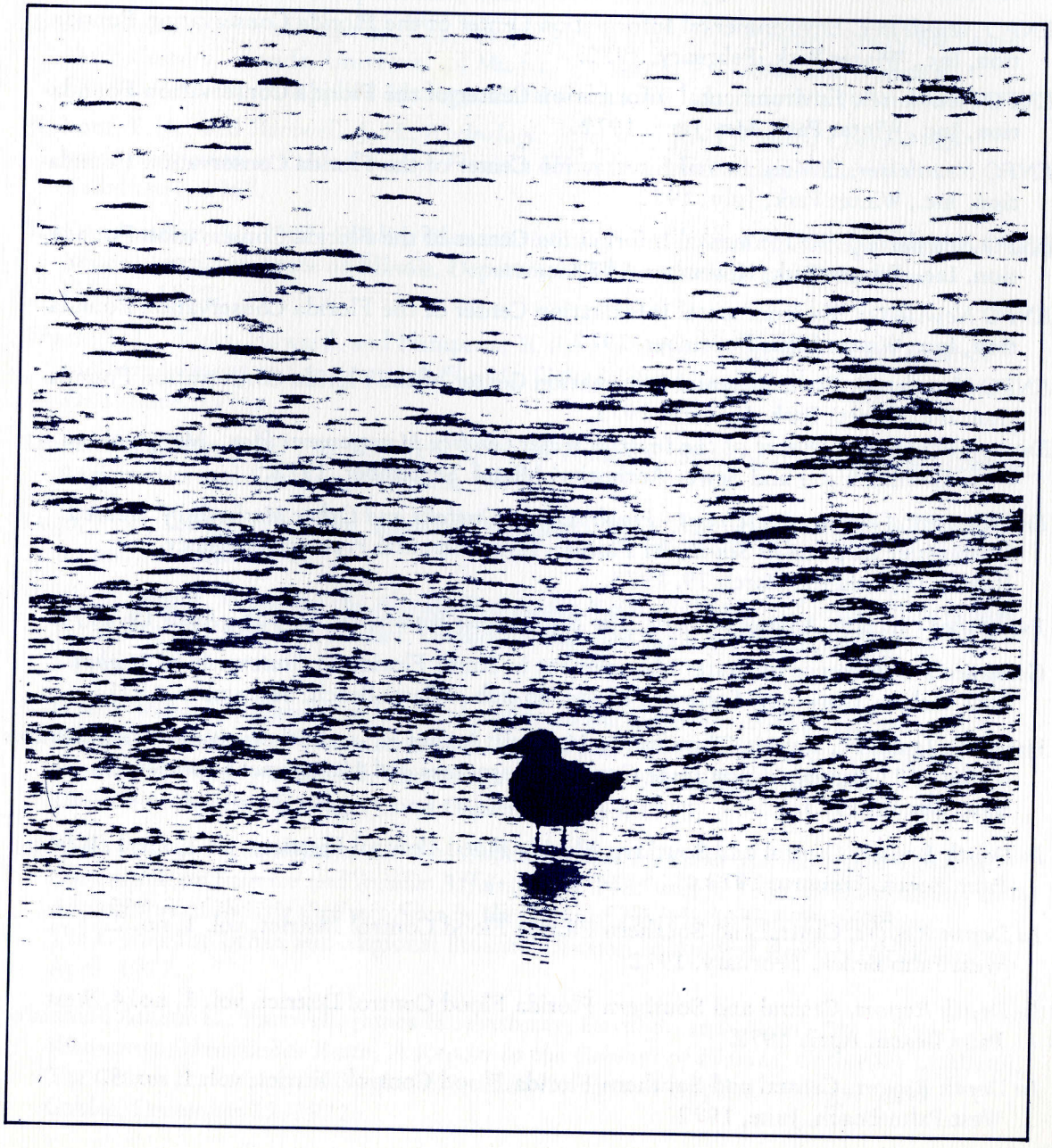
STATE OF FLORIDA

1. Adequately fund and staff effective water quality monitoring and pollution abatement programs in the Region.
2. Formulate advanced waste treatment requirements based upon the ecological stress limits and quality needs of specific receiving areas.
3. Act to define the relationships between comprehensive and functional plans and between comprehensive and functional planning agencies at the regional level.

FEDERAL GOVERNMENT

1. Conduct and support regional-scale research efforts in South Florida to provide the information needed for sound planning and management decisions.
2. Conduct the research necessary to define fertilizer and insecticide application rates that minimize water pollution while maintaining food and fiber production.

Bibliography



51 BIBLIOGRAPHY

Appraisal of Water Quality Needs and Criteria for Everglades National Park, United States Department of the Interior, National Park Service, Washington, D.C., June,1971.

Bishop, William B., Draft: *Interim Water Quality Management Plan for Palm Beach County,* Area Planning Board of Palm Beach County, February 9, 1973.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, June, 1971.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, August, 1971.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, February, 1972.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, May-June, 1972.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, July, 1972.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, November, 1972.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, December, 1972.

ENFO Newsletter, Environmental Information Center of the Florida Conservation Foundation, Inc., Winter Park, January, 1973.

Environmental Assessment of the Interim Water Quality Management Plan, Metropolitan Dade County Water and Sewer Authority, Miami, September, 1972.

Environmental Impact Statement - Final: Ocean Outfalls and Other Methods of Treated Wastewater Disposal in Southeast Florida, Environmental Protection Agency, Region IV, Atlanta, March 19, 1973.

Everglades - Jetport Advisory Board, *The Big Cypress Watershed,* no pub., April 19, 1971.

Governor's Conference on Water Management in South Florida, *A Statement to Reubin O'D. Askew, Governor, State of Florida,* no pub., Miami Beach, September, 1971.

Hartwell, James H., Keyser, Timothy C., Marshall, Arthur R., and others, *Water: Implications of the 1971 Drought Upon Dade County's Resources and Management Policies,* no pub., Miami, 1973.

In Depth Report, Central and Southern Florida Flood Control District, vol. 1, no. 1, West Palm Beach, January, 1972.

In Depth Report, Central and Southern Florida Flood Control District, vol. 1, no. 2, West Palm Beach, February, 1972.

In Depth Report, Central and Southern Florida Flood Control District, vol. 1, no. 4, West Palm Beach, April, 1972.

In Depth Report, Central and Southern Florida Flood Control District, vol. 1, no. 5, West Palm Beach, June, 1972.

In Depth Report, Central and Southern Florida Flood Control District, vol. 1, no. 7, West Palm Beach, July - August, 1972.

In Depth Report, Central and Southern Florida Flood Control District, vol. 1, no. 8, West Palm Beach, October-November, 1972.

In Depth Report, Central and Southern Florida Flood Control District, vol. 1, no. 9, West Palm Beach, December-January, 1973.

Interim Water Quality Management Plan for Metropolitan Dade County, Metropolitan Dade County Planning Department, Miami, June 25, 1972.

Izaak Walton League of America, The, *An Environmental Land Planning Study for South Dade County, Florida,* University of Miami, The Center for Urban and Regional Studies, Division of Applied Ecology, Coral Gables, Florida, July 15, 1971.

Kohout, F. A., and Hartwell, J. H., *Hydrologic Effects of Area B Flood Control Plan on Urbanization of Dade County, Florida,* United States Geological Survey, Tallahassee, 1967.

Kothandaraman, V., *Water Quality Characteristics of Storm Sewer Discharges and Combined Sewer Overflows,* State of Illinois, Department of Registration and Education, Urbana, 1972.

Leach, S. D., Klein, Howard, and Hampton, E. R., *Hydrologic Effects of Water Control and Management of Southeastern Florida,* United States Geological Survey, Tallahassee, 1971.

Lin, Shundar, *Nonpoint Rural Sources of Water Pollution,* State of Illinois, Department of Registration and Education, Urbana, 1972.

Lugo, Ariel, Sell, Maurice, and Snedaker, Samuel D., *Mangrove Ecosystem Analysis,* no pub., Gainesville, 1972.

Marshall, Arthur, *Repairing the Florida Everglades Basin,* University of Miami, The Center for Urban and Regional Studies, Division of Applied Ecology, Coral Gables, June 11, 1971.

Marshall, Arthur R., *Statement for Presentation to the Governor and Cabinet of Florida: A Review of Water Resource Projects and Problems in Central and South Florida,* University of Miami, The Center for Urban and Regional Studies, Division of Applied Ecology, Coral Gables, April 13, 1973.

Marshall, Arthur R., *Statement to: The Subcommittee on Parks and Recreation, Senate Committee on Interior and Insular Affairs, on S. 2465 and S. 3139, Bills Pertaining to the Acquisition of the Big Cypress Area in the State of Florida,* University of Miami, The Center for Urban and Regional Studies, Division of Applied Ecology, Coral Gables, April, 1972.

Marshall, Arthur R., Hartwell, James H., Anthony, David S., and others, *The Kissimmee-Okeechobee Basin, A Report to the Cabinet of Florida,* University of Miami, The Center for Urban and Regional Studies, Division of Applied Ecology, Coral Gables, December 12, 1972.

McCoy, H. J., *Ground-Water Resources of Collier County, Florida,* United States Geological Survey, Tallahassee, 1962.

McGiffert, David E., *Water Resources for Central and Southern Florida,* United States Government Printing Office, Washington, D. C., 1968.

Northrup, Martin R., *A Critique of the Draft Environmental Statement, Central and Southern Florida Project,* United States Army Corps of Engineers, Florida Audubon Society, Maitland, August 1, 1971.

Parker, Garald G., Ferguson, G. E., Love, S. K., and others, *Water Resources of Southeastern Florida,* United States Geological Survey, United States Governmental Printing Office, Washington, D. C., 1955.

Schroeder, Melvin C., and Klein, Howard, *Geology of the Western Everglades Area, Southeastern Florida,* Florida Geological Survey, Washington, D. C., 1954.

Schroeder, Melvin C., Klein, Howard, and Hoy, Nevin, *Biscayne Aquifer of Dade and Broward Counties, Florida,* United States Geological Survey, Tallahassee, 1958.

Sproul, C. R., *Saline-Water Intrusion from Deep Artesian Sources in the McGregor Isles Area Lee County, Florida,* United States Geological Survey and Florida Department of Natural Resources, Tallahassee, 1972.

Tabb, Durbin C., *A Summary of Existing Information on the Fresh-Water, Brackish-Water and Marine Ecology of the Florida Everglades Region in Relation to Fresh-Water Needs of Everglades National Park,* University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Miami, 1963.

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