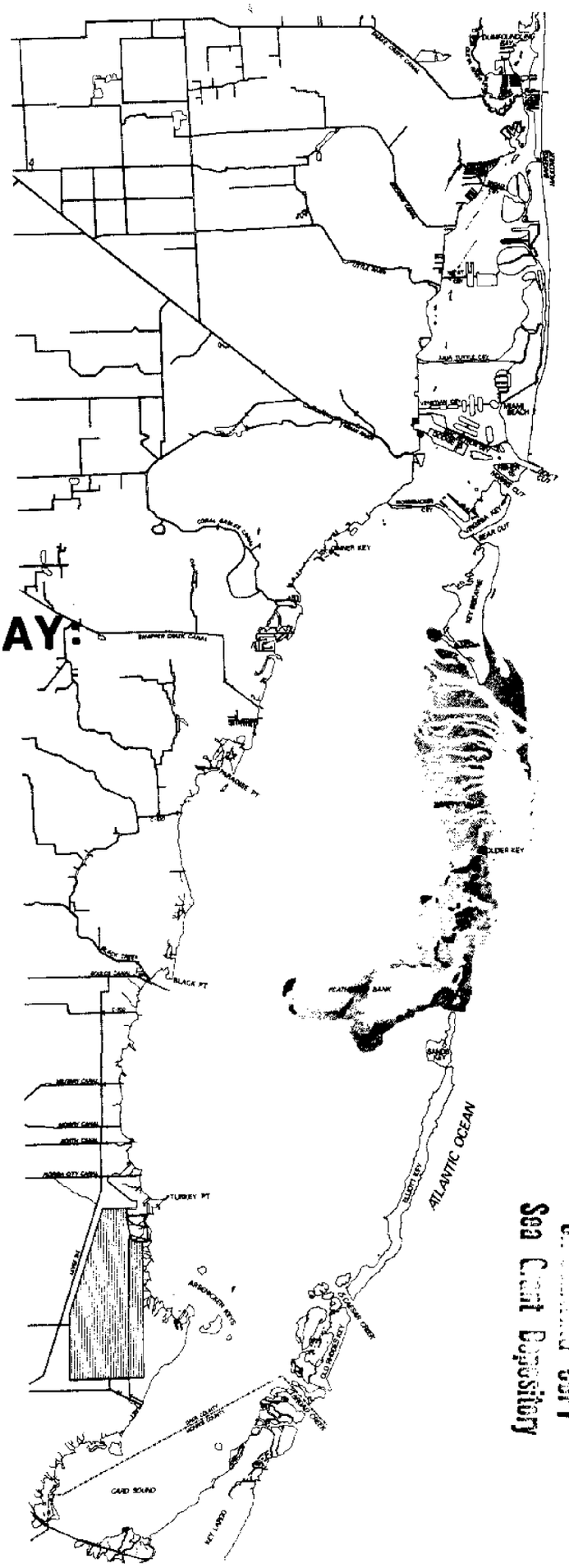
BISCAYNE BAY:

Environmental and Social Systems

Susan Uhl Wilson,



University of Miami Sea Grant

Special Report
Number 1

March 1975

Sea Grant Special Report #1

BISCAYNE BAY: Environmental and Social Systems

Susan Uhl Wilson, editor

University of Miami Sea Grant Program (NOAA Sea Grant No. 04-5-158-14)
Coral Gables, Florida 33124

Price: $3.00

Library of Congress Catalog Card Number: 75-7652

This work is a result of research sponsored by NOAA Office of Sea Grant, Department of Commerce, under Grant # 04-5-158-14. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

Information Services
University of Miami
Sea Grant Institutional Program
P.O. Box 249178
Coral Gables, Florida 33124

PREFACE

Biscayne Bay is unusual, actually nearly unique. It is a large, shallow lagoon, but a protected water body in the sense of boating safety. What makes it unusual is that, although close to a large center of population, it retains, in large part, a character of undisturbed tropical naturalness.

Are there problems with the bay? Is its future endangered? These and similar questions are simple to ask but difficult to answer. In this report, we don't try to provide answers, as those would depend upon the broad, collective conclusions of the public, its government, and science. Instead, we attempt to describe the bay, its uses, and how man has modified it and its shores (Figure 1).

This report had its beginnings some three years ago when the Greater Miami Chamber of Commerce became concerned with the bay as an asset which must be managed wisely. The work of a Chamber committee, under the chairmanship of Harris B. Stewart, Director of the NOAA Atlantic Oceanographic and Meteorological Laboratory at Virginia Key, stimulated the Metropolitan Dade County and State governments to place a higher priority on bay management. The University of Miami Sea Grant Program was asked to assemble and augment original material gathered by the committee.

This report is the first of a series focusing on Biscayne Bay. It is meant to be a point of information--a balance between the scientifically complex description and the inaccurate oversimplification. Those wishing to dig deeper into the subject are referred to Sea Grant Special Report No. 2 "A Bibliography of Biscayne Bay, Florida - Monitoring and Research Programs." That report lists many reports and publications on detailed scientific studies. The Sea Grant office also acts as an information center to guide questions to knowledgeable individuals.

At the time of this writing, a considerable effort in bay planning and management is being undertaken. At the state level the Florida legislature, recognizing Biscayne Bay as a resource area to be managed, has set-forth a number of specific requirements. At the local level, Metropolitan Dade County has, by ordinance, declared Biscayne Bay an "Aquatic Park and Conservation Area" and is proceeding with analyses of uses, priorities, and environmental studies needed to weigh the many alternative land and water uses and their impacts. In short, there has been a resurgence in interest in this bay resource, and the concerned reader should watch for news of local and state actions.

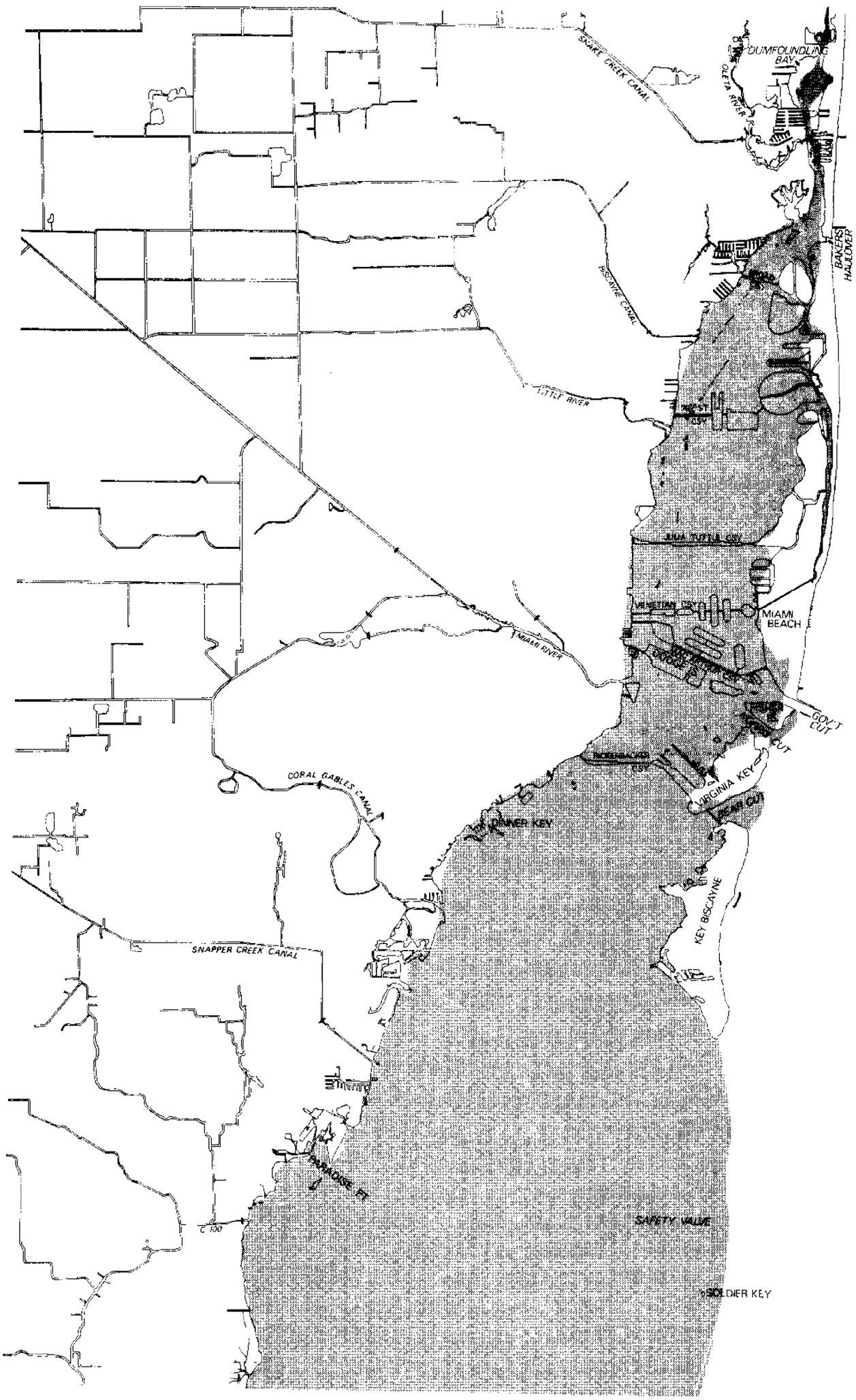
We hope this report helps to provide an informative background for these upcoming discussions and decisions.

T. W. Bilhorn

Thomas W. Bilhorn
Associate Director for Programs
University of Miami Sea Grant Program

CONTENTS

(Illustrations by Susan Suarez)


SNAKE CREEK CANAL
DUMFOUNDLING BAY
OLETA RIVER
BAKERS HAULOVER
BISCAYNE CANAL
LITTLE RIVER
NW 79 ST CSW
NW 54 ST CSW
MIAMI RIVER
MIAMI BEACH
GOVT CUT
CORAL GABLES CANAL
VIRGINIA KEY
DINNER KEY
KEY BISCAYNE
SNAPPER CREEK CANAL
PARADISE PT
C 100
SAFETY VALVE
SOLDIER KEY

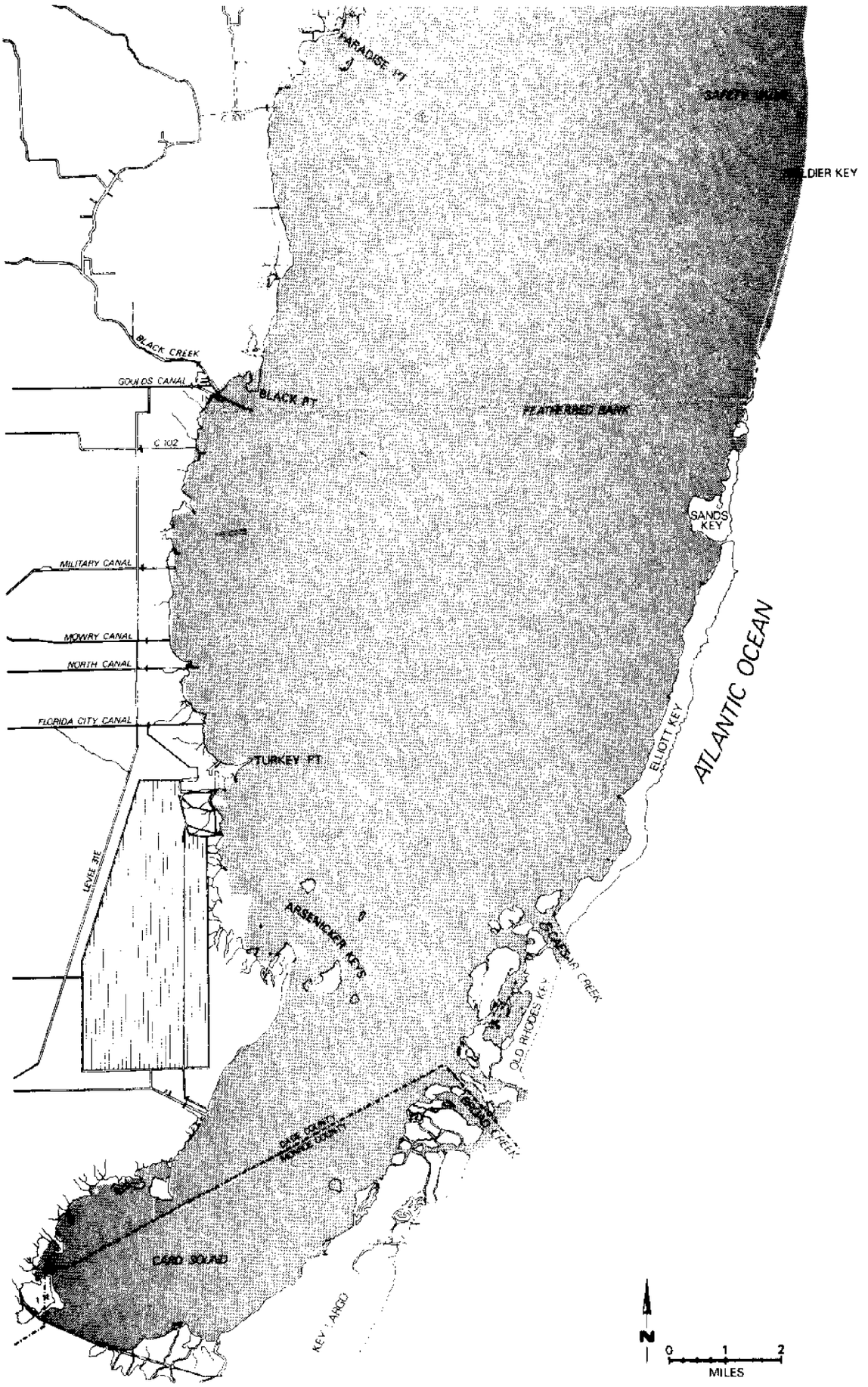


FIGURE 1: The shaded portion above delineates Biscayne Bay as it was mapped by Frederick and Brown Engineering Co.; Miami, Florida; August, 1911.

1. ENVIRONMENTAL SYSTEMS

1.1 Description

Biscayne Bay is a subtropical, coastal lagoon, the upper one-half of which lies adjacent to the City of Miami. The bay, including Dumfoundling Bay on the north and the Card Sound extension to the south, is approximately 45 miles long and 10 miles wide. Average depth is about six feet with maximum natural depths of 13 feet occurring in midbay. Shallows and flats of depths up to five feet are common throughout the bay.

Barriers, including Miami Beach on the north, Key Largo on the south, and the centrally located Safety Valve separate the bay from the Atlantic Ocean. Exchange with the ocean takes place through numerous tidal inlets and across the shallow Safety Valve, riven by narrow channels.

The bay proper is composed of three basins, separated from each other by shoals and causeways. The northern basin extends south to Rickenbacker Causeway; the central basin to Featherbed Bank; and the southern basin to the Arsenicker Keys. Card Sound lies between the Arsenickers and the Card Sound bridge. South of this, a series of basins connect to Florida Bay (Figure 2).

DUMFOUNDLING BAY

Dumfoundling Bay lies between the County Line and Sunny Isles Causeway. Here, land use is devoted to high-rise development and industry, comprised mostly of boat building and stockpiling of construction materials. Views of open water are limited and water qualities are depressed.

NORTHERN BASIN

With the exception of the Interama Tract, all of the shorelines of Dumfoundling Bay and the Northern Basin have been filled and vertically bulkheaded. Although the waters are of poor quality, pleasure boating is common.. Some use the spoil bank islands lying alongside the western shore for picnicking and wading.

In this basin, the bay ranges up to three miles wide. Water quality improves considerably in the region of Baker's Haulover Cut which affords the bay's only tidal exchange north of Government Cut. The open space and greenery of the Interama Tract stretches along the western bay shore to Arch Creek. On the eastern shore, opposite Interama, the northern portion is developed with high-rise apartments; Haulover Park extends southward one and one-half miles to Baker's Haulover Cut. With the exception of high-rises lining the southern edge of the cut, both sides of the bay between the cut and Broad Causeway are devoted to single-family homes.

Low-rise development and occasional high-rise structures are found on both sides of the bay stretching between Broad Causeway and Julia Tuttle Causeway. The 79th Street Causeway bisects the greenish-brown waters of this region. The causeway affords access to residential, commercial, and amusement uses in the islands through which it passes. In the area north of the Causeway, the bay is constricted somewhat by filled islands; to the south, the waters are open.

The filled sections of Julia Tuttle and MacArthur Causeways essentially impound the poor quality waters lying between them. Circulation is restricted further by the Venetian Causeway, which connects six islands fashioned into regular shapes by fill pumped from the bay bottom. The five western islands have been developed into well-landscaped, single-family homes. High-rise towers wall in Belle Isle and the bay shore of Miami Beach between Venetian and MacArthur Causeways. Four Sunset Islands hug the Miami Beach shore where development is essentially low-rise. West of the Sunset Islands, emergent pilings define "Pelican Island," a section of bay bottom purchased by Miami Beach, but never filled. Three other islands lie to the north of MacArthur Causeway accessed by bridges which permit water flow. In this section, along the western shore, low-rise development gradually gives way to high-rise towers.

The working part of the bay lies between MacArthur and Rickenbacker Causeways. The former crosses Watson Island, site of public parks and bases for the Goodyear Blimp, helicopters, and seaplanes. The thirty-six foot deep ship canal parallels MacArthur Causeway and exists to the ocean via Government Cut between Miami Beach and Fisher Island. It is the main channel for the larger merchant and cruise ships which berth at the Port of Miami on Dodge Island. To the east lie nearly undeveloped, tree-covered Lummus and Fisher Islands. The shallow Norris Cut divides Fisher Island and Virginia Key, which completes the southeastern boundary of the northern basin.

Virginia Key is nonresidential in character, housing Miami's major sewage treatment plant, the Marine Stadium, the Seaquarium, public parks, and marine research laboratories. On the western shore, Bayfront Park forms the base for high-rise towers which line Biscayne Boulevard. To the south

is Claughton Island at the mouth of the Miami River. The remaining western shoreline south to Rickenbacker Causeway is rapidly developing into a series of high-rise apartments along Bayshore Drive and Brickell Avenue. Bay water is brown and of poor quality at the mouth of the Miami River; to the south it improves sufficiently to invite swimming and water skiing along Rickenbacker Causeway.

CENTRAL BASIN

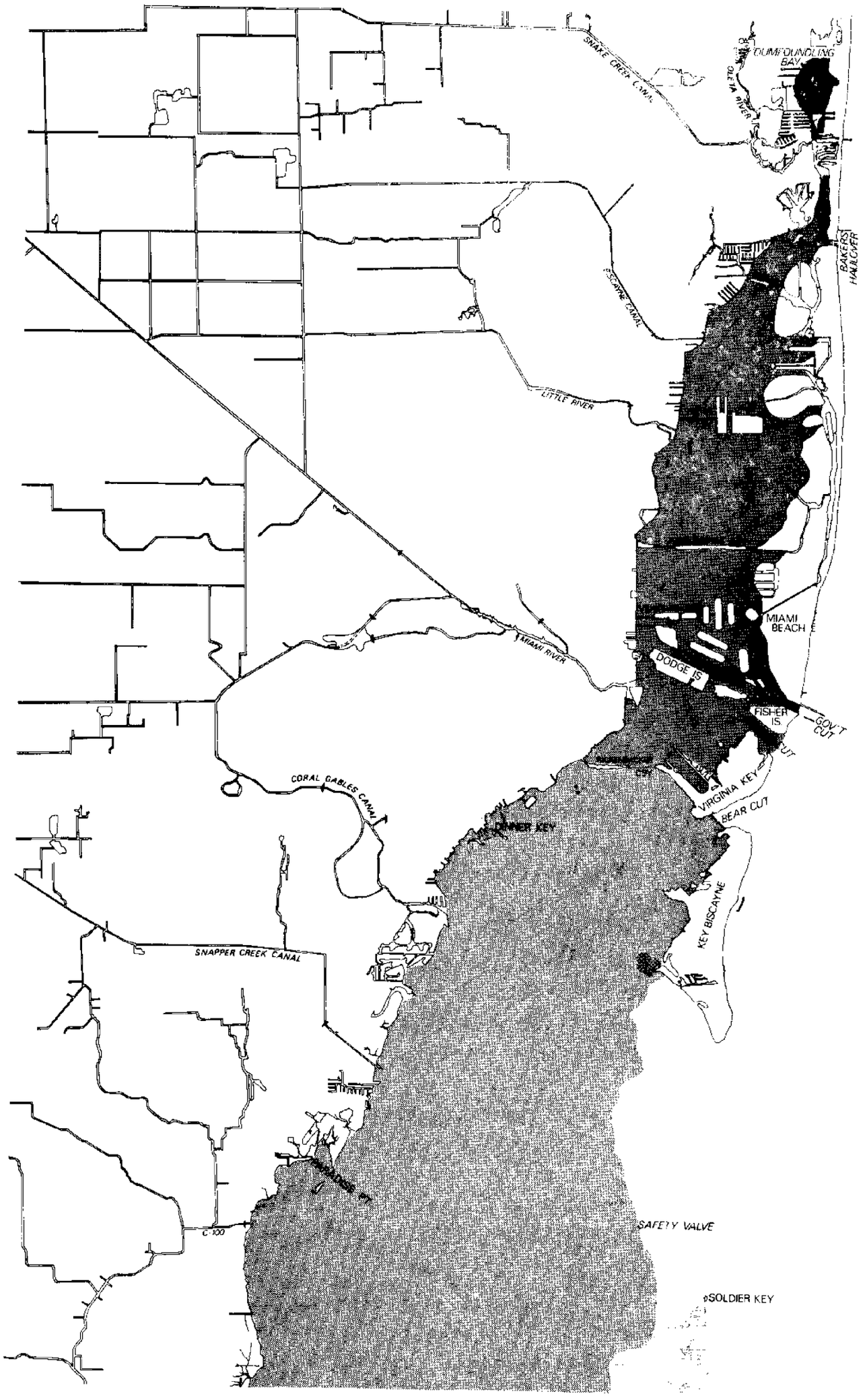
Waters of the central basin are of highest quality in the southern region where the shoreline is relatively undeveloped and along Safety Valve, where some tidal exchange occurs. Water color is generally blue-green except over sandflats, such as Safety Valve and Featherbed Banks, where the stirred-up bottom material imparts a beige coloration. The northern two-thirds of the central basin's western shore are low and green where single family dwellings occur; exceptions are Mercy Hospital and high-rises at Coconut Grove and the mouth of the Coral Gables Waterway. To the south, park lands and the undeveloped low western shoreline are overgrown with mangroves except where low density residential development occurs. In the latter instance, many natural amenities have been retained; however, much of this shoreline is bulkheaded. A major landmark near Chicken Key is the Cutler power plant stack. In the east, high-rise apartments and the Cape Florida Lighthouse rise above Key Biscayne. Green mangroves and landscaped yards of single-family residences line the bay shore of the key.

SOUTHERN BASIN AND CARD SOUND

This southernmost area remains essentially in its natural state with bluish-green water of exceptional clarity. To a great extent, colors depend upon bay bottom material; turtle grass appears dark green and sand is white or tan. Shoal areas are lighter in color because of the sandy bottom.

On the east, Elliott and Sand Keys appear as heavily vegetated, long, low islands. The waters here are calm and clear, a favorite of boaters and swimmers. Towards the south, Biscayne Bay fades into Card Sound, narrowing noticeably with the Arsenickers on the west and Adams and Old Rhodes key on the east. Throughout the southern basin and Card Sound, the mangrove forest along the western shore forms a low green profile, broken only by the Turkey Point electric power plant.

To the southeast, the Key Largo bay shore is broken by residential and commercial development. Nearby lies Pumpkin Key, a hardwood hammock, with elevations reaching an unusually high 11 feet.


SNAKE CREEK CANAL
OLETA RIVER
DUMFOUNDLING BAY
BAKERS HAULOVER
BISCAYNE CANAL
LITTLE RIVER
MIAMI BEACH
MIAMI RIVER
DODGE IS.
FISHER IS.
GOV'T CUT
VIRGINIA KEY
BEAR CUT
CORAL GABLES CANAL
SNAPPER CREEK CANAL
KEY BISCAYNE
C-100
SAFETY VALVE
SOLDIER KEY

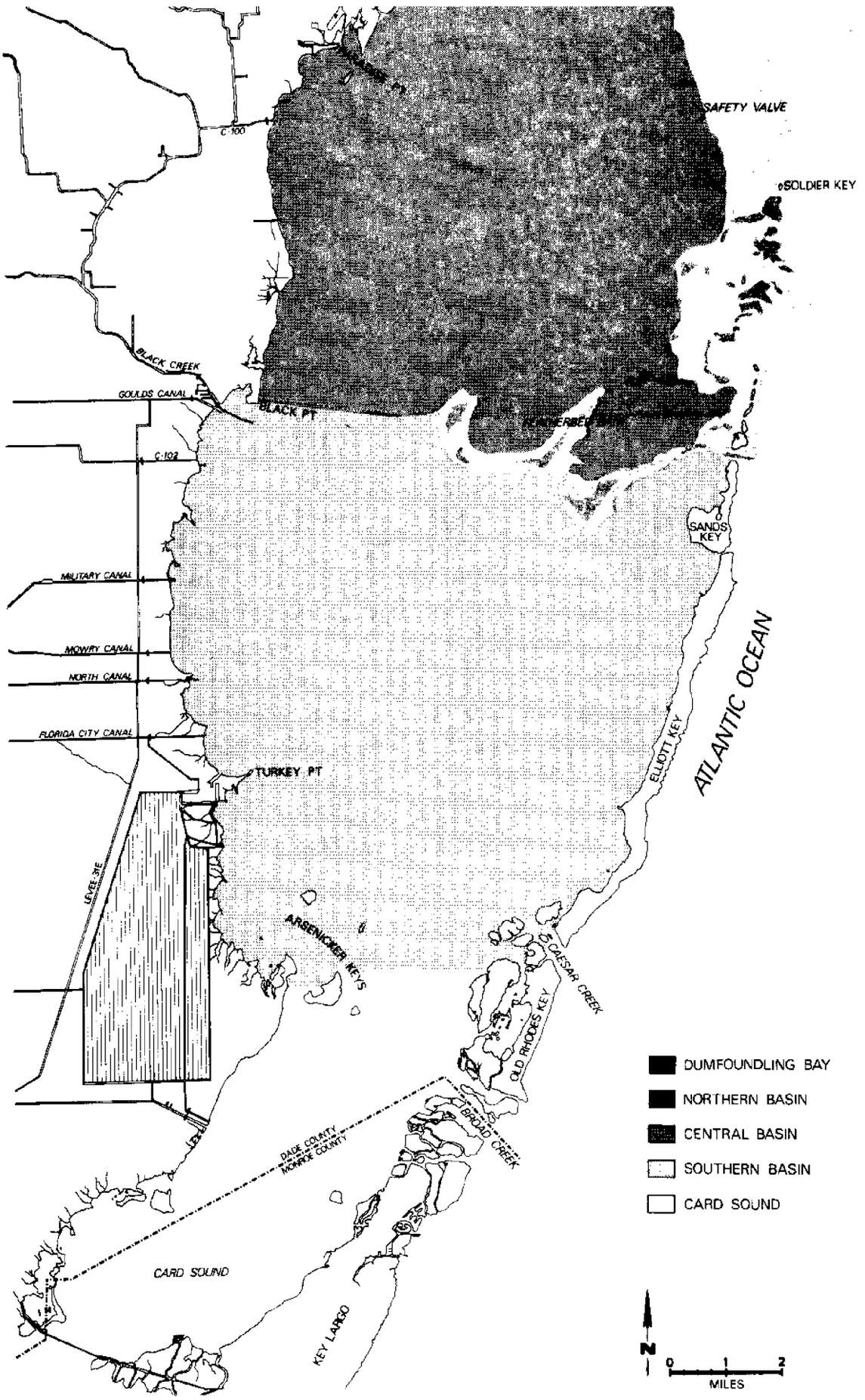


FIGURE 2: Biscayne Bay proper is composed of three basins separated from each other by shoals and causeways. Dumfoundling Bay lies to the north; Card Sound to the south.

1.2 Geology

The geology of Biscayne Bay has been described by H. R. Wanless (Figure 3). The bay lies between two fossil limestone ridges. Along the mainland shoreline, a limestone ridge of oolitic sand rises from the bay to elevations of 10 to 25 feet. This ridge, on which the line of cities from Miami to Homestead is perched, provides nearly complete separation of Biscayne Bay from the broad, low expanse of the Everglades to the west.

The eastern boundary of Biscayne Bay is a ridge of coral limestone. To the south, this fossil coral ridge forms an emerging string of islands--the northern Florida Keys. The longest, Elliott Key, isolates southern Biscayne Bay from the more seaward reef-dotted shelf bordering the Straits of Florida. To the north, the coral limestone ridge is submerged, but capped by the sand island barriers of Miami Beach, Fisher Island, Virginia Key, and Key Biscayne. These islands, separated by natural and artificial channel cuts, set off northern Biscayne Bay from the narrow offshore shelf. Safety Valve, grass-covered flats of lime-mud and sand, close the gap between the sandy island barriers to the north and the coral limestone keys to the south. The numerous tidal channels cutting across these flats provide the prime source of tidal exchange with offshore waters while still protecting central Biscayne Bay from ocean storm waves.

The fossil ridge-basin-ridge configuration, now filled by Biscayne Bay waters, formed 80,000 to 120,000 years ago when sea level was about 25 feet above the present elevation. Then, the coral ridge was a flourishing line of reefs. To the north, the reef was only poorly developed and strong tidal currents swept onto the submerged south Florida platform generating an inner belt of shallow marine oolitic sand ridges. Growth of these ridges produced a back reef lagoon--now Biscayne Bay. During this stage, the shoreline of peninsular Florida lay far to the north, beyond the area of Lake Okeechobee. The seas receded some 80,000 years ago as waters were taken up by expanding polar glaciers. Sea level dropped to about 300 feet below present level, leaving the southern Florida peninsula high and dry and providing what must have been a spectacular view at the outer edge of the Florida Straits.

Following this major glacial episode, the sea slowly began its rise to its present level. About 6,000 years ago, the sea began to flood into the deeper portions of central Biscayne Bay. Since then, the bay has slowly evolved to its present character. About 5,000 years ago, Biscayne Bay basin was a gently sloping limestone valley with mangrove and freshwater swamps filling the valley floor. As the sea rose, storm and tidal erosion pushed back these mangrove shorelines, creating an expanding shallow bay. At first, the bay probably was only a narrow sand channel on the limestone floor, but later, lime and muds began to accumulate in the deeper portions with the aid of bottom stabilizing sea grasses. Today, in those parts of Biscayne Bay having a rock floor greater than nine feet below mean sea level, a grass blanketed mud bottom has built up to within nine or 10 feet of the water surface. Shallower areas are still underlain with a rocky bottom, which is swept clean by storms.

A little over 4,000 years ago, when sea level was still ten to 12 feet lower than today, quartz and shell sand, drifting south along the Atlantic shore, reached the Miami area. This continual drift of sand slowly crept south, forming the barrier islands of Miami Beach, Virginia Key, and Key Biscayne. Fisher Island was once a narrow cape of Miami Beach snipped off during dredging of Government Cut and later filled to its present shape by Carl Fisher who envisioned it becoming Miami's port.

The body of sediment forming Key Biscayne extends to the southeast of the barrier islands as a shallow sand bank (longshore clastic sand) lying about one-half mile east of Safety Valve. Behind the protection of the sandy islands, sands and shelly muds quickly accumulated in northern Biscayne Bay forming broad flats and mangrove islands, leaving the northern bay much different from the more open areas to the south. At 3,000 years ago, with sea level only five feet below present level, central and southern Biscayne Bay were protected to the east by the emergent fossil coral rock ridge. Gradually, however, the sea crept over the ridge in central Biscayne Bay so that today, Soldier Key is the only emergent expression of this fossil rim.

Lime sands and muds, again with the aid of sea grasses, rapidly accumulated in the bayside lee of the submerged ridge to form an elongate belt of mud and sand known as the Safety Valve. Numerous tidal channels, cutting across these flats, are commonly bordered by luxurious intertidal meadows of finger corals and carbonate encrusted red algal "bushes." To the south, Elliott Key still provides a complete seaward barrier to Biscayne Bay. Between Safety Valve and Elliott Key, the partly submerged coral limestone ridge forms the Ragged Keys. Storm waters, passing through the natural bedrock channels between keys, have generated narrow sinuous sand and mud bars such as the Featherbed Banks, which extend over half way across Biscayne Bay.

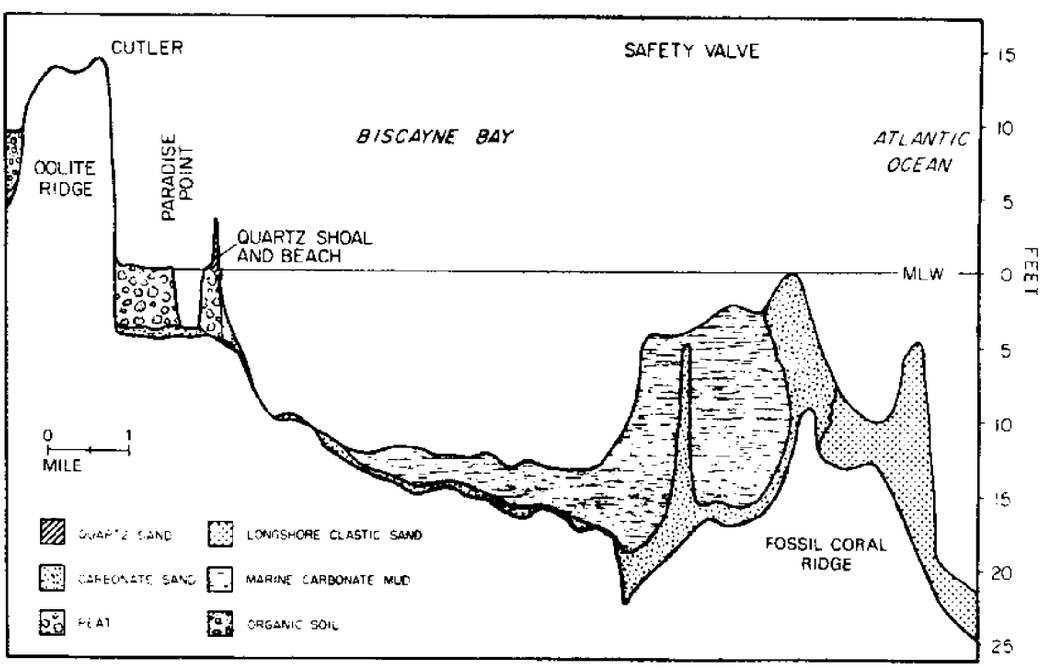


FIGURE 3: A cross-section extending across the bay from immediately north of Chicken Key on the west to Safety Valve on the east illustrates Biscayne Bay and confining fossil ridges. All data are relative to mean low water (MLW). (from Wanless, 1967).

1.3 Climate and Weather

CLIMATE

The climate of the Biscayne Bay area essentially is subtropical marine, characterized by a long warm rainy summer, followed by a mild, dry winter. The marine influence is expressed by the low daily range of temperature and the rapid warming of cold air masses passing to the east. Winds blow from the east or southeast about 50 per cent of the time.

During the summer months (May to October) gentle to moderate winds from the southeast to east prevail. The prevailing winds during the winter are from the northeast and east. Winter storm winds generally are from the north, northeast, and east; their velocity ranges from 20 to 30 miles per hour. Although these speeds are not high for inland activities, bay waters become rough and interaction of these winds with the fast-flowing Florida current produces dangerously steep waves.

Miami Beach has a mean annual air temperature of 76.3^{o}F with normal extremes varying from a low of 64^{o}F in January to a high of 89.4^{o}F in August. The highest and lowest recorded temperatures since 1941 are 35.1^{o}F and 98.1^{o}F. Although records do not include subfreezing temperatures, strong evidence indicates they may have occurred occasionally over Biscayne Bay and Miami Beach in earlier years. Temperatures average about 63^{o}F in winter and 88^{o}F in summer. Extremes observed during a five-year study of water temperatures at shallow stations in mid-south bay were 48^{o} and 95^{o}F.

The lowest barometric pressure observed in Miami was 27.61 inches during the September 1926 hurricane; highest observed barometric pressure was 30.51 inches (January, 1928 and 1938).

During the warmer months, rainfall over the bay is largely connected with the passage of easterly storm fronts and other disturbances in the tropical circulation. There is a strong diurnal effect with the greatest frequency of shower activity during the night and morning hours. Afternoon summer thundershowers, originating over land, often lose much of their precipitation before reaching the bay. Miami has an average annual rainfall of 55.8 inches, of which 73 per cent falls during the summer months. Tropical storms with winds of hurricane intensity (greater than 75 mph) affect Biscayne Bay about once every seven years.

HURRICANES AND TROPICAL STORMS

Hurricanes and tropical storms are the most important deviations from routine daily weather conditions. Thunderstorms and line squalls, moving into the bay from the mainland during summer months and occasionally ahead of cold fronts in winter, are of importance to boating and marine interests. In summer, frequent but generally nondestructive, waterspouts occur.

Nine major hurricanes have passed through or close to Dade County since 1926. They are mapped in Figure 5. Almost 80 per cent of Miami hurricanes occur during the months of September and October. Tropical storms (winds of 40 to 74 mph) which comprise about one-third of the cyclonic systems during the period are more likely in the remaining months of the hurricane season. of June through November. On the average, one hurricane passes through Dade County every five years. At any given location, however, winds of hurricane force are likely about one year in three or four.

September hurricanes tend to be large and intense, affecting widespread areas with high tides and winds. October hurricanes, on the other hand, are usually small and intense sometimes affecting only a portion of Dade County even when the center of the hurricane passes directly over the county.

The height of a hurricane-generated tide in Biscayne Bay depends upon several factors; speed and direction from which the hurricane approaches, distance of maximum sustained winds from the center, slope of the continental shelf, configuration of the bay, point of landfall, and the height of the normal tide prevailing at that time. Hurricanes moving inland perpendicular to the coast cause maximum high water.

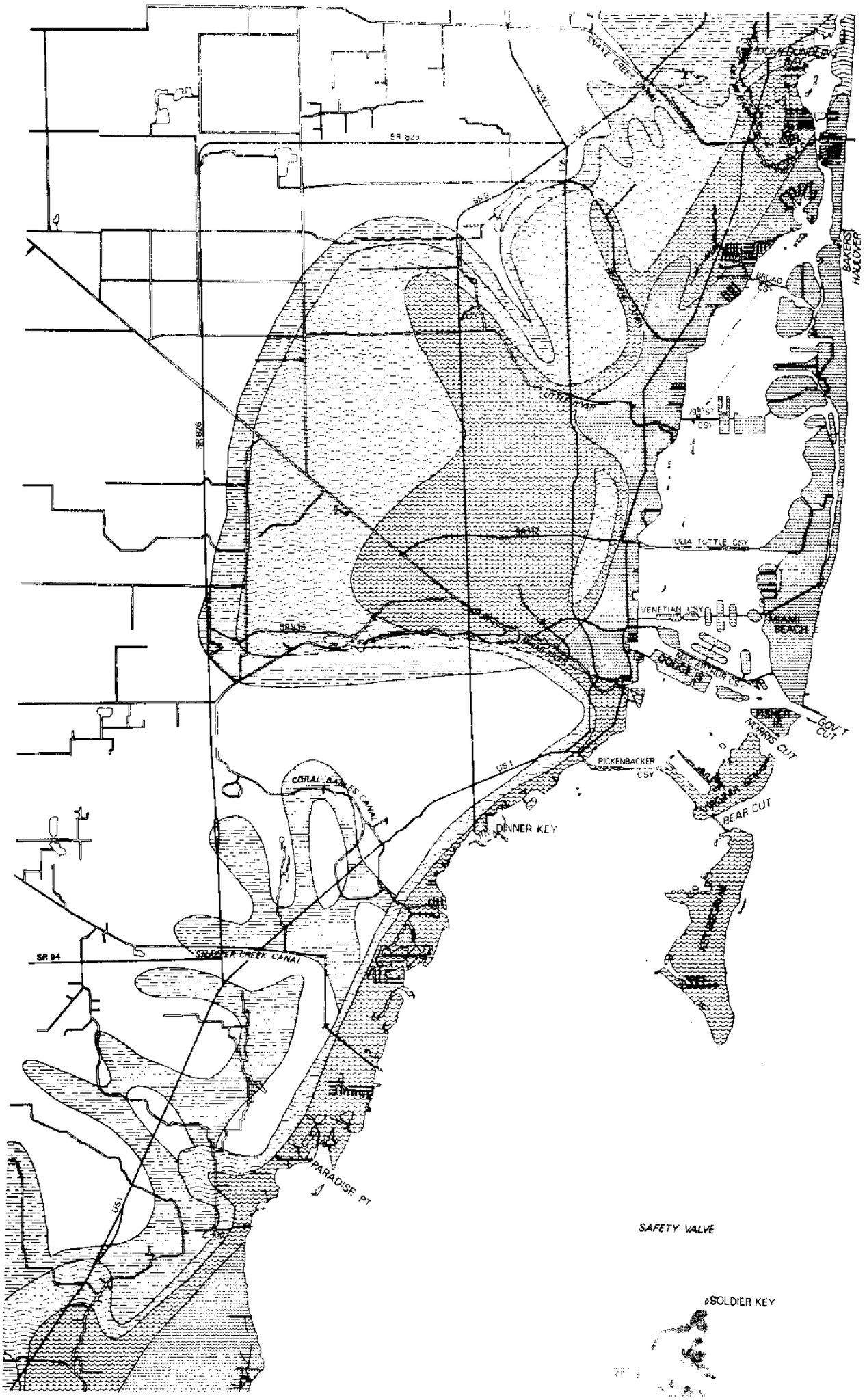
Maximum hurricane tides believed possible in Biscayne Bay with a hurricane of the intensity of Camille (which struck the Louisiana coast in 1969 with 200 mph winds) have been computed objectively by a technique called SPLASH.[1] Maximum high water would rise about 20 feet above mean sea level. Figure 4 illustrates the approximate areas which would be flooded by such a tide.

Another important effect which may occur during passage of a hurricane across Biscayne Bay is a seiche[2]. In some instances, a seiche could pose a greater threat of inundation to the bay side of the islands in the

---

[1] SPLASH is an acronym for Special Program to List Amplitudes of Surges from Hurricanes, a system devised by C. P. Jelesnianski of the NOAA National Weather Service.

[2] A wave that oscillates from a few minutes to a few hours as a result of seismic or atmospheric disturbances.


SNAKE CREEK
SR 823
SR 826
BISCAYNE BAY
BAKERS HAULOVER
BROAD CSY
JULIA TUTTLE CSY
VENETIAN CSY
MIAMI BEACH
FISHER IS.
GOVT CUT
NORRIS CUT
BEAR CUT
RICKENBACKER CSY
US1
CORAL GABLES CANAL
DINNER KEY
SR 94
SNAPPER CREEK CANAL
PARADISE PT
SAFETY VALVE
SOLDIER KEY

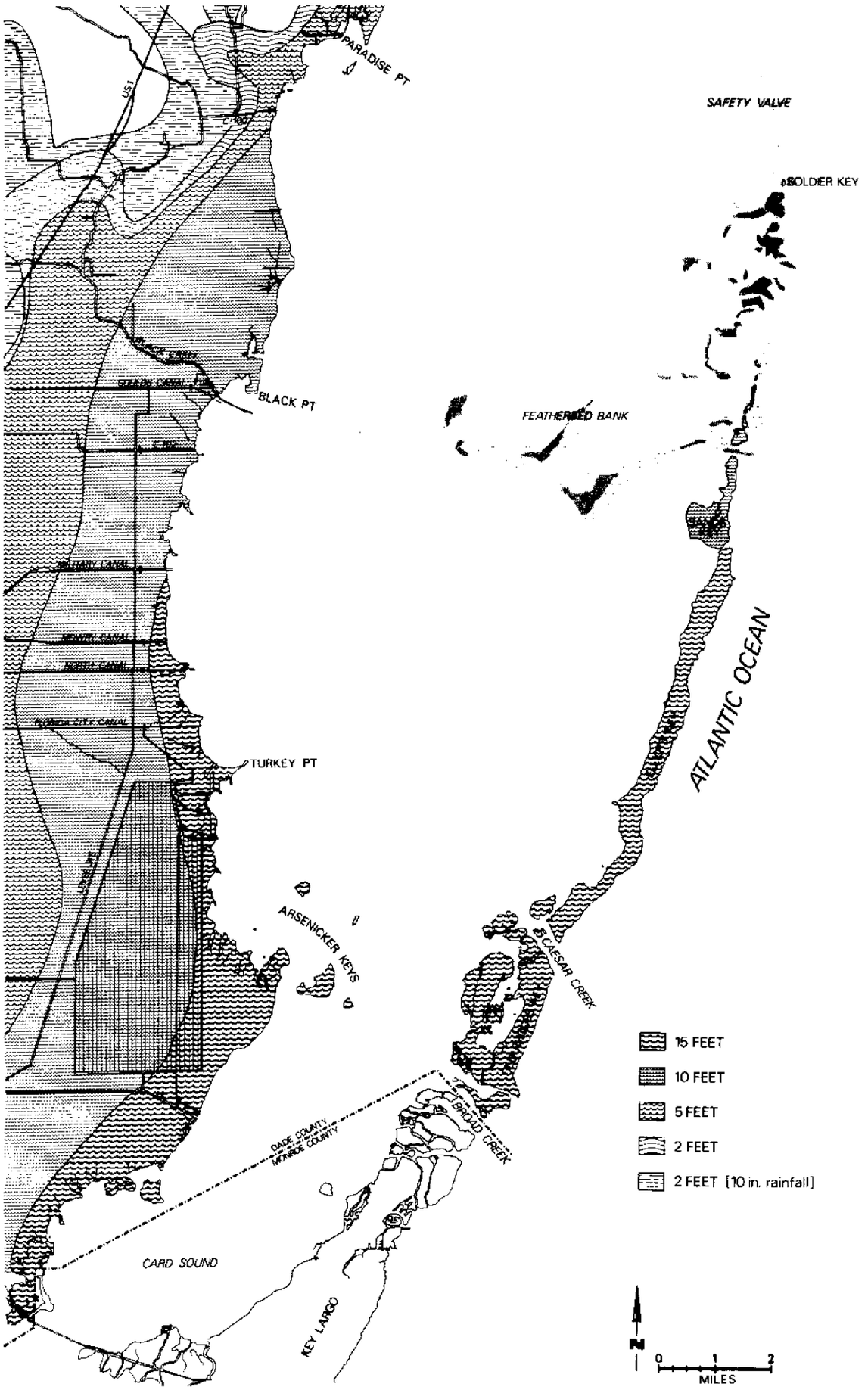
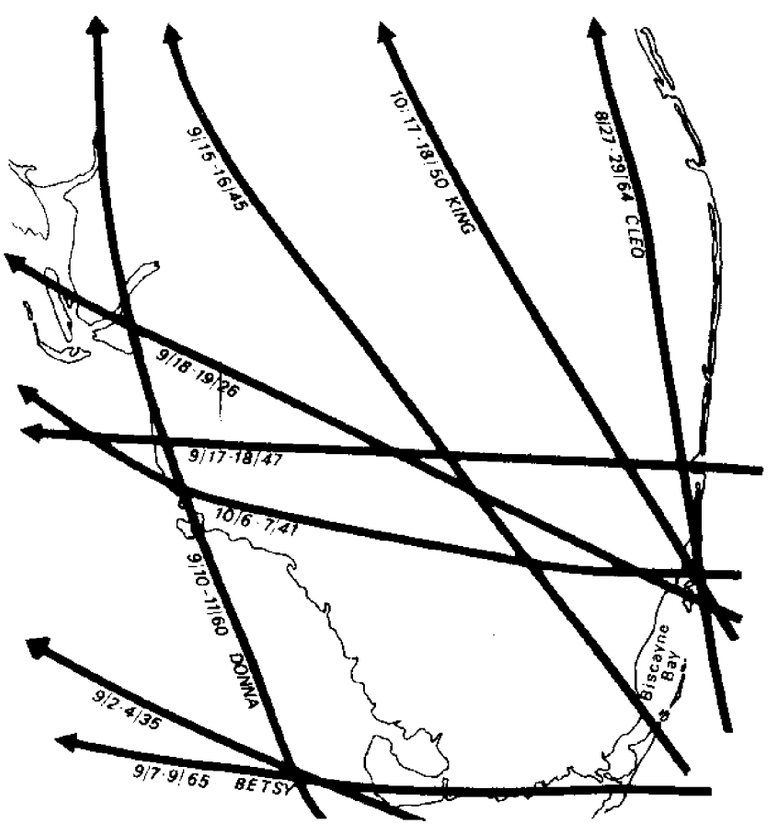


FIGURE 4: The NOAA National Weather Service has computed the degree of flooding expected to result from a tide generated by a hurricane with 200 mph winds. If 10 inches of rain accompanies the hurricane, additional flooding will occur.

same manner as a hurricane crossing the north end of the bay with strong offshore winds which would pile bay water up against the islands.

The strongest winds recorded in Miami were 138 mph in the 1926 hurricane and 122 mph with gusts up to 150 mph in the 1950 "King" hurricane. Although destructive, these storms are categorized as being of medium intensity. Meteorologists fear that Miami residents whose experience is limited to hurricanes occuring in the Miami area since 1950 may be unduly complacent. The greatest rainfall recorded in Miami in association with a hurricane or tropical storm was 15.5 inches occurring in association with a late season hurricane which moved inland near Tampa on November 30, 1925.

Tornadoes frequently occur in connection with hurricanes; the greatest outbreak in the Miami area accompanied Isabel in 1964. In general, they are more similar to waterspouts in strength.



Date	Maximum Sustained Winds	Barometric Pressure	Maximum Tides
9/18-19/1926	138 mph	27.61 in	13.2 ft
9/2-4/1935	200 (est.)	26.35	13.2
10/6-7/1941	123	28.48	8.0
9/15-16/1945	109	29.19	10.0
9/17-18/1947	155	27.97	9.8
10/17-18/1950 (King)	122	28.20	5.3
9/10-11/1960 (Donna)	140	27.46	13.0
8/27-29/1964 (Cleo)	110	28.71	5.5
9/7-9/1965 (Betsy)	125	28.12	9.0

FIGURE 5: Nine major or extreme hurricanes have passed through the Biscayne Bay area since 1926. Accompanying winds have ranged from 109 to an estimated 200 mph, whereas tides have ranged from 5.3 to 13.2 feet above normal (Johnson, 1970; Sugg and Carrodus, 1969).

1.4 Tides and Currents

Biscayne Bay interacts with coastal waters through tidal channels along the eastern edge of the bay. Fresh water is introduced from small mainland rivers and creeks, groundwater percolation along western Biscayne Bay, and rainfall. As Biscayne Bay is shallow throughout, vertical stratification[3] is rare and a one layer circulation system prevails. Generalized patterns of water movement are illustrated in Figure 6.

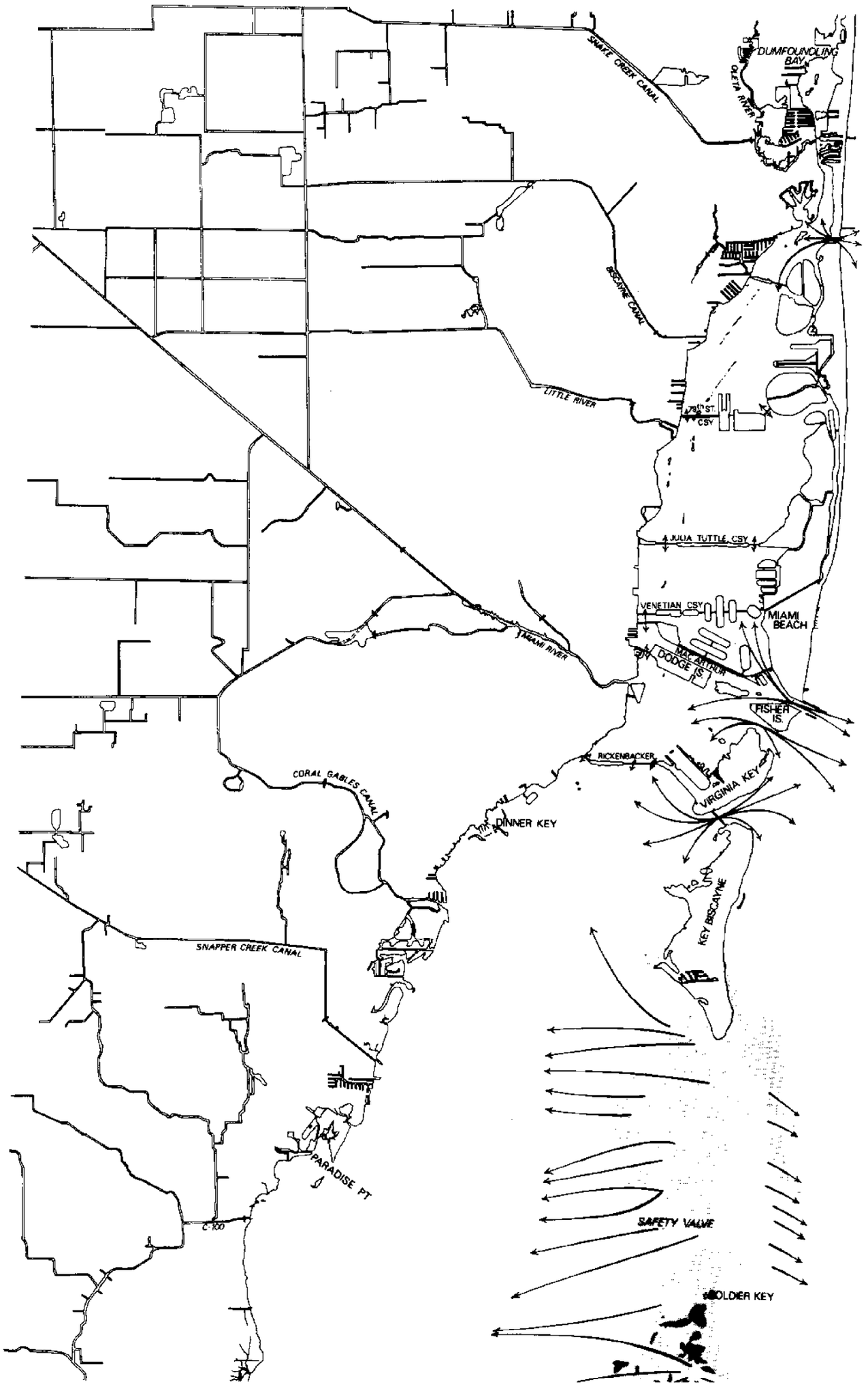
Major tributaries are the Oleta, Little, and Miami Rivers and the Biscayne, Snake Creek, Coral Gables, Snapper Creek, C-100, Black Creek, Goulds, C-102, Military, Mowry, North, and Florida City Canals. Of these, the Miami River is the largest. It has been estimated that an average flow of 626 cubic feet per second enters the bay at the mouth of the Miami River. Maximum discharge is generally in October, minimum is in June (Morrill and Olson, 1955).

The tides of Biscayne Bay are semidiurnal (periods of 12.4 hours) and, at the Miami Harbor entrance, have a mean tidal range of 2.5 feet. The mean spring[4] tidal range is 3.0 feet. Mean tidal ranges decrease to the south reaching a value of 0.74 feet in Card Sound (Schneider, 1969). Winds may strongly affect both the time and height of high water. Current velocities through the numerous tidal passes along the eastern edge of the bay average one half to three knots. Within Biscayne Bay, tidal currents are less than one knot and average less that a half knot.

---

[3]Stratification refers to the condition wherein discrete layers of water with differing temperature or salinity exist; the deeper, denser waters and the upper, lighter waters do not mix to any extent.

[4]Spring tides occur when the sun and moon are so positioned that their tidal producing forces are combined, thus causing especially high tides. Such tides occur during the new and the full moon.


SNAKE CREEK CANAL
DUMFOUNDLING BAY
OLETA RIVER
BISCAYNE CANAL
LITTLE RIVER
79th ST. CSY
JULIA TUTTLE CSY
VENETIAN CSY
MIAMI BEACH
MIAMI RIVER
MACARTHUR
DODGE IS.
FISHER IS.
RICKENBACKER
VIRGINIA KEY
CORAL GABLES CANAL
DINNER KEY
KEY BISCAYNE
SNAPPER CREEK CANAL
PARADISE PT
C-100
SAFETY VALVE
SOLDIER KEY

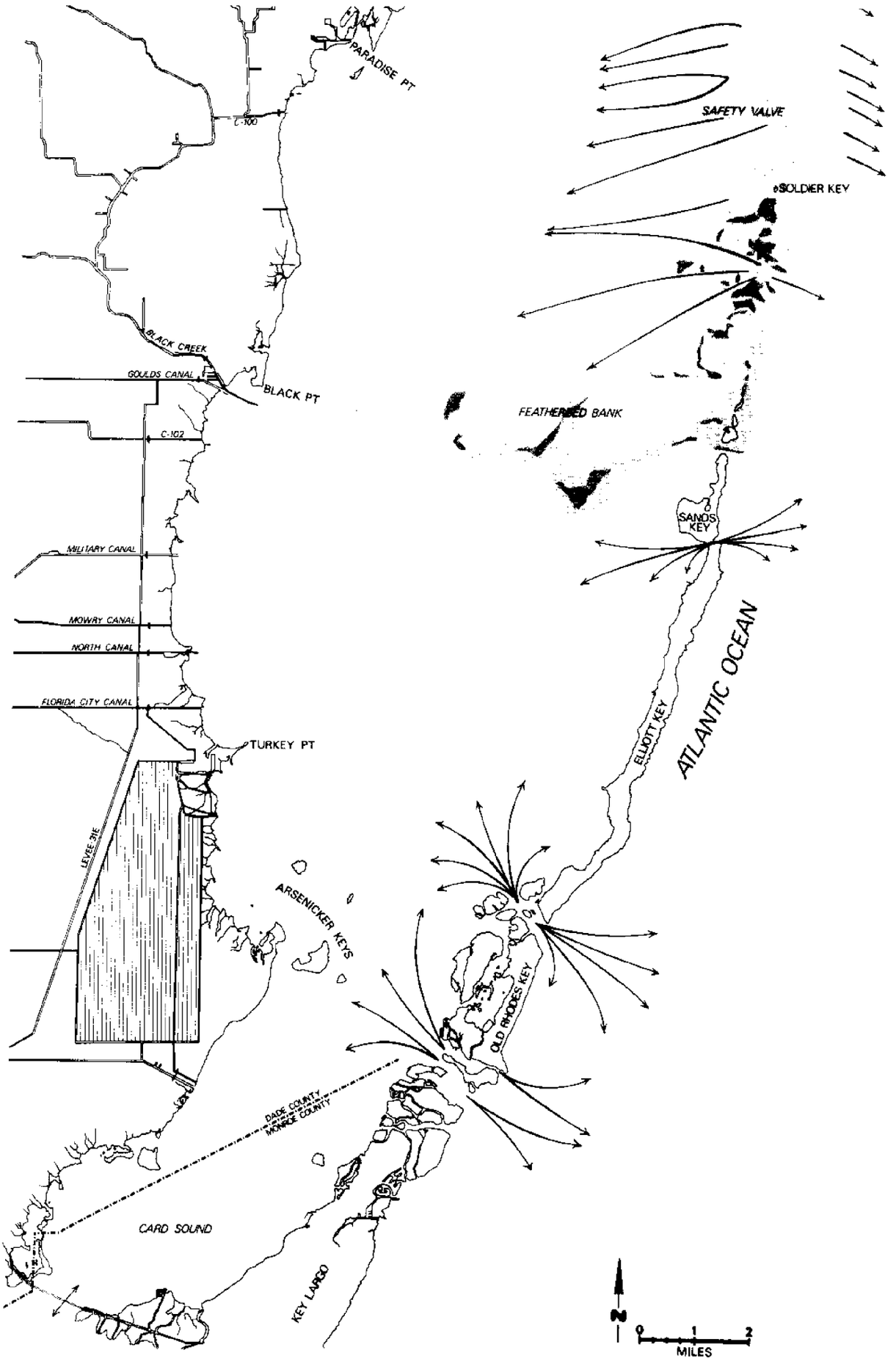


FIGURE 6: In Biscayne Bay, exchange with the ocean takes place through tidal inlets and across Safety Valve. Water movement within the bay is restricted by shoals and filled islands.

Shoals and filled islands greatly restrict water circulation within and between the basins of the bay; water exchange which does occur is over the shoals and through dredged navigational channels.

Exchange with the ocean takes place through Baker's Haulover and Government, Bear, and Norris Cuts in the northern sector. To the south, exchange occurs across a broad shoal honeycombed with narrow flow channels (Safety Valve) and numerous narrow inlets which separate the keys forming the eastern boundary of the southern basin and Card Sound. Because of constricted internal circulation, low tidal differentials, and shallowness of the bay, bay-ocean tidal exchange is confined to the vicinity of tidal inlets.

In the northern part of the bay, tidal flow enters through Baker's Haulover and flows southward to Broad Causeway. Government Cut and Norris Cut waters flow northward to the Venetian Causeway and southward toward Coconut Grove. Bear Cut and Safety Valve inlets flow southward in the general direction of Coconut Grove and Black Point (Hela et al., 1957). Inlets south of Featherbed Bank tend to exchange the eastern side of the bay, while the western portion receives mostly a north-south sloshing effect, except during strong wind events (Lee and Rooth, 1973).

Movements of currents are influenced by tides, winds, and the borders and shallows of the bay. Prevailing easterly winds will drive waters into constricted areas inhibiting flushing in some parts of the bay, but, in the southern part of the central basin, helping to set up a weak, but regular, circulation.

The residence time of water within an inlet exchange region is greatly influenced by the magnitude of the longshore coastal current seaward of the inlet. If, on the ebb tide, the estuarine discharge intersects a strong coastal current flowing parallel to the shoreline, then a large portion of the discharge will be removed from the vicinity of the inlet, thus reducing the residence time of this very local region to about one day. Often, the coastal currents off Biscayne Bay are weak. A large portion of an ebbing discharge thus returns to the bay on the flood tide. The residence time in the vicinity of a tidal inlet, in this case, will range from about several days to a week.

To date, the best estimate of residence time of interior waters of the central and southern basins and Card Sound is about three months (Lee, 1974). Water could be trapped in the northern basin for as long as three years. The residence time, or in the reverse sense the flushing rate, is a critical property of the bay. This slow rate of flushing points out a limiting characteristic for Biscayne Bay. Silt and debris, as well as dissolved pesticides, fertilizers, hydrocarbons, etc., remain in the bay and coastal waters for long periods, during which time, they concentrate and lower water quality.

1.5 Water Quality

It is the recommendation of Florida State agencies and the Dade County Department of Pollution Control that all Biscayne Bay waters meet Class III standards: waters fit for fish and wildlife propagation and water contact sports. (Appendix A lists the water quality criteria established by the Dade County Code for Biscayne Bay.)

Point source discharges into Biscayne Bay have decreased since 1956 when raw sewage was diverted from the bay to the Virginia Key sewage treatment plant; however, detrimental effects of earlier loadings still exist (McNulty, 1970).and the non-point runoff from the urbanized surroundings create a continuing problem.

In general, water quality increases as one proceeds from north to south in the bay. Turbidity levels are high near the City of Maimi and generally decrease southward, with the exception of the Featherbed Bank shallows where wind and some boat action can stir the bottom. Waters of the central and southern basins are generally well oxygenated. Normally, there is a salinity gradient with low salinities near the western shore and higher salinities as one proceeds eastward. During draught periods, this gradient is sometimes reversed and hypersaline conditions occur along the western shore.

Nutrients, particularly nitrogen and phosphorus, stimulate plant growth causing algal blooms and concomitant lowering of dissolved oxygen levels and buildup of organic bottom ooze. The waters of Biscayne Bay are well enriched with phosphorus, but contain relatively little nitrogen. Additions of nitrogen could increase the rate of vegetative growth since the other essential nutrient, phosphorus, is present (USDI, 1973).

Certain materials, such as heavy metals and pesticides, are highly insoluble; their presence can best be determined by sampling bottom sediments to which they adhere. Concentration of lead in bottom sediments is generally low ranging from 15 to 30 parts per billion (ppb). Higher concentrations occur at the mouth of the Miami River and Black Creek Canal. Mercury in bay bottom sediments ranged from 10 to 325 ppb (average 40 ppb). For comparison, the average level of mercury in bottom sediments of remote Florida Bay is 10 ppb; in south San Francisco Bay, it is 370 ppb. Concentrations of DDE, a breakdown product of DDT reach a high

of 3.4 ppb in sediments underlying inshore waters and 120 ppb in the Miami River. At the same Miami River site, near the Hialeah wellfield, pcb's (polychlorinated biphenyls) were found in concentrations of 3200 ppb. (Meyer and Wimberly, 1972). Heavy metals and pcb's can cause severe illness. DDT and DDE have not been demonstrated to be harmful to humans; however, they have been implicated in decreasing the reproductive capacity of birds (Cade et al., 1971).

Recent data (Office of the County Manager, 1972) indicates that of 17 canals tributary to Biscayne Bay, seven (Snake Creek, Biscayne, Comfort, Coral Gables, Snapper Creek, Black Creek, and Bel Aire) evidence a downward trend in average coliform bacteria counts. Tamiami and Florida City Canals show upward trends. The remaining canals (Little River, Red Road, Wagner Creek, C-100, Goulds City, Military, North, and Miami River) fluctuate, but indicate general improvement between 1969 and 1971; however only three canals (Bel Aire, Goulds City, and C-100) have total coliform[5] counts low enough (MPN less than 1000) to be considered safe for swimming

WASTEWATER INPUTS

Point sources of pollutants entering the bay and its tributaries include effluents from industries and sewage treatment plants. Industrial effluents contain such toxic materials as hydrocarbons, heavy metals, and cyanides. According to the degree of treatment, sewage effluents contain coliform bacteria, viruses, oxygen demanding materials (measured in terms of BOD[6]), and fertilizing agents (nitrogen and phosphorus).

Non-point sources include groundwater seepage and storm-water runoff. About 32 per cent of the population of Dade County is served by septic tanks which infiltrate groundwater. About 13 per cent of Dade's sewage effluents are discharged into tributary canals or into seepage pits, which in turn infiltrate groundwater. In addition, considerable amounts of contaminants leach into the groundwater from dumps (USGS, unpublished data). Neither the extent of groundwater contamination nor the amount of such contamination entering the bay has been determined. It should be noted that some polishing of the water occurs as it slowly migrates through the ground. Heavy metals, nutrients, viruses, etc. are adsorbed onto dirt particles; however, this adsorption capacity has a limit beyond which no further adsorption can occur.

---

[5]Coliform organisms are of diverse origin, ranging from strains which are usually of soil or vegetable origen to strains which are usually of fecal origin. MPN is a statistically derived number used to reduce the time required to run tests in the laboratory; it refers to the number of coliform organisms expected to be found in a 100 milliliter water sample.

[6]BOD (biochemical oxygen demand) is a measure of the quantity of oxygen ta taken up by the oxygen depleting material in the water.

Stormwater runoff from an urban area has been estimated to be of a quality similar to that of secondarily treated sewage effluents (Burke, 1971). After a dry period, quality of the first inch of runoff water approximates that of raw sewage. Urban stormwater contains heavy metals, hydrocarbons, coliform bacteria, high levels of BOD and suspended solids. Agricultural stormwater contains significant levels of pesticides, fertilizing agents, and coliform bacteria.

The Virginia Key sewage plant discharges about 57 million gallons per day (MGD) of treated sewage effluent via 4,500 feet of 90 inch pipe into 17 feet of water (Figure 9). The treatment process is a modified aeration type of activated sludge with no primary settling units. BOD removal by such a process ranges from 60 to 75 per cent (Metcalf and Eddy, 1972). Actual BOD removals range from 52 to 68 per cent; removal of suspended solids ranges from 56 to 70 per cent.

To meet State and Federal guidelines requiring 90 per cent BOD removal, the Miami-Dade Water and Sewer Authority plans to construct additional aerators, secondary settling tanks, and sludge digestion at the Virginia Key plant in addition to a new plant which will use oxygen gas to lower BOD levels. The Virginia Key sewage treatment complex will treat 110 MGD with 90 per cent BOD removal. The present outfall is to be extended to 12,000 feet offshore for discharge into 90 feet of water. The new outfall location is expected to reduce significantly the amount of effluent entering Biscayne Bay.

THERMAL ADDITIONS

Addition of hot water can raise water temperatures above the tolerance limits of marine organisms as well as lower the dissolved oxygen content of the water. Hot effluent waters (104^{o}) from Florida Power & Light's Turkey Point electrical generating plant caused fish kills and damaged plant life, corals, molluscs, and crabs in July 1969. Since then a self-contained cooling system has been constructed to eliminate thermal discharges to Card Sound. Effluents from FP&L's Cutler Power Plant are discharged into the bay. These discharges are within Metro Dade County Pollution Department standards: temperatures not to exceed 92^{o}F (June - September), 90^{o}F (October - May); salinities not to be higher than 10 per cent above receiving waters. (see Appendix A).

1.6 Biota

PERMANENT COMMUNITIES (Figure 7)

The Littoral Mangrove Fringe

Urbanization has claimed almost all of the mangroves in North Bay except for those growing on the Interama tract, Virginia Key, and Key Biscayne. To the south, healthy stands remain along the shores of the mainland, bayside of the barrier islands, and on low lying keys.

The mangrove community benefits the bay area stabilizing shorelines, providing a storm buffer, offering habitat to developing marine organisms, contributing to estuarine productivity, and enhancing water quality. The community is characterized by three species which generally grow in zones parallel to the land-water interface. The more seaward red mangrove is backed by the black mangrove and the white mangrove, although modifications of this pattern prevail throughout the area. Oysters, algae, sponges, barnacles, hydroids, and other organisms attach themselves to the prop roots and lower trunks of the red mangrove where these structures are submerged or washed by tides. These organisms and the tangle of roots themselves, as well as the needle-like emergent black mangrove roots, serve to slow water flow allowing silt to settle and nutrients and pollutants to be locally assimilated up to the capacity of the system. Where the waters are deep enough, grunts, snappers, snook, small barracuda, and spiny lobsters are very common.

The dense mangrove fringe is backed by Juncus marshes, dotted with scrub red and white mangroves, and interlaced with thick mangroves lining tidal creeks and mosquito control ditches.

Hammocks

Several of the more elevated keys support broad-leaved, hardwood hammocks. In these jungle-like areas are found gumbo limbo, mahogany, Spanish stoppers, crabwood, lancewood, poisonwood, spicewood, mastic, bustic, black, red, and white ironwood, Jamaica dogwood, sapodilla, palm, geiger tree, ficus, spider lily, et al. On other high islands where land has been disturbed, Australian pines have invaded.

Benthic Plant Communites

The benthic (bottom) plant communities south of MacArthur Causeway were mapped in 1973 (Roessler et al.). Little or no data is available for the northern portion of the bay although it is believed that the prevailing high turbidities would render conditions adverse to significant plant growth.

The turtle grass (Thalassia) community is ecologically the most important within the bay waters. It is found most commonly from Rickenbacker Causeway south to the clean waters of Featherbed Bank and close to the Keys. Cuban shoalweed (Diplanthera) and manatee grass(Syringodium) also occur in the bay. Usually, Cuban shoalweed is found closer to shore, while manatee grass occurs farther into the bay. These grasses provide substrate for the attachment of algae, protozoans, sponges, hydroids, bryozoans, and offer grazing surface or shelter for numerous gastropods, bivalves, polychaete worms, crustaceans, and many other invertebrates. Their root system stabilizes the bottom and their long leaves function as a sediment trap, thus enhancing water clarity and supplementing the same function performed by mangroves. In the waters of Biscayne National Monument, these grasses form a prime nursery ground for commercial species of shrimp, Florida lobster, and many small fish, including sea trout.

The sparse turtle grass-green algae community generally occurs in the central portions of the bay where numerous crevices and pot holes occur. In thinner sediments of the same area are found the hard sand-green algae community composed predominately of Udotea, Penicillus, Rhipocephalus, and Halimeda. In the southern basin, this community includes sponges, crabs, gorgonians, stone crabs, shrimp, spiny lobster, and sea urchins. A large number of organisms, such as brittle stars and snapping shrimp, live within the canals of the sponges and in the coralline alga, Halimeda.

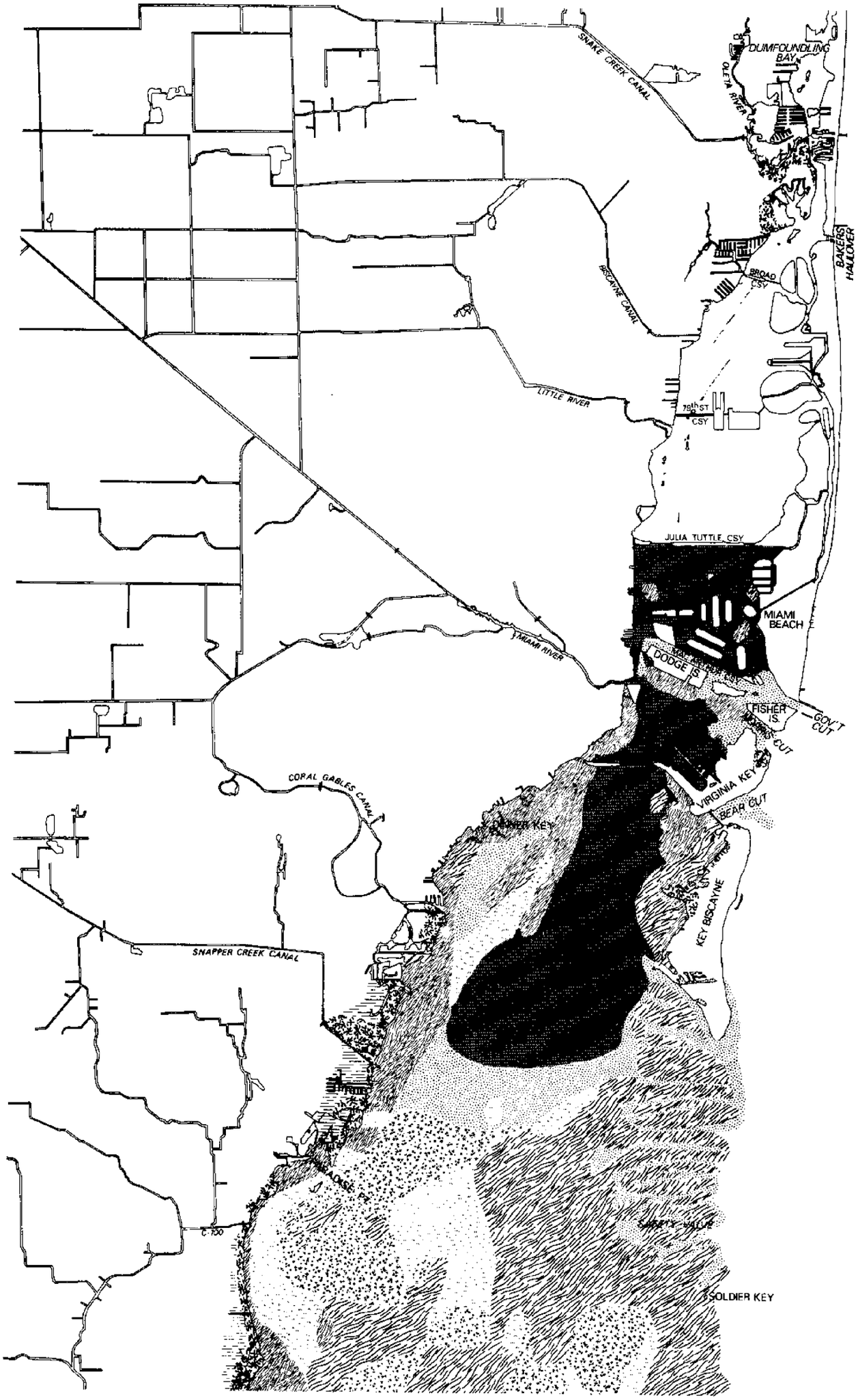
Sand, which is almost barren, occurs in the tidal channels of Safety Valve and in a transect across the central basin.

The soft mud-silt community occurs in two distinct areas. The area south of Rickenbacker Causeway appears to be associated with relatively high turbidity and runoff from urbanized areas to the west. The Card Sound mud appears to be associated with runoff from Key Largo developments and poor water circulation. In shallow areas, the mud-silt community supports large numbers of benthic diatoms (especially Pleurosigma), brittle stars, worms, echinoids, and a large number of molluscs.

MIGRATORY SPECIES

Planktonic Communities

Plankton comprises those organisms, mostly of small size, which float or drift with the currents or tides. The plant plankton (phytoplankton)


SNAKE CREEK CANAL
DUMFOUNDLING BAY
OLETA RIVER
BAKERS HAULOVER
BROAD CSY
BISCAYNE CANAL
LITTLE RIVER
75th ST CSY
JULIA TUTTLE CSY
MIAMI BEACH
MIAMI RIVER
DODGE IS
FISHER IS
GOV'T CUT
BEAR CUT
VIRGINIA KEY
CORAL GABLES CANAL
DINNER KEY
KEY BISCAYNE
SNAPPER CREEK CANAL
C-100
SOLDIER KEY

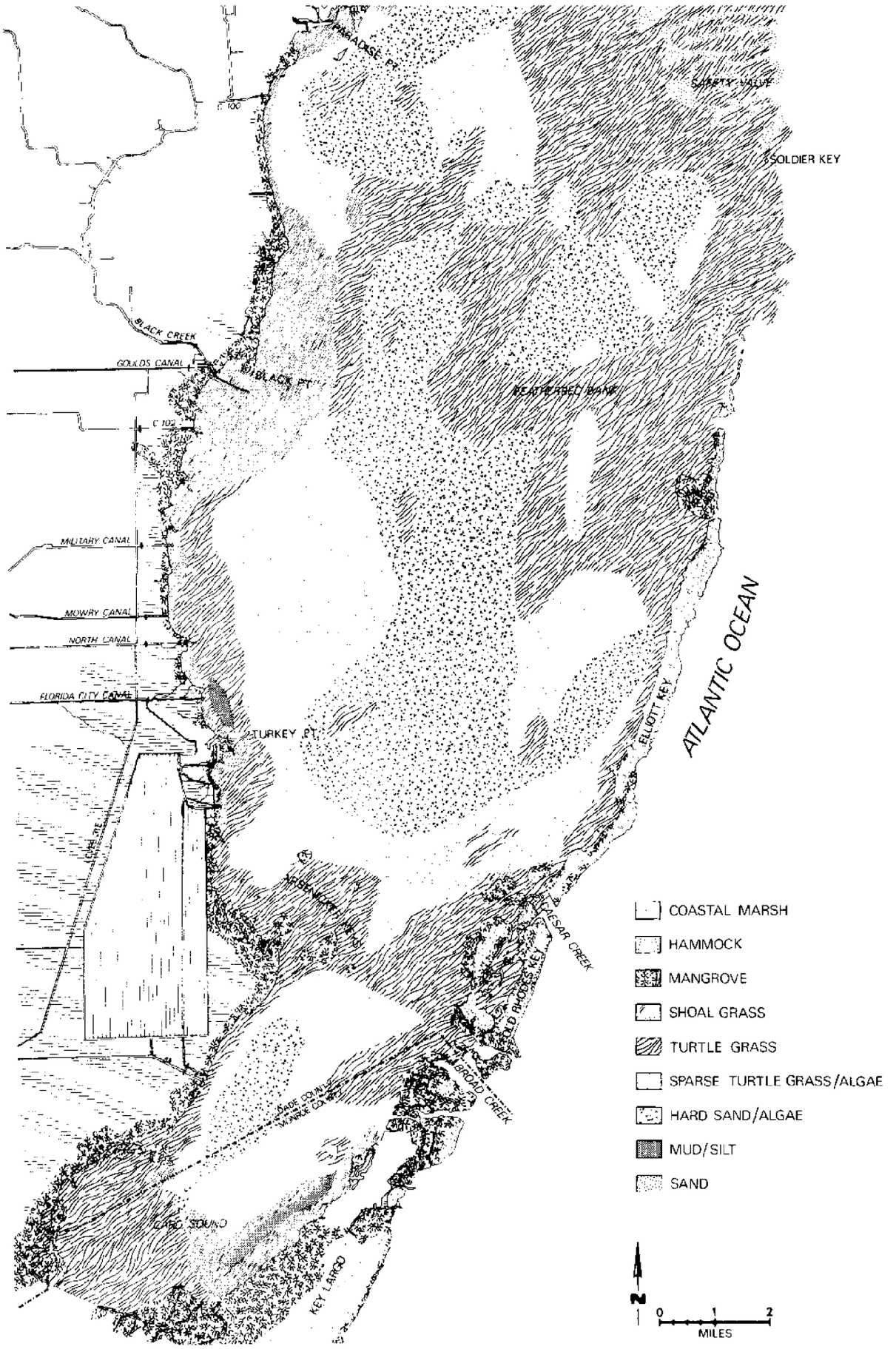


FIGURE 7: A generalized map of natural vegetative communities has been mapped on the basis of existing data (Roessler et al., 1973). Unfortunately, data are unavailable for submerged areas north of Julia Tuttle Causeway.

includes microscopic plants such as one-celled algae and diatoms as well as the larger free-floating Sargassum seaweed. Zooplankton includes microscopic animals and the larger comb jellies, jellyfish, shrimp, etc. Zooplankters also count among their numbers the larval stages of many of the animals which inhabit the shallower coastal waters.

In general, phytoplankton populations respond directly to the amount of dissolved nutrients and available light. Nutrients enter the bay via land runoff, which is greater in the north and central basins than in the southern basin. Other sources include nutrient-rich effluents discharged to tributary canals by sewage plants following secondary treatment and, to a lesser degree, rainfall and discharges from commercial and pleasure boats.

Zooplankton biomass[7] is directly dependent upon the mass of available phytoplankters. These relationships are borne out by data indicating that concentrations of phytoplankton range up to six times greater at Bear Cut than in the southern basin (Roessler and Beardsley, 1974), and zooplankton biomass is up to 10 times higher in central basin than in Card Sound (Reeve, 1973).

Plankton populations in Biscayne Bay exhibit seasonal variations. Numbers of larger zooplankters are reduced by 75 per cent in July and August, followed by an autumn population peak (bloom). This drastic reduction is possibly the result of low food levels combined synergistically with high summer temperatures (Reeve, 1973). The autumn bloom may be related to nutrient input from land runoff following the rainy season (Woodmansee, 1958).

Fishes

At least 468 species of fishes representing 71 fish families (excluding sharks, rays, and skates) have been recorded in the bay. Of these, 90 species are of commercial importance, 89 are considered to be sport fishes, and 128 are important as forage fishes (those regularly eaten by the economically important fishes and used for bait).

The sport's catch consists mainly of Spanish mackerel, grunts, crevalle jack, snappers, king mackerel, bluefish, sea trout, snook, tarpon, and bonefish. Practically all sports fishing occurs south from Rickenbacker Causeway (deSylva, 1970).

Many oceanic species also depend upon bay resources. Authorities estimate that about 65 per cent of marine fishes breed or spend their juvenile period of growth in an estuary (Clark, 1968; Smith, 1968). J. L. McHugh (1968) of the U. S. Department of Commerce reports that 95 per cent of the commercial crop of the Gulf of Mexico is estuarine dependent.

---

[7] Biomass is the amount of living matter expressed in terms of weight.

Mammals and Reptiles

Mammals in the bay consist of manatees and porposes. Both are rare; however, manatees often frequent the warmer waters of the Miami River in winter. Reptiles include the loggerhead, hawksbill, and green turtles, and the American crocodile. Occasional invasions of alligator, diamond back terrapin, and mangrove water snakes occur when the mainland edge of the bay becomes fresh during periods of heavy railfall (Kohout and Kolipinski, 1964).

Birds

Biscayne Bay supports a large number of nesting and migratory water fowl and shore birds. Location of major rookeries are depicted in Figure 6.

Large rookeries are located in Greynolds Park and the Arsenicker Keys. The Park provides nesting sites for anhingas, cattle egrets, white ibis, and several species of small herons. Brown pelicans, snowy and cattle egrets, cormorants, ibis, and great white, great blue, and various small herons nest on the Arsenickers. The forested areas near the Virginia Key Sewage Plant afford nesting sites for Wilson plovers, blackneck stilts, willets, and least terns.

Blue herons nest on Key Biscayne. In the early 60's, bald eagles nested on Key Biscayne and Gables-by-the-Sea. In 1974, the only known nesting of bald eagles was on northeast Arsenicker Key. A few pairs of ospreys--no more than 10--nest along the shores of south Biscayne Bay. Throughout the bay area least terns select gravel roofs for nesting.

Many migratory birds use Biscayne Bay as a feeding and resting stop. Frigate birds roost on Elliott and Arsenicker Keys; white crowned pigeons frequent Pumpkin Key. Herons, ibis, gulls, terns, many shorebirds, and occasionally roseate spoonbills can be observed feeding in the shallow waters off Rickenbacker Causeway. At low tide, shorebirds, gulls, and terns gather on the sand flats north of Julia Tuttle Causeway. Coots, red-breasted mergansers, and lesser scaup comprise the major portions of waterfowl which winter in south Biscayne Bay.

2. SOCIAL SYSTEMS

2.1 Political Jurisdictions

All of the Biscayne Bay complex lies within Dade County with the exception of the southeastern half of Card Sound which falls within the boundaries of Monroe County. Eleven municipalities border on the bay. They are North Miami Beach, North Miami, Bal Harbour, Surfside, Bay Harbor Islands, Indian Creek Village, Miami Shores, North Bay Village, Miami Beach, Miami, and Coral Gables (Figure 8).

MANAGEMENT

Land use of the environs of Biscayne Bay is under the direct supervision of the bordering municipalities and Metropolitan Dade County. Where developments of regional impact (DRI) are concerned, review by the South Florida Regional Planning Council is required. The Central and Southern Florida Flood Control District maintains and controls salinity barriers and water staging structures located on tributaries of the bay, in addition to having sole authority to grant permits to withdraw water or drill wells with bores of two inches or more.

Water use is regulated by federal, state, county, and municipal authorities. Navigation of the bay is under federal control. The Florida Inland Navigation District and the U. S. Army Corps of Engineers concern themselves with the Intracoastal Waterway and its maintenance; the Coast Guard regulates bridges, markers, buoys, and other navigation works.

The Florida Department of Natural Resources Marine Patrol assists in rescue operations and enforces state statutes, which include fishing and boating regulations, boat registrations, etc. The Metropolitan Public Safety Department is primarily involved in rescue work within the bay and out to three miles offshore, in addition to routine patrolling and reporting pollution and zoning offenses. The cities of Miami Beach, North Miami Beach, and North Miami patrol their waters to prevent crime and to enforce boating and zoning regulations.

DREDGE AND FILL

Permission to dredge and fill coastal waters of Florida is granted only after the applicant has gone through a complex process. The Cabinet of Florida, acting as Trustees of the Internal Improvement Fund, first must issue a permit. The U.S. Corps of Engineers also must

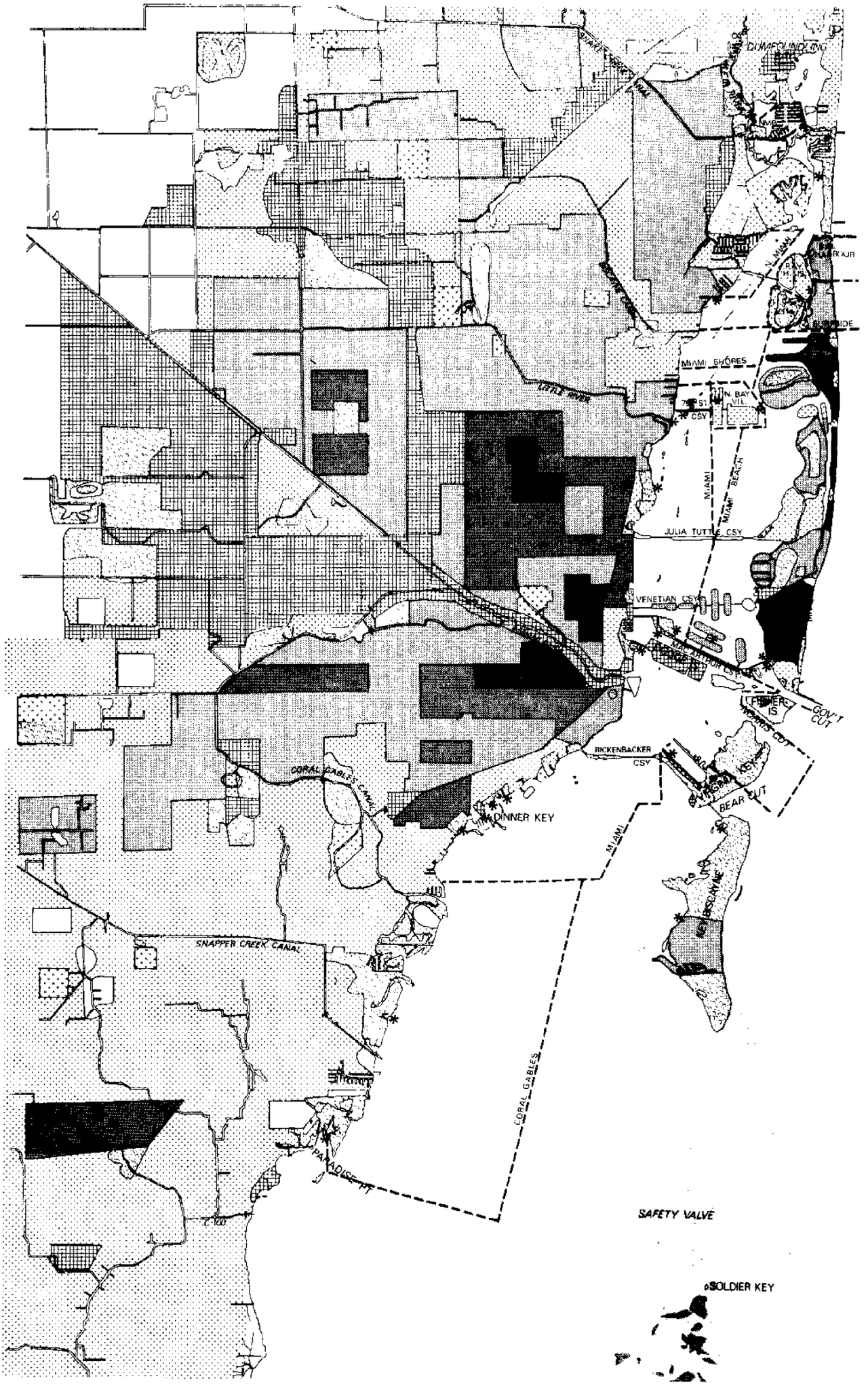
issue a permit after considering comments solicited from the U.S. Department of Interior, the Florida Department of Natural Resources, and the Florida Department of Pollution Control. Finally, the appropriate county or municipal government must issue a permit.

Since 1902, the area of Biscayne Bay has been reduced considerably by dredging and filling (Figure 1); however, the 1967 Randall Act amended the Florida Statutes and gave clear-cut power to the Trustees of the Internal Improvement Fund of the State of Florida to regulate the dredging and filling of coastal waters and the approval of bulkhead lines. Prior to that time, the jurisdiction was legally uncertain, even though the trustees had sold off parts of the bay bottom to private interests. The new law requires that any filling of the bay be in the public interest as bottom lands are held by the state in perpetual trust for the use and enjoyment of the public

AQUATIC PARK AND PRESERVE

In April, 1974, with Ordinance No. 74-13, the Dade County Commission declared Biscayne Bay an "Aquatic Park and Conservation Area." The ordinance empowers the county manager "to develop a plan for the protection and preservation of said 'Aquatic Park and Conservation Area' including the initiation and coordination of appropriate research and analysis, the development of both short and long-range plans, and the promulgation of rules and regulations which, after ratification by the Board of County Commissioners and the appropriate agencies of the State of Florida and of the Federal Government, shall have the force and effect of law"

Dade County's action was followed by the Florida Legislature which enacted House Bill No. 4018, establishing Biscayne Bay as an aquatic preserve. The Governor approved the bill in June, 1974. The bill assigns management of the preserve to the Trustees of the Internal Improvement Trust Fund, who are instructed not to permit further sale or lease of sovereignty submerged lands except in the case of a demonstration of extreme hardship or that such sale, lease, or transfer is in the public interest. Dredging and filling is only allowed for public navigation and maintenance of existing facilities or projects which will not adversely affect water quality or would eliminate public health hazards. In general, drilling of wells and excavation for shell or minerals is prohibited within the preserve; however, allowance is made for the preservation of riparian rights of upland property owners and reasonable improvement is to be allowed for ingress or egress, mosquito control, shore protection, and public utility expansion. Copies of the Dade County ordinance and House Bill 4018 comprise Appendix B.


MIAMI SHORES
N. BAY VIL.
79 ST
CSY
MIAMI BEACH
JULIA TUTTLE CSY
VENETIAN CSY
MACARTHUR CSY
FISHER IS
GOV'T CUT
NORRIS CUT
RICKENBACKER CSY
BEAR CUT
KEY BISCAYNE
DINNER KEY
CORAL GABLES CANAL
SNAPPER CREEK CANAL
CORAL GABLES
PARADISE PT
C-100
SAFETY VALVE
SOLDIER KEY

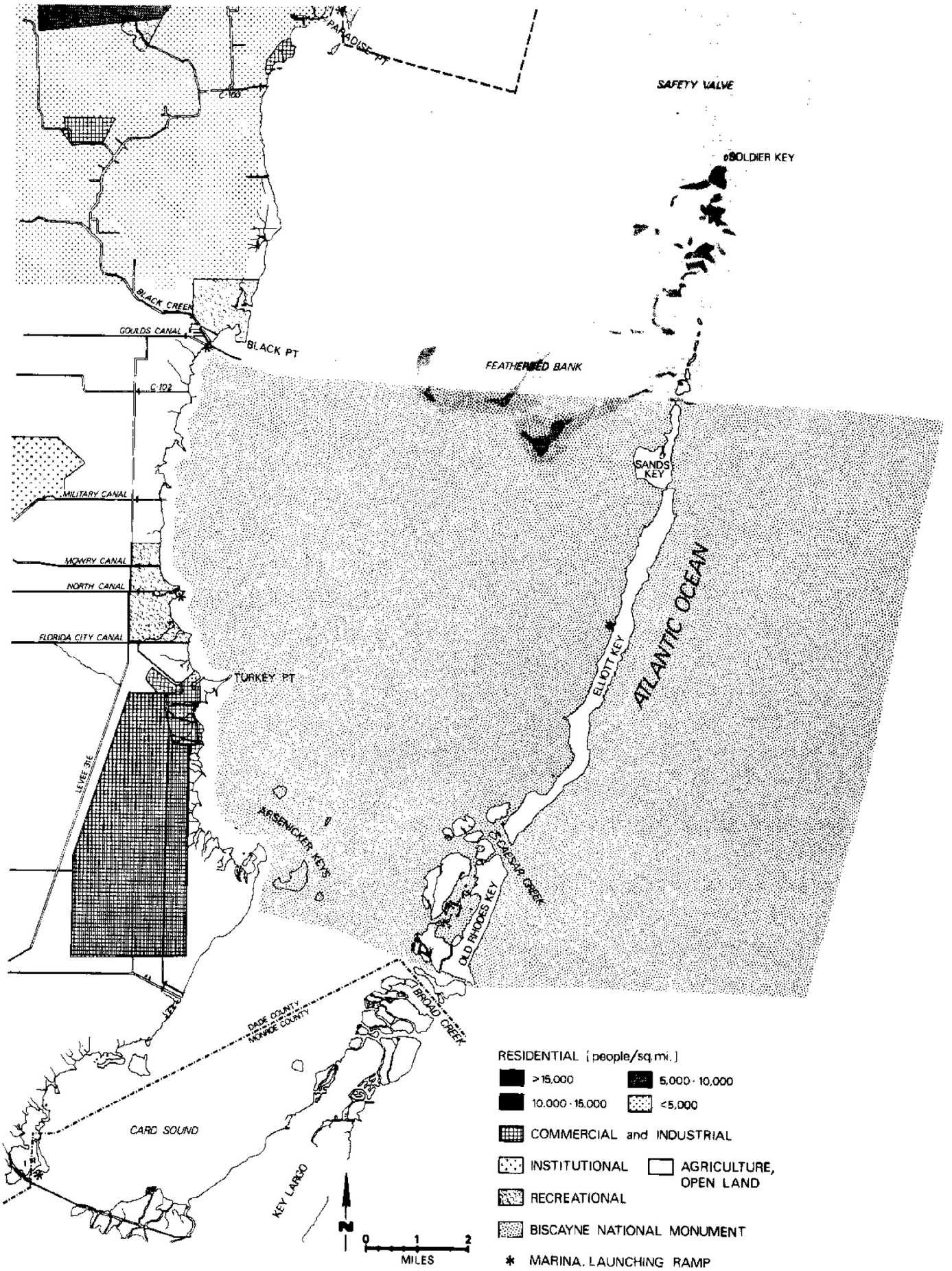


FIGURE 8: Land use is most intense in areas bordering the northern basin; it decreases to the south.

2.2 Residential Land Use

Land use of the environs of Biscayne Bay is illustrated in Figure 8.

DUMFOUNDLING BAY

Several extensive high-rise developments have been constructed along the western shore of Dumfoundling Bay, with thousands of high and medium density units still in the planning stages. Century 21 and Aventura are two of the larger developments underway. Between the ocean and the bay are tourist oriented accommodations. Population densities in the area are high, ranging from 1,152 to 8,448 [8] (Jenna 1972).

NORTHERN BASIN

Single-family homes are found along the bay's west shore, south of the Interama tract as well as on a portion of Bay Harbor Islands. North and south of Haulover Park are found high-rise apartments and condominiums along the bay and ocean, mixed in with single-family dwellings, hotels, and motels. In the area north of Broad Causeway, population densities range from 1,408 to 5,248.

With the exception of several high-rise apartment towers, the Miami shore and the west side of Miami Beach is predominately single-family residential, with apartment uses along the northern city limits and hotels, motels, and apartments along the ocean. Surfside is single-family residential in character along the bay with high density oceanside residential condominiums, apartments, and hotels.

North Bay Village is of mixed residential use. The census tracts included in the region lying between Broad and Julia Tuttle Causeways list five population densities ranging from 4,352 and 28,736.

The islands along Venetian and MacArthur Causeways are developed into estates with the exception of high-rise apartment structures on Belle Isle (overall population density: 5,760). The Miami Beach section of this area is essentially high density residential development--high-rises line the bay, hotels are concentrated along the ocean, and single-family homes face the golf courses south of 41st Street (population density ranges from 16,128 to 23,774). The Miami waterfront is primarily high and medium density residential in character. (population density: 11,200)

High and medium density structures are found on Miami Beach's south end and in the vicinity of downtown Miami. Several of the high-rise structures are both residential and tourist in nature (population density ranges from 16,128 to 23,774). Proposals for residential development on Fisher and Claughton Islands have been proposed.

---

[8] Persons per square mile; all population figures are from the 1970 census.

CENTRAL BASIN

On Key Biscayne, between Crandon and Cape Florida Parks, single-family residential areas front the bay; high and lowrise apartments, condominiums, and hotels are located on the ocean side. As the census tract data (population density: 9,600) for this area includes non-residential Virginia Key, actual Key Biscayne density would be considerably higher.

Development along the western shoreline from Rickenbacker Causeway to Dinner Key ranges from single-family homes to high-rise apartments (population density: 3,776). From Dinner Key south to Coral Gables city limits,land use is basically single-family with a few multi-family dwellings located near the Coconut Grove business district (population density: 3,328). Development in the region lying east of Old Cutler Road south to Paradise Point, (population density: 448) has been limited to estates along the road and large homes in fingers into the bay at Gables-by-the Sea, Gables Estates, and Old Cutler Bay. Along Old Cutler Road south to Eureka Drive development is essentially high value, single-family homes on large lots. This census tract area (population density: 4,288) extends westward to Dixie Highway where density is somewhat higher. Population densities in the northern half of the remaining western shoreline of the central basin are 3,008; southern half: 320. The northern area includes the developing Saga complex east of Old Cutler Road. The plan for the Saga area retains the natural shoreline with residential development pushed westward; both single and multi-family units are proposed. Considerable future residential development is forecast for this area as large tracts of land have been assembled by corporations.

SOUTHERN BASIN AND CARD SOUND

This area remains essentially undeveloped with the exception of Turkey Point generating plant, the park buildings on Elliott Key, and a low to medium density development on northern Key Largo.

2.3 Industry and Commerce

Sources at the Chamber of Commerce and the Marine Council estimate that the local marine industry, shipping, cruise lines, boat manufacture, sales and service, shipyards, marinas, bait and tackle shops, yacht clubs, etc., contribute roughly 20 per cent to the overall economy of Dade County, ranking third in economic importance and preceeded only by tourism and the airlines.

Ship and boat building and repairing is still the largest single marine related industry in Dade County, although significant decreases in number of establishments and employees have occurred since 1968 (Table). The second and third largest industries are marine cargo handling and dealers, followed by commerce in fish and seafoods, tugboat and marine towing services, and water transportation. In Dade County, the latter category includes commercial boat rentals, non-pleasure craft, salvaging, marinas, and operations of boat basins.

TABLE: Number of employees and establishments for marine industries in Dade County, 1972 and 1968. *

Marine Activity	1972		1968	
	Employees	Units	Employees	Units
Ship and boat building and repair	2267	55	2589	80
Marine cargo handling	780	7	751	11
Boat dealers	390	45	277	36
Water transportation services	206	46	325	45
Wholesale fish and seafoods	249	27	306	23
Local water transportation	-	18	220	16
Fisheries	-	18	97	17

* Data is from Riverfront Study, City of Miami Planning Department. Local water transportation and fisheries data are unavailable for 1972.

HARBOR FACILITIES

Dade County's major harbor facility is the new Port of Miami, located on Dodge Island, a 300-acre bulkheaded area connected to downtown Miami by vehicular and railroad bridges. It was created from a string of spoil banks dredged from Miami Harbor over the last half-century.

A complete surface and sanitary sewerage system services the port; all utilities are underground. Miami-based cruise vessels are equipped with holding tanks.

It is anticipated that, as the community grows, dependence upon waterborne cargo will increase. A 25-year master plan for the port through the year 1995 envisages an eastward extension to Lummus Island. The future channels for this extension will provide direct access from the ocean to the Miami River without passing under the port bridges. Projected development of the Port of Miami facilities is expected to meet community needs through the end of the century.

Cost to the taxpayer of the $30,000,000 port facility was $14,000,000; it is presently self-sustaining and self-funding. Revenues from cruise and cargo operations amount to $50,000,000 annually.

The port leads all Florida ports in dollar value of imports and exports; dollar value of exports exceeds imports. The amount of freight handled has increased from over 1,000,000 tons in 1964 to over 5,000,000 tons in 1973[9]. Inbound cargo consists of fuel oil and gasoline, foodstuffs, and raw materials while outbound cargo consists of manufactured goods, locally produced agricultural products, and foodstuffs bound for Caribbean islands and Latin America.

Additional facilities for shipment of cargo are located on the Miami River. Several steamship lines, which are served by the Florida East Coast Railway Company and Seaboard Coast Lines as well as various trucking companies, ship approximately 300,000 tons of freight per year. This cargo is bound for the Bahamas, Mexico, Cayman Islands, Haiti, Dominican Republic, other Caribbean islands, and South America.

A substantial amount of freight is shipped through Biscayne Bay via the Intracoastal Waterway. Nearly 2,000,000 tons per year are shipped between Jacksonville and Miami, and about 1,000,000 tons per year are shipped between Miami and Key West; fuel oil leads all other commodoties in volume.

In 1973, the amount of freight shipped through Biscayne Bay via the Intracoastal Waterway, the Miami River facilities, and the Port of Miami totaled 8,000,000 tons.

The advisability of a second seaport to be located in south Dade County was investigated by a special committee, composed of technical experts of the Greater Miami Chamber of Commerce. The committee report pointed out that no channel or natural harbor exists in the southern basin of the bay or Card Sound and concluded that the project, estimated to cost over $86,000,000, was financially infeasible. Furthermore, the facility would irreversibly damage the southern Biscayne Bay ecosystem.

---

[9] All tonnage figures were obtained from the U.S. Army Corps of Engineers.

FISHERIES

State regulations permit netting of bait fish only within the bay. The use of roller nets is required. Of the three dominant species caught--shrimp, silver mullet, and ballyhoo--live shrimp is by far the most important crop with annual wholesale sales amounting to over $640,000, followed by dead shrimp ($23,700), and silver mullet ($17,300)[10]. In general, retailers double the wholesale price. The area fished lies south of Rickenbacker Causeway.

A few fishermen fish commercially for finfish with hook and line within the confines of the bay. Some lobsters and crabs are trapped in the central and southern portions of the bay and an annual $61,000 crop of ballyhoo are netted along the fringes of Biscayne Bay and the Florida Straits. In 1972, over 924,000 pounds of finfish worth $275,000 and about 7,000,000 pounds of shellfish worth over $6,000,000 were landed in Dade County; however, practically all of these commercial crops were caught in areas other than Biscayne Bay.

COMMERCIAL PLEASURE BOATING

Three companies operate excursion boats offering evening entertainment cruises as well as daytime rides to Vizcaya, to the Everglades, and past waterfront estates. The Florida Department of Natural Resources (DNR) lists 27 head boats in Dade County. The boats, which disembark from various docks along the bay, take out large fishing parties, and charge individual fees (by the "head").

The DNR lists 42 charter boats (captained boats chartered for the day or longer) which tie up to the Castaways or Haulover Beach docks. Additional charters are available at public and hotel docks. Scattered throughout the bay are individual companies which rent bare boats (no captain) by the hour or longer. Offerings include powered skiffs, single-hulled sailboats, and catamarans.

TOURISM, RECREATION, AND ENTERTAINMENT

Water oriented entertainment facilities dependent upon the bay include the Miami Seaquarium and the Marine Stadium. Both are located on Virginia Key. The Seaquarium features performances by trained marine mammals and a large collection of living marine animals. Employed are 106 full-time persons and additional help seasonally in addition to personnel working in ancillary services, such as gift shops, lunchrooms, etc. Total payroll is estimated to be approximately $1,000,000. In 1973, there were about 1,250,000 paid admissions. The Seaquarium pumps 11,000 gallons of water per minute from Bear Cut. This water is filtered, circulated, and returned to the bay. The City of Maimi Marine Stadium is equipped to accommodate a variety of functions ranging from regattas, boat races, and water-shows to boxing, concerts, and theater productions. Seating capacity exceeds 6,500.

---

10 Statistics are from Annual Summary, 1972, 1973, Florida Department of Natural Resources, Tallahassee, Florida.

LAND USE

Miami River

Waterfront industry, for the most part, is localized on the banks of the navigable portion of the Miami River. Tides determine the direction of waterflow in this section of the river which lies bayward of the salinity control dam at NW 36 Street.

The largest amount of riverfront land is devoted to marine related industries, pleasure craft repair yards, yacht brokerages, dockage, towing and salvage services, large vessel service, commercial fish houses, and one shipping line. Also located on the river banks are the Florida Power & Light electrical generating plant at SW 2nd Avenue, and pest control, printing, and computer facilities. Aircraft engine maintenance and overhaul facilities are housed on the Miami International Airport properties abutting the river.

Biscayne Bay

A relatively small portion of the bay waterfront has been developed for industrial purposes. As the highest return on land investment is in residential housing and office space, valuable waterfront lands, earmarked for industry, are being converted to residential use. Negotiations are underway to build condominiums on the vacant portion of the 55-acre Atlas Terminal Industrial Park, where only five companies have located within the last 10 years.

Immediately north of the Venetian Causeway are the Miami Beach Yacht Corporation and the Maule Cement Industries. An investment group holds an option to buy the Yacht Corporation and the Maule Industries have received zoning approval to build a hospital.

Bordering the Miami Harbor ship channel are the blimp, seaplane, and helicopter base on Watson Island and oil depots off the eastern end of MacArthur Causeway. Lying along the southern edge of the channel are the Dodge Island seaport and the Belcher Oil Company storage facility on Fisher Island.

Several boatyards and yacht brokerages are located on the western Bayshore in Coconut Grove. Marinas, public and private, are located in scattered areas along the river and the bay. They are discussed in the Recreation section of this report.

To the south are two Florida Power & Light generating plants; the Cutler Plant and the Turkey Point facilities. Two plans for industrial use of an area fronting the bay east of Homestead Airforce Base have been rejected--first the proposed Seadade Oil Refinery and then the South Dade Sea Park. The former was considered a threat to the tourist industry; disinterest by industry and lack of access to deep water led to abandonment of the latter.

2.4 Recreation

BOATING

As of 1974, Dade County has issued over 33,000 boat registrations. Of these, it is estimated that about 5,800 require berths (Greenleaf et al. 1973). The Dade County Recreation Department estimates that there are about 3,300 boat slips and moorings in Dade County. They are divided between 37 commercial marinas (about 1,700 slips), 12 private yacht clubs (497 slips and moorings), three municipally operated marinas (622 slips), and five county operated marinas (460 slips). Public boat hoists are located at Pelican Harbor, Crandon Park, and Homestead Bayfront Park. The county operates eight launching ramps and the City of Miami provides three.

In addition to existing marinas at Haulover Beach Park, Pelican Harbor, Crandon Park, Matheson Hammock, and Homestead Bayfront Park, the County Recreation Department plans to develop a 400-slip marina at Chapman Field and new facilities in the Black Point and Homestead Bayfront Park properties. Metropolitan Dade County recognizes the need for some regulation of boat heads; however, ordinances requiring holding tanks and dumping facilities for pleasure boats has been put in abeyance pending passage of federal legislation.

FISHING

Sport fishes and commercial sport fishing opportunities are discussed in sections 1.6 and 2.3, respectively. There are a few land-based locations from which persons can fish in Biscayne Bay. In the northern basin, fishing is permitted off the 79th Street Causeway and from catwalks along MacArthur and Rickenbacker Causeways. In the central basin, the sea-walls at Cape Florida State Park and at Coconut Grove Bayfront Park are used for fishing; there is a children's pier located at Dinner Key. The marina at Matheson Hammock affords some fishing opportunities. In the southern basin, fishing is permitted from the dock on Elliott Key and the marina at Homestead Bayfront Park. Areas near the Cutler Ridge and Turkey Point Power Plants are accessible to fishermen as well most of the Central and Southern Florida Flood Control District Canals in the southern part of the county. Fishing also is permitted from the Card Sound Bridge.

WATER CONTACT SPORTS

The Florida Department of Pullution Control has placed Biscayne Bay waters in the Class III catagory--waters suitable for water contact and the propagation of fish and wildlife. The Dade County standards for tidal salt water meet the criteria of Class III waters; however, the criteria establish water quality goals and do not always reflect actual conditions.

Public beaches are located along the ocean and on the bay at Matheson Hammock and Homestead Bayfront Park. Authorized swimming areas are provided with lifeguards and checked for water quality by the county Health Department. The public regularly uses non-supervised waterfront areas, especially Rickenbacker Causeway, for swimming, small boat launching, and water skiing.

2.5 Public Land Use

PARKS

Public lands within the environs of Biscayne Bay fall under municipal, county, state, and federal jurisdictions. Publicly owned sites are depicted in Figure 8; Appendix C lists existing and proposed parks closely related to estuarine or marine resources.

Federal

The U.S. Department of Interior has assumed ownership of Biscayne National Monument, an area encompassing 96,000 acres of bay bottom, reefs, and islands extending from Sands Key on the north to Old Rhodes Key on the south, and reaching from a line 3,000 feet east of the mean high water mark along the mainland shore eastward to the 80-foot depth contour in the Atlantic Ocean.

Within the monument, proprietary jurisdictions prevail; that is, federal, state, and county laws are all enforced by their respective agencies. Often enforcement officers from differing jurisdictions travel in the same boat. Fishing by hook and line and commercial netting of bait shrimp and mullet are permitted in monument waters; however, no spearfishing or collecting of marine organisms and no dredging are allowed except in the case of easements existing at the time of acquisition of the monument. These easements include the channel connecting Elliott Key and Homestead Bayfront Park.

State of Florida

The State of Florida owns and operates Cape Florida State Park, 546 acres located on the southern tip of Key Biscayne. Of the 450 acres of Black Point, the state controls about 310 acres. The remainder has been purchased by Metropolitan Dade County from private individuals.

Metropolitan Dade County

The principal areas which Dade County has acquired and developed for water-oriented recreation are Homestead Bayfront Park, 910 acres; Crandon Park, 898 acres; Matheson Hammock, 561 acres; Haulover Beach, 177 acres; and Virginia Beach, 147 acres. Although not on the bay proper, Greynolds Park, 242 acres fronting on the Oleta River and Maule Lake, supports substantial rookeries of several species of water fowl. Vizcaya, an art museum surrounded by 51 acres of gardens and nature trails, affords docking space for sightseeing boats. Development of Chapman Field Park, 566 acres, and the county's share of Black Point, 140 acres, are in the planning stages. Along the bayshore, south of Turkey Point, 110 acres are devlote to a nature preserve.

INSTITUTIONS

An area of 162 acres on Virginia Key has been set aside by the City of Miami for marine research. Concentrated in this area are the U.S. Department of Commerce National Oceanographic and Atmospheric Administration, Atlantic Oceanographic and Meteorological Laboratory, the National Marine Fisheries Service, and the University of Miami Rosenstiel School of Marine and Atmospheric Science (RSMAS). International Oceanographic Foundation facilities, housing a museum and administrative offices, will be completed in 1975. The former U.S. Quarantine Station on Fisher Island has been converted by RSMAS into geological laboratories.

Fate of the financially plagued Interama tract is still in doubt. Plans calling for a Bicentennial Exposition and permanent Inter-American Cultural and Economic Center are being re-evaluated. Of the total 1,688 acres, 350 acres have been deeded to the City of North Miami, 150 acres along the Oleta River will accrue to Metropolitan Dade County, and 40 acres are earmarked for a second Florida International University campus.

2.6 Transportion and Utilities

Major transportation corridors and utilities' pipelines are depicted in Figure 9.

HIGHWAYS

Six major causeways transverse the bay. On the north, Broad Causeway crosses from NE 123rd Street to Bay Harbor Islands. To the south, in order, are the 79th Street Causeway connecting Miami with North Bay Village and Normandy Isle; Julia Tuttle Causeway connecting the Airport Expressway and Miami Beach's Arthur Grodfrey Road; Venetian Causeway crossing the Venetian Isles from NE 15th Street in Miami to Dade Boulevard in Miami Beach; MacArthur Causeway connecting the Dolphin Expressway, Watson Island, and Alton Road in Miami Beach; and the Rickenbacker Causeway tying into 26th Road on the mainland, crossing Virginia Key to Key Biscayne.

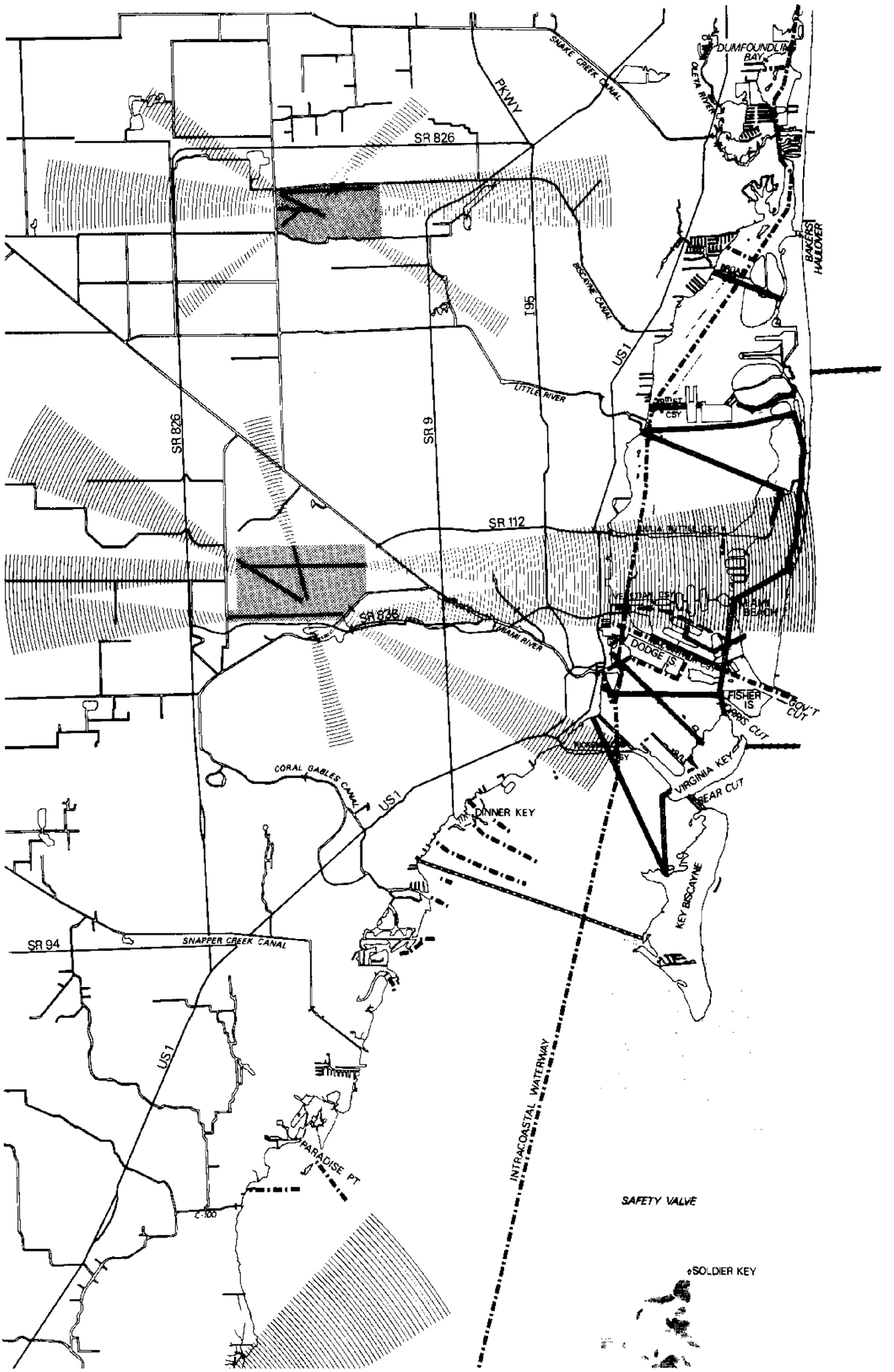
The Dade County Transportation Coordinator's Office is investigating use of the bay as a corridor for waterborne transportation as a commuter alternative.

MAJOR CHANNELS

The Intracoastal Waterway channel extends southward from Dumfoundling Bay, hugging the mainland shore to Rickenbacker Causeway, and thence southward through the middle of the bay and Card Sound. The channel is maintained to a depth of 10 feet north of Miami Harbor and seven feet south of the harbor.

AIRSPACE

Portions of the airspace above the bay are subject to Miami International Airport Terminal Control. All craft must contact Miami Approach Control if they fly between 1,000 and 7,000 feet in an arc roughly described by Matheson Hammock on the south, Virginia Key on the east,


SR 826
PKWY
SNAKE CREEK CANAL
DUMFOUNDLING BAY
OLETA RIVER
BAKERS HALLOVER
BISCAYNE CANAL
I95
US1
LITTLE RIVER
SR 826
SR 9
SR 112
SR 836
MIAMI RIVER
DODGE IS
FISHER IS
GOV'T CUT
CORAL GABLES CANAL
US1
DINNER KEY
VIRGINIA KEY
BEAR CUT
KEY BISCAYNE
SR 94
SNAPPER CREEK CANAL
US1
PARADISE PT
C-100
INTRACOASTAL WATERWAY
SAFETY VALVE
SOLDIER KEY

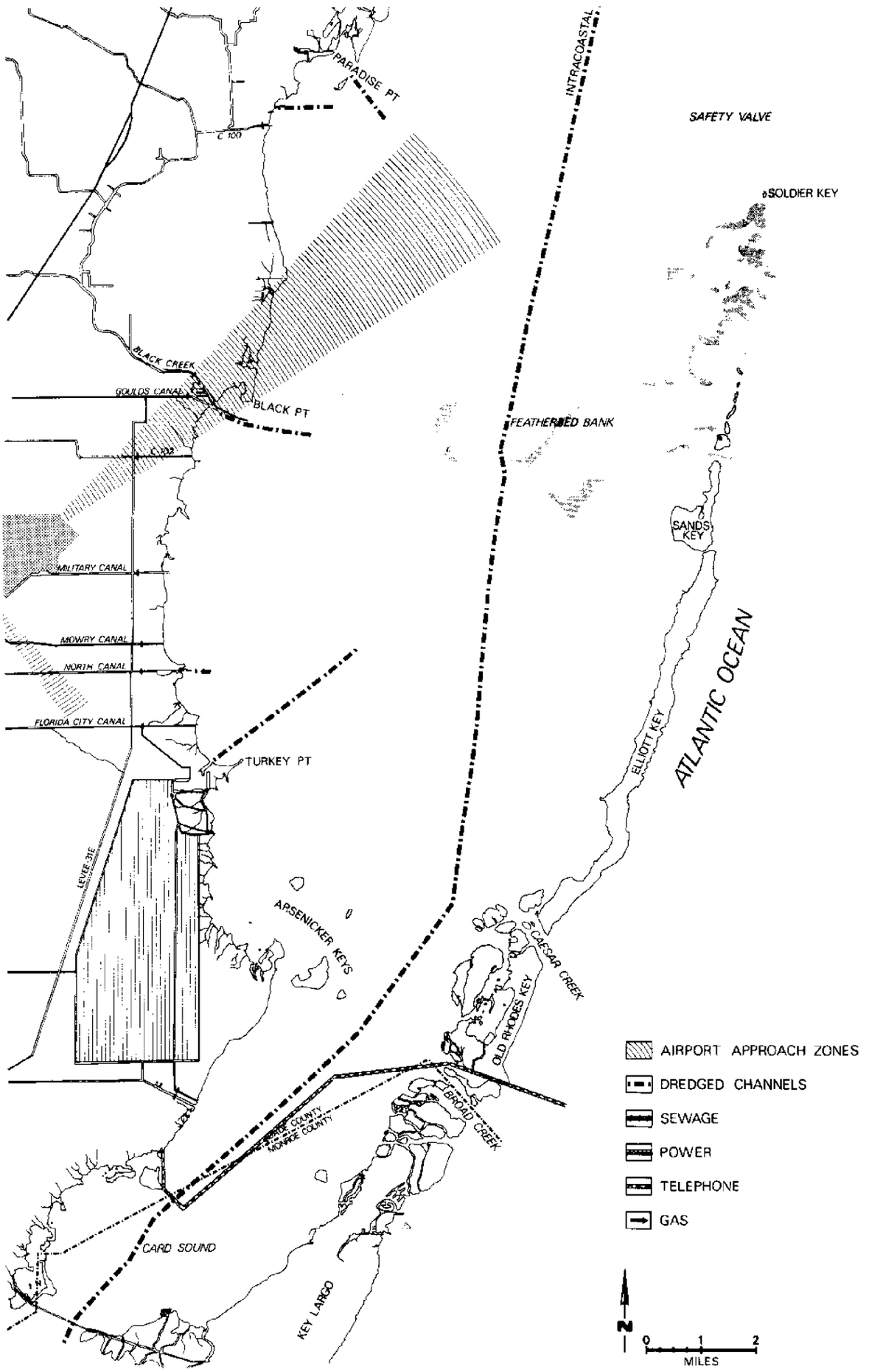


FIGURE 9: Only major submerged and buried pipelines and cable crossings are illustrated above. Small lines often are merely laid directly on the bottom. In addition, many major lines cross the bay via bridges and causeways.

and Little River on the north. From Matheson Hammock south to Black Point, Terminal Control regulates the airspace between 5,000 and 7,000 feet. The remaining northern section is controlled in the 2,000 to 7,000 feet range.

Aircraft flying below 3,000 feet within five miles of Homestead Air Force Base must contact the base's tower. A small section of the western side of the bay between Black Point and Turkey Point is involved (see Figure 9.)

UTILITIES CORRIDORS

Figure 9 also illustrates the locations of major submerged pipelines and cables crossing the bay. All water mains cross via causeways or bridges.

The Metropolitan Dade County Water and Sewer Authority major sewage force main, with a pressure of 100 pounds per square inch (psi), crosses the bay from Bayfront Park to Virginia Key sewage treatment plant. The 72-inch concrete pipe lies about two-feet below the bay bottom. The City of Miami Beach sewage system serves Normandy Isle with a 12-inch force main laid south of the Isle.

A submerged 10-inch secondary force main connects Hibiscus, Palm, and Star Islands with Miami Beach. Proposed are an additional 54-inch force main to connect the Miami Beach collection system with Virginia Key via Government Cut, Fisher Island, and Norris Cut, and two buried 16-inch pipelines to transmit sludge from the Interama site to Virginia Key. The latter lines will cross the bay diagonally from Ball Point. Other mains cross the bay via causeways and bridges.

One six-inch natural gas transmission pipeline crosses the bay from NE 16th Street on the west to south Miami Beach. The 100 psi pipeline is laid in a trench and covered with about three feet of fill.

Florida Power & Light Company transects the bay with four eight-inch pipelines, one six-inch pipe, and several lateral connections lying under the bay and Indian River. FP&L's pipes consist of seamless one-fourth-inch steel tubings which encase cables immersed in polybutyl oil maintained under a pressure of 220 psi. The pipes are laid in a trench and covered with three feet of fill. Numerous connective cables are submerged throughout the bay.

Southern Bell cables, laid loosely on the bottom or in trenches, cross the bay in six areas. MacArthur and Venetian Causeways carry telephone connections via conduits on bridges and underground cables. A buried international cable to the Bahamas crosses Card Sound and exits to the ocean immediately south of Old Rhodes Key.

BIBLIOGRAPHY

Burke, Roy III. A survey of available information describing expected constituents in urban surface runoff with special emphasis on Gainesville, Fla. Department of Environmental Engineering, University of Florida. 1971

City of Miami Planning Dept. Riverfront Study. Miami, Florida. 1972.

Cade, T.J., J.L. Linder, C.M. White, D.G. Roseneau, and L.G. Schwartz. D.D.E. residues and eggshell changes in Alaskan falcons and hawks. Science Vol. 172. No.3986 pp.955-957. May 28, 1971.

Clark, John. Save-the-estuaries campaign is announced. Commercial Fisheries Review. p.6. July, 1965.

Dade County Office of the County Manager. Profile of Environment. Dade County Community Improvement Program. 1972.

deSylva, D.P. Ecology and distribution of postlarval fishes of southern Biscayne Bay, Florida. Progress report to the U.S. Environmental Protection Agency. University of Miami Rosenstiel School of Marine and Atmospheric Science. 1970.

Florida Department of Natural Resources. Annual Summary. Tallahassee, Florida. 1973

Greenleaf, Telasco. Planning Engineers. Proposed marina: feasibility study and master plan, Miami Beach, Florida. 1973.

Hela, I., C.A. Carpenter, Jr.,and J.K. McNulty. Hydrography of a positive shallow tidal bar-built estuary. Bulletin Marine Science, University of Miami. 1957.

Jenna, W.W. Metropolitan Miami, a Demographic Overview. University of Miami Press, Coral Gables, Florida. 1972.

Johnson, W.O. Minimum teperatures in the agricultural areas of peninsula Florida, summary of seasons 1937-1967. Institute of Flood and Agricultural Services Publication No. 9. University of Florida, Gainesville, Florida.

Kohout, F.A. and M.C. Kolipinski. Biological zonation related to groundwater discharge along the shore of Biscayne Bay. Miami, Florida. In Estuaries G.H. Lauff (ed.) American Association for the Advancement of Science. 1967.

Lee, T.N. Annual report to the Atomic Energy Commission. University of Miami Rosenstiel School of Marine and Atmospheric Science. 1974

Lee, T.N. and C. Rooth. Water movements in shallow coastal bays and estuaries. University of Miami Sea Grant Program. 1973.

Malcom Pirnie Inc. and Ray L. Hart, Inc. Sewage system improvements for City of Miami Beach, Preliminary Engineering Report. Jan., 1974.

McHugh, J.L. Are Estuaries Necessary? Commercial Fisheries Review. p.31. Nov.,1968.

McNulty, J.K. Effects of Abatement of Domestic Sewage Pollution on the Benthos, Volumes of Zooplankton, and the Fouling Organisms of Biscayne Bay, Florida. University of Miami Press, Coral Gables, Florida. 1970.

Metcaff and Eddy Inc. Wastewater Engineering. McGraw Hill Book Co. New York. 1972.

Meyer, F.W. and E.T. Wimberly. Summary of data collected for the Miami River restoration project during March and September 1971. Open-File Report 72020. U.S. Geological Survey.

Morrill, J.B. and F.C.W. Olson. Literature survey of Biscayne Bay area. Report for U.S. Navy Hydrographic Office. Florida State University Oceanographic Institute, Tallahassee, Florida. 1955.

Reeve, M.R. Seasonal changes in the zooplankton of south Biscayne Bay. Bulletin of Marine Science. University of Miami Rosenstiel School of Marine and Atmospheric Science. 1970.

Reeve, M.R. The ecological significance of the zooplankton in the shallow sub-tropical waters of South Florida. University of Miami Rosenstiel School of Marine and Atmospheric Science. 1973.

Roessler, M.A., G.L. Beardsley, and Roy Smith. Benthic Communities of Biscayne Bay. University of Miami Sea Grant Program. 1973.

Schneider, J.J. Tidal relations in the south Biscayne Bay area, Dade County. Florida. U.S. Geological Survey. Tallahassee, Florida. 1969.

Simpson, R.H., N.L. Frank, and R. Carrodus. The hurricane storm surge in south Florida. ESSA Weather Bureau. Miami, Florida. April, 1969.

Smith, R.L. Competition for the aquatic environment. Commerical Fisheries Review. p.27. May, 1968.

Sugg, A.L. and R.L. Carrodus. Memorable hurricanes of the United States since 1873. Technical Memorandum WBTM-SR-42. U.S. Department of Commerce, ESSA. 1969.

U.S. Department of Interior. Resource and Land Information, South Dade County, Florida. U.S. Geological Survey Investigation I-850. 1973.

U.S. Office of Management and Budget. Evacuation of coastal residents during hurricanes. Pilot Study for Dade County, Florida. Washington, D.C. 1973.

Wanless, H.R. Sediments of Biscayne Bay: distribution and depositional history. Ph.D. dissertation. University of Miami. 1967.

Woodmansee, R.A. The seasonal distribution of the zooplankton of Chicken Key in Biscayne Bay, Florida. Ecology. 1958.

APPENDIX

A. WATER QUALITY STANDARDS

(4) WATER QUALITY STANDARDS FOR DADE COUNTY:

Chemical, Physical, or Biological Characteristic	*Fresh Water (Water Containing Less than 500 ppm Chlorides)*	*Tidal Salt Water (Water Containing More than 500 ppm Chlorides)*	*Ground Water*
Dissolved oxygen (mg/l)	5 ppm during at least 10 hours per 24-hour period, never less than 4 ppm, unless acceptable data indicate that the natural background D.O. is lower than the values established herein.		——
Biochemical oxygen demand (mg/l)	Shall not exceed a value which would cause dissolved oxygen to be depressed below values listed under dissolved oxygen and in no case shall be great enough to produce nuisance conditions.		——
pH	6.0—8.5[1]	6.0—8.5[1]	6.0—8.5[1]
Floating solids, settleable solids, sludge deposits	None attributable to sewage, industrial wastes or other wastes.	None attributable to sewage, industrial wastes, or other wastes.	——
Oil and grease (mg/l)	15[2]	15[2]	15[2]
Odor producing substances	None attributable to sewage, industrial waastes, or other wastes. Threshold odor number not to exceed 24 at 60°C as a daily average.		——
Temperature			
Sources permitted prior to July 1, 1972	Shall cause no environmental damage.		——
Sources permitted after July 1, 1972	3° above ambient.	(June-September) 2° above ambient (October-May) 4° above ambient	
Turbidity	50-Except after heavy rains.		
Ammonia (mg/l)	.5 ppm as N	.5 ppm as N	.5 ppm as N
Chlorides (mg/l)	500[3]	(3)	500[3]
Chromium (mg/l)			
Total	.05	.05	.05
Copper (mg/l)	0.4	0.4	0.4
Cyanides (mg/l)	Non detectable	None detectable	None detectable
Detergents (mg/l)	0.5	Insufficient to cause foaming	0.5
Fluoride (mg/l)	1.4 as F	10 as F	1.4 as F
Lead (mg/l)	0.95	0.35	0.05
Phenol (mg/l)	0.001	0.005	0.001
Zinc (mg/l)	1.0	1.0	1.0
Sulfides (mg/l)	0.2	1.0	0.2
Coliform organisms (MPN/100 ml)	1,000[4]	1,000[5]	50
Mercury	None detectable	None detectable	None detectable
Iron	0.3 mg/l	0.3 mg/l	0.3 mg/l
Arsenic	0.05 mg/l	0.05 mg/l	0.05 mg/l
Specific conductance	500 micromhos per cm (fresh water). Not more than 100% above background, in waters other than fresh.		
Dissolved solids	Not to exceed 500 mg/l for monthly average or 1000 mg/l at any time.		
Radio active substances	Gross Beta Activity (in known absence of strontium 90 and Alpha emitters), not to exceed 1000 micro-microcuries at any time.		
Other compounds	Other toxic or undesirable compounds than those listed above may occur in individual waste streams, Limits for these components may be specified by the pollution control officer based on the latest scientific knowledge concerning toxicity and adverse effects of the intended water use.		
Synergistic action	Whenever scientific evidence indicates that a combination of pollutants exert a greater effect than the individual pollutants, the pollution control office may, on the basis of these findings, lower the herein established limits to the level necessary to prevent damage to the waters of the county.		

1. Shall not cause the pH of the receiving waters to vary more than 1.0 unit. When the natural background pH lies outside the limits established, the introduction of a waste shall not displace the pH of the receiving waters more than 0.5 pH units from these standards.
2. Shall not be visible, defined as irridescence, or cause taste or odors.
3. Waste shall not increase natural background more than 10 percent.
4. Maximum MPN/100 ml in a surface water used as a drinking water supply shall be 100.
5. Maximum MPN/100 ml in a tidal water from which shellfish are harvested for human consumption shall be 70.

B(1). ORDINANCE 74-13, METROPOLITAN DADE COUNTY

Alternate
Agenda Item No. 2 (a)
4-2-74

ORDINANCE NO. 74-13

ORDINANCE DECLARING BISCAYNE BAY AND ITS ENVIRONS AN "AQUATIC PARK AND CONSERVATION AREA"; AUTHORIZING THE COUNTY MANAGER TO ISSUE RULES AND REGULATIONS; PROVIDING FOR INCLUSION IN THE CODE OF METROPOLITAN DADE COUNTY, FLORIDA; AND PROVIDING AN EFFECTIVE DATE

BE IT ORDAINED BY THE BOARD OF COUNTY COMMISSIONERS OF DADE COUNTY, FLORIDA:

Section 1. In recognition that it is in the interest of the public welfare to protect and preserve unique, natural, aesthetic and recreational values, Biscayne Bay and its environs is hereby declared to be an "Aquatic Park and Conservation Area" for the use and benefit of the citizens of Dade County.

Section 2. The County Manager is hereby empowered to develop a plan for the protection and preservation of said "Aquatic Park and Conservation Area" including the initiation and coordination of appropriate research and analysis, the development of both short and long-range plans, and the promulgation of rules and regulations which, after ratification by the Board of County Commissioners and the appropriate agencies of the State of Florida and of the Federal Government, shall have the force and effect of law.

Section 3. It is the intention of the County Commission, and it is hereby ordained that the provisions of this ordinance shall become and be made a part of the Code of Metropolitan Dade County, Florida; that the sections of this ordinance may be renumbered or relettered to accomplish such intention; and that the word "ordinance" may be changed to "section", "article", or other appropriate word.

Section 4. That the provisions of this ordinance shall become effective ten (10) days after its adoption.

B(2). HOUSE BILL NO. 4018, FLORIDA LEGISLATURE

CHAPTER 74-171

House Bill No. 4018

AN ACT relating to Biscayne Bay in Dade and Monroe Counties; providing for the establishment of Biscayne Bay as an aquatic preserve; providing powers, duties and responsibilities of the trustees of the internal improvement trust fund, respecting said preserve; providing restrictions on the sale and use of lands and waters in the preserve; providing for relocation of bulkhead lines; providing for rules and regulations; providing for riparian rights of upland owners within or adjacent to the preserve; providing that no wastes or effluents shall be discharged into the preserve which substantially inhibit the accomplishment of this act; providing for enforcement, application of existing law, and severability; providing an effective date.

Be It Enacted by the Legislature of the State of Florida:

Section 1. Biscayne Bay in Dade and Monroe Counties, as hereinafter described to include Card Sound, is designated and established as an aquatic preserve under the provisions of this act. It is the intent of the legislature that Biscayne Bay be preserved in an essentially natural condition so that its biological and aesthetic values may endure for the enjoyment of future generations.

Section 2. (1) For the purposes of this act Biscayne Bay, sometimes referred to in this act as the preserve, shall be comprised of the body of water in Dade and Monroe Counties known as Biscayne Bay whose boundaries are generally defined as follows:

Begin at the southwest intersection of the right-of-way of State Road 826 and the mean high water line of Biscayne Bay (Township 52 South, Range 42 East, Dade County); thence southerly along the westerly mean high water line of Biscayne Bay to its intersection with the right-of-way of State Road 905A (Township 59 South, Range 40 East, Monroe County); thence easterly along such right-of-way to the easterly mean high water line of Biscayne Bay; thence northerly along the easterly mean high water line of Biscayne Bay following the westerly shores of the most easterly islands and Keys with connecting lines drawn between the closest points of adjacent islands to the southeasterly intersection of the right-of-way of State Road 826 and the mean high water of Biscayne Bay; thence westerly to the point of beginning, said boundary which extends across the mouths of all artificial waterways but includes all natural waterways tidally connected to Biscayne Bay. Except however those submerged lands conveyed to the United States for the establishment of the Biscayne National Monument as defined by public law-90-606 of the United States. .

(2) The preserve established by this act shall include the submerged bottom lands and the water column upon such lands, as well as all publicly owned islands, within the boundaries of the preserve. Any privately held upland within the boundaries of the preserve shall be deemed to be excluded therefrom; provided that the trustees of the internal improvement trust fund may negotiate an arrangement with any such private upland owner by which such land may be included in the preserve.

Section 3. The trustees of the internal improvement trust fund are authorized and directed to maintain the aquatic preserve hereby created pursuant and subject to the following provisions:

(1) No further sale, transfer or lease of sovereignty submerged lands in the preserve shall be approved or consummated by the trustees of the internal improvement trust fund, except upon a showing of extreme hardship on the part of the applicant and when the trustees shall determine such sale, transfer or lease to be in the public interest.

(2) No further dredging or filling of submerged lands of the preserve shall be approved or tolerated by the trustees of the internal improvement trust fund except:

(a) Such minimum dredging and spoiling as may be authorized for public navigation projects or for such minimum dredging and spoiling that may be constituted as a public necessity, or for preservation of the bay according to the expressed intent of this act;

(b) Such other alteration of physical conditions as may be necessary to enhance the quality or utility of the preserve; and

(c) Such minimum dredging and filling as may be authorized for the creation and maintenance of marinas, piers, docks and their attendant navigation channels and access roads. Such projects may only be authorized upon a specific finding by the trustees of the internal improvement trust fund that there is assurance that the project will be constructed and operated in a manner that will not adversely affect the water quality of the preserve. This subsection shall not approve the connection of upland canals to the waters of the preserve.

(d) Such dredging as is necessary for the purpose of eliminating conditions hazardous to the public health or for the purpose of eliminating stagnant waters, unsightly mud flats, islands, and spoil banks the dredging of which would enhance the aesthetic quality and utility of the preserve and is clearly in the public interest as determined by the Trustees of the Internal Improvement Trust Fund.

Any dredging or filling under this section or improvements under section 5 hereof shall be approved only after public notice and hearings in the area affected pursuant to chapter 120, Florida Statutes.

(3) There shall be no drilling of wells, excavation for shell or minerals, and no erection of structures (other than docks), within the preserve, unless such activity is associated with activity authorized by this act.

(4) The Board of Trustees shall not approve any seaward relocation of bulkhead lines or further establishment of bulkhead lines except when a proposed bulkhead line is located at the line of mean high water along the shoreline. Construction, replacement or relocation of seawalls shall be prohibited without the approval of the trustees of the internal improvement trust fund which approval may be granted only if riprap construction is used in the seawall.

(5) Notwithstanding other provisions of this act, the trustees of the internal improvement trust fund may, respecting lands lying within Biscayne Bay:

(a) Enter into agreements for and establish lines delineating sovereignty and privately owned lands; and

(b) Enter into agreements for the exchange and exchange sovereignty lands for privately owned lands; and

(c) Accept gifts of land within or contiguous to the preserve; and

(d) Negotiate for and enter into agreements with owners of lands contiguous to sovereignty lands for any public and private use of any of such lands; and

(e) Take any and all actions convenient or necessary to the accomplishment of any and all of the acts and matters authorized by this subsection (5).

Section 4. (1) The trustees of the internal improvement trust fund shall adopt and enforce reasonable rules and regulations to carry out the provisions of this act and specifically to provide:

(a) Additional preserve management criteria as may be necessary to accommodate special circumstances; and

(b) Regulation of human activity within the preserve in such a manner as not to unreasonably interfere with lawful and traditional public uses of the preserve, such as fishing (both sport and commercial), boating and swimming.

(2) Other uses of the preserve, or human activity within the preserve, although not originally contemplated, may be permitted by the trustees of the internal improvement trust fund, but only subsequent to a formal finding of compatibility with the purposes of this act.

Section 5. Neither the establishment nor the management of the Biscayne Bay aquatic preserve shall operate to infringe upon the riparian rights of upland property owners adjacent to or within the preserve. Reasonable improvement for ingress and egress, mosquito control, shore protection, public utility expansion, and similar purposes may be permitted by the trustees of the internal improvement trust fund, or department of pollution control, subject to the provisions of any other applicable laws under the jurisdiction of other agencies.

Section 6. No wastes or effluents shall be discharged into the preserve which substantially inhibit the accomplishment of the purposes of this act.

Section 7. The provisions of this act may be enforced in accordance with the provisions of section 403.412, Florida Statutes; provided further the department of legal affairs is authorized to bring an action for civil penalties of five thousand dollars ($5,000) per day against any person, natural or corporate, who violates the provisions of this act or any rule or regulation issued hereunder.

Section 8. The provisions of this act shall be subject to the provisions of sections 403.501 through 403.515, Florida Statutes.

Section 9. If any provision or application of this act is held to be invalid or nonoperable for any purpose such holding shall not affect the validity or operation of the remaining provisions or applications of the act, and to this end the provisions and applications of this act are deemed to be severable.

Section 10. This act shall take effect immediately upon becoming a law.

Approved by the Governor June 11, 1974.

Filed in Office Secretary of State June 12, 1974.

C. MARINE ORIENTED PARKS

Name	Acres	Facilities		Administrative Agency
		Existing	Proposed	
Biscayne National Monument (SE Dade County)	96,300	camping docking fishing nature trails		U.S.Park Service
Cape Florida State Park (Key Biscayne)	900	beach picnicking fishing		Florida Park Service
South Bayshore Property (South of Turkey Point)	110	nature preserve		Dade County
Black Point Park (SW 248 St.and Biscayne Bay)	548		boat ramp campground swimming fishing nature trails	Dade County
Chapman Field (SW 136 St. and Tigraham Highw	566		marina boat ramp picnicking	Dade County
Crandon Park	1,220	marina boat hoist boat ramp bicycle path nature trails		Dade County
E. Greynolds Park (NE 163-171 St.)	58	bird rookeries	fishing picnicking bird rookery	Dade County
Greynolds Park (NE 20 Ave.and 174-186 St.)	170	bird rookeries	fishing picnicking	Dade County
Haulover Beach (10500 Collins Ave.)	172	beach picnicking boat ramp docking fishing		Dade County
Homestead Bayfront Park (SW 312 St. and Bay)	910	beach picnicking boat hoist boat ramp docking		Dade County
Matheson Hammock (Old Cutler Road and SW 97 St.)	561	beach picnicking boat ramp docking nature trails		Dade County
Pelican Harbor (N.Bay Causeway)	44.2	boat hoist boat ramp docking		Dade County
79th Street Boat Ramp (79 St. Causeway)	37.5	boat ramp fishing		Dade County

Sunny Isle Beach (Sunny Isles Boulevard)	.5	beach fishing		Dade County
Virginia Beach (Virginia Key)	145	beach fishing picnicking		Dade County
Bayfront Park (SE 2 to NE 6 St.)	39.3	marina docking		Miami
Coconut Grove Bayfront Park (McFarlane Rd. and Bayshore Dr.)	15	picnicking		Miami
Dinner Key (SW 27 Ave. and Bayshore Dr.)	41	marina boat ramp docking		Miami
Legion Park (NW 66 St. and Biscayne Boulevard)	13.5	picnicking	marina	Miami
Morningside Park (NW 55 Terr. and 7 Ave.)	33.7	boat ramp picnicking		Miami
"Old Port Site"	10		aquisition of 10 acres from FEC RR anticipated	Miami
Virginia Key Stadium (Virginia Key)	1,559	boat racing spectator		Miami
Wainwright Park (U.S.1 and Brickell Ave.)	16		nature study	Miami
Watson Island Park (Watson Island)	65	boat ramp nature study		Miami
Altos del Mar (80 St. and Collins Ave.)	9	beach picnicking		Miami Beach
Collins Park (21 St. and Collins Ave.)	7.7	beach		Miami Beach
Government Cut Park (Alton Rd. and Government Cut)	7.1	scout camp	marina fishing	Miami Beach
Indian Beach (46 St. and Collins Ave.)	10.3	beach		Miami Beach
Lummus Park (600-1400 Ocean Dr.)	48.2	beach		Miami Beach
North Shore Beach (72 St. and Collins Ave.)	68	beach		Miami Beach
Ocean Front Park (2-3 St. and Ocean Dr.)	64	beach		Miami Beach
Pier Park (55 Ocean Dr.)	4.7	beach fishing		Miami Beach
64th Street Park	3.2	beach		Miami Beach
Loggia Beach	0.8	beach		Golden Beach
Interama (Bay and 135 - 163 St.)	1,698		350 acres deeded to N. Miami for park development	Various

EDITOR'S NOTE: The foregoing would not have been possible without the active assistance of many individuals and organizations. Chief among them are faculty members of the Rosenstiel School of Marine and Atmospheric Science, who authored sections; they are followed closely by colleagues who provided invaluable information and review: Gary Beardsley, Randy Bushey, James Carpenter, Donald deSylva, James Higman, Shirley Pomponi, Raoul Rehrer, Frank Rose, Peter Rosendahl, Lowell Thomas, Co Van de Kreeke, Gilbert Voss, and Robert Work as well as Ron Shamling of the Greater Miami Chamber of Commerce. Governmental agencies gave generously of their time and knowledge. They include: U.S. Geological Survey; the National Marine Fisheries Service and the National Weather Service of NOAA; Florida Department of Natural Resources; Metropolitan Dade County Departments of Health, Parks and Recreation, Planning, Pollution Control, Public Safety, and Water and Sewers; and the City of Miami Departments of Parks and Public Safety. We are also indebted to Florida Power & Light Co., Southern Bell Telephone Co., and Wometco Enterprises.