CONSERVATION AND COASTAL ELEMENT DATA INVENTORY AND ANALYSIS

This section addresses the data inventory requirements supportive of the development of goals, objectives, policies, and implementation programs for the Conservation and Coastal Element. (§9J-5.012(2) and §9J-5.013(1), F.A.C.)

Environmental Setting of Marathon and the Florida Keys

The low-lying limestone islands comprising the Florida Keys extend 233 miles southwestward in a gradual arc from Biscayne bay at the southeastern tip of the Florida peninsula to the Dry Tortugas in the Gulf of Mexico. Southeast of the Keys is the Florida Reef Tract, a continuous band of coral reefs bordering the Straits of Florida, lying five to seven miles offshore and extending 220 miles from Solider Key to the Dry Tortugas. To the west and northwest is Florida Bay, a shallow embayment of the Gulf of Mexico with an extensive network of carbonate mud shoals and seagrass beds (Florida DER, 1987d). At the top of the Upper Keys, Card Sound and Barnes Sound are shallow embayments which tie into Biscayne Bay.

Climate

Marathon and the Florida Keys experience a subtropical savanna-type climate characterized by warm humid summers and mild dry winters. The mean annual sunshine is 3,300 hours, ten percent more than the Florida Peninsula to the north.

The average annual temperature in the Florida Keys ranges from a summer high of 89 degrees in July to a winter low of 63 degrees in February. Temperatures below freezing have not been recorded in the Keys, primarily due to the meliorative effects of the warm marine waters in the area and the presence of the warm Gulf Stream along the coast.

The average annual total precipitation in the Keys is estimated at 36 inches. Most of the rainfall comes in the wet season during the months of May through October. Winter rainfall accounts for less than one-third of the annual precipitation. Thunderstorms are the primary source of water during the wet season. During hot summer days, moist oceanic air heats up over the land, becoming unstable and rising. As the moisture condenses, thunderstorms form. This process is favored by the orientation of the Keys, which lie at approximate right angles to the prevailing easterlies. During the dry winter season, most of the rainfall is due to cold fronts which pass over the area on the average of once a week. Day-long dry-season storms are rare.

There is a net decrease in precipitation and seasonal difference in precipitation southward from the Upper Keys to Lower Keys. This is due to two factors. Winter cold fronts do not pass into the Lower Keys as often as they pass into the Upper Keys. Further, convective thunderstorms do not develop as readily over small islands as they do over the mainland.

Prevailing tradewinds from the east and southeast in the Keys are relatively mild, averaging 11 to 12 knots throughout the year. The strongest winds occur during the winter months from December through March, when cold fronts move over the area from the northern quadrants.

The Keys lie in an area which is susceptible to tropical cyclones and hurricanes. These low pressure systems vary in intensity and orientation. Tropical depressions or disturbances are cyclones with winds of less than 38 miles per hour (mph). By comparison, tropical storms exhibit distinct circulation patterns, with winds exceeding 38 mph. When the maximum winds exceed 74 mph, the storm becomes a hurricane.

Physiography, Geology and Mineral Resources

Physiographic Features

The Florida Keys belong to the Southern Zone of the Coastal Lowlands physiographic province, also referred to as the Gold Coast and Florida Bay. This area lies south and southeast of Lake Okeechobee, is primarily underlain by Pleistocene limestone, and is characterized by low relief, poor drainage and extensive areas of coastal mangrove swamps. Elevations on the Keys are low, generally less than five feet above sea level. Most of the land area is only 2 to 3 feet above high tide. The highest point lies on Windley Key, where the maximum elevation is 18 feet above sea level.

The islands generally slope very gradually up from the sea to flattened, gently rounded tops (Lane, 1986). Irregularities of the rock surfaces are a result of the heterogeneous topography of the coral reefs that created the islands, and also the result of erosion and solution of the limestone rocks (Lane, 1986). Solution features, such as pitted and pinnacled surfaces occur throughout the Keys, including many sinkholes, filled with peat or carbonate sediments, up to several feet in diameter and several feet deep (Lane, 1986).

Geologically and physiograpically, the Florida Keys can be divided into three main areas: the Upper Keys (Coral Reef Keys); the Lower Keys (Oolitic Keys); and, approximately 50 miles to the west, distal atolls, otherwise know as the Dry Tortugas.

Upper Keys

Marathon is part of the Upper Keys which are a linear chain of islands made up primarily of limestone coral rock. The main axis of the islands lies parallel to the main access of the chain. They extend from Soldier Key in Dade County to the north, to the New Found Harbor Keys. On their seaward side lies a well developed reef tract composed of an outer fringe reef that borders the inner edge of the narrow continental shelf. Between the Keys and this relatively continuous outer fringe reef, shallower banks and deeper channels dotted with patch reefs run parallel to the islands. These living reefs, unique in the United States, are best developed in the Upper Keys area. Because corals are exceedingly sensitive to turbidity, their development is favored by the long orientation of the Upper Keys and the lack of tidal channels providing water circulation from Florida Bay. This blocks the influx of carbonate muds from the bay and prevents silting of the reef tract.

Geology

Structure and Geologic Setting
The Florida Keys, Florida Bay and Everglades National Park are underlain by the Floridan Plateau. This plateau separates the Gulf of Mexico from the Atlantic Ocean, extending offshore beyond the present land mass beneath all of the submerged areas surrounding the state to the edge of the continental shelf at approximately the 300 foot depth contour (SWFMD, 1991). In the Gulf, the plateau slopes gently to the west and extends out to 150 miles offshore; on the south and east, the plateau drops off sharply into the Straits of Florida, approximately 5 to 7 miles offshore.

Marine carbonate sediments nearly 20,000 feet in depth underlie the Keys. These sediments range in age from Jurassic to Holocene and have accumulated over a period of 136 million years above a Triassic-Jurassic basement of volcanic rocks (Antoine & Harding, 1963). Beneath the Florida Peninsula the rock floor is a truncated surface of various igneous and sedimentary rocks of chiefly Precambrian and early Paleozoic age (SFWMD, 1991).

Stratigraphy
Although the Mesozoic sediments represent thicknesses well in excess of 10,000 feet, only the more recent Cenozoic sediments have a direct bearing on the history and formation of the Keys. Of these, the most important are the sediments deposited since Miocene time, including the Miami Oolite, the Key Largo Limestone, the Tamiami Limestone and the Hawthorne Group.

Reconstruction of the past is complicated by oscillations in sea level which have occurred since Middle Tertiary Miocene times. Some 20,000 years ago, sea level may have been as low as 450 feet below present level. Geologic evidence, such as the presence of peat under Crane Key 4 to 10 feet below present sea level, indicates a much lower sea level as recently as 4,000 years ago. Recent indications are that sea level has risen some 8 to 10 inches during the past century alone.

Hawthorne Group
The Hawthorne Group underlies both the Miami Oolite and Key Largo Limestone and acts as confining layers which inhibits the downward movement of groundwater. It separates the surficial aquifer system from the Floridan Aquifer System. It is relatively impermeable and consists of silt, clayey sand and sand. It is phosphatic and greenish in color. The formation averages approximately 60 to 90 meters in thickness throughout the Florida Keys area.

Natural Resources
This section identifies and inventories the physical and natural resources found within the City. The physical natural resources are presented first followed by the biological natural resources.

Physical Natural Resources

Physical natural resources discussed within this subsection include air, floodplain, water, minerals, and soil.

Air Quality

The US Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (DEP) have implemented an air quality monitoring program throughout the State which measures concentrations of major pollutants in the ambient air. This program is designed to provide data regarding compliance with the legal limitations on concentrations of major pollutants in the ambient air established by both EPA and DEP. Ambient air is defined as that portion of the atmosphere near ground level and external to buildings or other structures.

Legal limitations on pollutant concentration levels allowed to occur in the ambient air, or ambient air quality standards, have been established by the EPA and the DEP for six pollutants: carbon monoxide (CO), lead, nitrogen dioxide (NO2), ozone (O3), particulate matter (10 microns or less in diameter (PM10) and 2.5 microns or less in diameter (PM2.5)), and sulfur dioxide (SO2). Since health-based criteria have been used to establish the standards, these six pollutants are referred to as 'criteria air pollutants'.[1] (see Table 4.1) Two types of national ambient air quality standards (NAAQS) have been established by the EPA for each pollutant. "Primary ambient air quality standards are established to protect public health. Secondary ambient air quality standards are established to protect the public welfare including the protection of animal and plant life, property, visibility and atmospheric clarity, and the enjoyment of life and property."[2]

Air quality in the Florida Keys is generally excellent. Low intensity development combined with the limited number of point sources of pollution has resulted in low pollutant loads. The pollutant loads that are generated are quickly dispersed by the sea breezes. Based upon ambient air quality monitoring, the DEP has designated Monroe County as an attainment area for all six major air contaminants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). The attainment area designation indicates that the concentrations of major pollutants are within the acceptable limits set by the DEP and the EPA.

The DEP operated two air quality stations in the Keys to measure particulate matter (PM 10). Overall, the DEP rates the air quality in Marathon as excellent, and as a result has decommissioned these two monitoring stations. The first station, located at the DEP office in Marathon, was operational until September 27, 2000. The second station, located at Gerald Adams Elementary School on Stock Island, was discontinued on October 1, 2001. The air quality standard for PM10 is an annual arithmetic mean of 50 $\mu g/m^3$ with any one 24-hour period not to exceed 150 $\mu g/m^3$. The Marathon Station had an annual arithmetic mean of 19 $\mu g/m^3$ in 1998; 15 $\mu g/m^3$ in 1999 and a mean of 19 $\mu g/m^3$ to the date of decommissioning in September of 2000. (Florida Department of Environmental Protection, 2002)

Table 4.1:

[1] Florida DEP, Air Monitoring Report, 2002, pp. 10

[2] Florida Statues - 62-204.200 (5)(a).

State and Federal Ambient Air Quality Standards.
(Note: In 1987, the ambient air quality standards for particulate matter were revised and made applicable to inhalable particles, i.e., particles less than 10 micrometers in diameter.)

Averaging Time	Florida Standard	Primary NAAQS	Secondary NAAQS
8-hour	9 ppm	9 ppm	--
1-hour	35 ppm	35 ppm	--
Quarterly[b]	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$
Annual[b]	100 $\mu g/m^3$ (.05 ppm)	.053 $\mu g/m^3$ (100 $\mu g/m^3$)	.053 $\mu g/m^3$ (100 $\mu g/m^3$)
1-hour[c]	0.12 ppm	0.12 ppm	0.12 ppm
8-hour[d]	--	.08 ppm	.08 ppm
Annual[b]	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$
24-hour[c]	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$
Annual[b]	--	15 $\mu g/m^3$	15 $\mu g/m^3$
24-hour[c]	--	65 $\mu g/m^3$	65 $\mu g/m^3$
Annual[b]	1.5 $\mu g/m^3$	0.030 ppm	--
24-hour[a]	1.5 $\mu g/m^3$	0.14 ppm	--
3-hour[a]	1.5 $\mu g/m^3$	--	0.5 ppm

a - Not to be exceeded more than once per year.
b - Arithmetic mean.
c - Not to be exceeded on more than an average of one day per year over a three-year period.
d - Not to be exceeded by the three-year average of the 4th highest daily max.
e - Not to be exceeded by the three-year average of the 98th percentile of the 24-hour averages.

Source: Florida DEP, Air Monitoring Report, 2002, page 11

Known Sources of Air Pollution in Marathon

Potential sources of air pollution in the City of Marathon generally include vehicle emissions, naturally occurring sea salt, airborne dust from disturbed areas, controlled open burning, and point sources (permitted under Chapter 17-2 and Chapter 17-4, Florida Administrative Code). Florida Keys Electric Co-operative is the only source of air pollutants with an active DEP Permit within the City.

Potential for Conservation, Use, or Protection of Air Quality in the City of Marathon

Ambient air quality in the City and the Keys is likely to remain excellent due to the low intensity of development, sea breezes and limited number of point sources of pollutants. However, actions can be taken by local government to reduce the potential for localized concentrations of pollutants, particularly particulates and to support initiatives for statewide programs to reduce vehicle emissions.

Particulates escaping from disturbed areas in the form of fugitive dust can be controlled by on-site dust control measures. Areas exposed during construction can be treated with mulch, spray,

grass, or other appropriate methods in order to control dust. Use of these measures can be required as a condition of Development Orders.

Floodplains

Floodplain Occurrences

Flood Elevations for the 100-year floodplain range from 6 to 15 National Geodetic Vertical Datum (NGVD) feet above the mean sea level. The National Flood Insurance Program administered by the Federal Emergency Management Agency has determined that all of the land area within the City is subject to flooding from a 100-year storm. *Map 7: FIRM Flood Zones* of the map series illustrates the flood zones within the City.

Most of the land area in Marathon is, on average, 2 to 3 feet above mean sea level. Maximum elevations reach approximately 6 to 7 feet above mean sea level in a few areas. As a result, Marathon and the Keys are extremely susceptible to storm flooding.

Floodwater sources potentially affecting Marathon include the Atlantic Ocean, Florida Bay, and the Gulf of Mexico. In general, coastal areas which border these water bodies are subject to storm surge flooding as a result of hurricane and tropical storm activity. Large tidal surges, combined with wave action and heavy rainfall that accompany these storms typically can result in severe flooding.

The Federal Emergency Management Agency completed a detailed coastal flooding analysis of the complete coastline of Monroe County, including Marathon (FEMA, 2003). This study investigated the existence and severity of flood hazards. Both floodplain maps and flood elevations were developed. Analyses were carried out to establish the peak elevation-frequency relations for each flooding source. Hydraulic analyses, considering storm characteristics and the shoreline and the bathymetric characteristics of the flooding sources studied, were completed to provide estimates of the elevations of floods of the selected recurrence intervals along all shorelines in the Keys (FEMA, 2003)

Flood zone designations which have been assigned to areas within Marathon are as follows:

- *Zone AE*: Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by detailed methods. In most instance whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.
- *Zone VE:* Zone VE is the FIS zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Existing Commercial, Recreational or Conservation Uses in the Floodplain

Flood elevations for the coastal storms having a recurrence interval of 100 years (Zone AE) range from 7 feet to 12 feet NGVD. Because all of the City of Marathon lies below this elevation, water from this intensity storm would flood all areas within the city. All commercial, residential, recreational, and conservation uses within Marathon are located in the floodplain.

Known Pollution Problems or Issues Related to Flooding Hazard

The potential for surface water contamination from flooding in Marathon arises primarily from the widespread use of poorly functioning on-site wastewater disposal systems or complete lack of a system. When flooded these systems typically can provide little or no treatment and wastewater discharge is relatively untreated into the soil or directly into adjacent surface waters. This condition would persist following subsidence of flood waters until soil moisture is reduced to normal levels.

The potential for surface water contamination from flooding also exists where hazardous materials and hazardous wastes are stored. However, aboveground and underground storage tanks, if constructed and maintained according to current state and federal regulations, should be adequately protected from rupture by flood waters and should not constitute a serious threat of contamination. Pollutant loadings to surface water from urban runoff would be elevated during major storms.

Potential for Conservation, Use, or Protection from Flood

Because all of Marathon is located within the 100-year floodplain, potential activities for conservation, use, or protection of floodplain are related to those which:

a. prevent disturbances to areas which provide critical flood water storage and filtration functions, including mangroves, salt ponds, saltmarsh and buttonwood wetlands, and freshwater wetlands;
b. prevent excessive clearing and disturbance to natural upland vegetation within the floodplain; and
c. minimize the alteration of natural drainage patterns within the floodplain.

Lands which retain natural floodplain functions or water storage filtration should be retained where possible, in their natural condition. This includes all wetlands within the City. Development activity should be directed away from areas of high quality upland vegetation which lies in the floodplain, including hardwood hammocks and pinelands. Land clearing, grading and filling should not disturb natural drainage patterns.

Marine Water Resources

Hydrographic setting

Overview

The Florida Keys lie between the lagoonal system of the Florida Bay and the oceanic waters of the Atlantic Ocean. North Key Largo is the only exception, located between the Atlantic Ocean and Card Sound and Barnes Sound, within the watershed of Biscayne Bay. Waters of Florida Bay, Biscayne Bay, and the Atlantic Ocean offshore of the Keys are topical and oligotrophic, characterized by a mosaic of interacting biological communities, including coral reefs, seagrass beds, and mangrove forests. The former lies along the City's southern shoreline and the latter along its northern shoreline. Boot Key Harbor, a large sheltered port of deep water and shallow grass beds, lies between Key Vaca and Boot Key. Many man-made canal systems and excavated basins are found within residential subdivisions in the City on both the ocean and the bay side.

The configuration and orientation of the Keys control the nature of tidal mixing between the estuarine waters and the oceanic waters. The islands comprising the Upper Keys, including Marathon, constitute a continuous barrier to the exchange of water between Florida Bay, Biscayne Bay, and the Atlantic Ocean.

Some cyclical lateral flow of groundwater occurs throughout the Keys from one side of the islands to the other (Ginsburg, 1956; 1974; and Enos, 1977). This is the result of the porosity of the Miami limestone and the Key Largo limestone, tidal gradients, and the narrow width of the Keys. (Source: Monroe County Comprehensive Plan Technical Document)

Florida Bay

Florida Bay is an extensive shallow estuarine receiving basin for runoff from mainland Florida. The Bay varies from a positive functioning estuary during high rainfall years to a tropical, highly saline, lagoon during years when evaporation exceeds upland runoff and oceanic exchange (Tilmant, 1989). Circulation within the Bay is primarily tide and wind driven. Florida Bay is generally isolated from the Gulf Loop Current and Florida Current.

The most significant environmental parameters affecting Florida Bay are the quantity, quality, distribution, and timing of freshwater runoff from the Florida mainland. Contributing drainage routes to the Bay include Shark Slough and associated estuaries on the western side; and Taylor Slough and the C-111 basin on the east. There is an inverse relationship between salinity in northern Florida Bay and the height of the south Florida groundwater table (Tabb, 1967; Thomas, 1974; SFWMD, 1991).

The most characteristic feature of Florida Bay is an astonishing array of shallow mud banks composed of shelly calcareous silts that cordon the may into a lacework of interconnected shallow basins, referred to as “lakes” (Multer, 1977). These basins are generally shallow, five to six feet deep, and nowhere do the exceed depths of ten feet (Ginsburg, 1964).

The Central Bay is characterized by small basins, shallow water, and restricted tidal flow (SFWMD, 1991). The Western Bay experiences more tidal exchange than the upper two bays (SFWMD, 1991) due to the presence of tidal channels between the Keys south of Upper Matecumbe Key.

Much of Florida Bay is characterized by extensive seagrass beds. The majority of the carbonate sediments on the Gulf side of the Lower Keys have been trapped by the marine grass *Thalassia testudinum* and the calcareous green alga *Halimeda opuntia* (Schomer and Drew, 1982).

Atlantic Ocean

The shallow submerged seastrate on the east side of the Florida Keys extends from the shoreline to the shallow shelf break at the edge of the Floridan Plateau. There at the 300-feet depth, approximately 5 to 7 miles offshore, the bottom falls off into the Florida Straits.

The Florida Current, running south and east of the Keys, generally controls the hydrology of the oceanic waters landward of the Straits of Florida. Circulation is influenced by tides and winds, both of which vary by season. In winter, water movement is toward the south-southwest, caused in part by changes in atmospheric pressure. In summer, waters move in a northeastern pattern in response to southeast winds.

Shoreline features of the Atlantic coastline include small tidal creeks, harbors, and embayments. Numerous large channels provide connections between the oceanic and the shallow nearshore waters in the Lower Keys. Shallow water less than 20 feet in depth extends approximately two miles offshore in the Upper Keys, including Marathon.

The nearshore area is typified by a belt of exposed rocky bottom. The intertidal zone is a broad, shallow shelf of exposed bedrock material with a thin veneer of sediment. The bedrock surface is crenellate and solution pocked, the result of the soluble nature of limestone and the burrowing and boring organisms that inhabit the intertidal zone (Florida DNR, 1991 c).

In subtidal areas the hardbottom is interspersed with accumulations of calcareous mud associated with areas of restricted circulation. This mud is extremely fine and is the product of the decomposition of calcareous algal skeletons (Enos, 1977). Some mud is produced within the Florida Bay and is introduced through tidal channels. Where mud depth exceeds 3 inches and where current velocities are low, the mud bottom is stabilized by seagrasses (Scoffin, 1970). In contrast, where sediment is thin, the bottom is colonized by hardbottom coral communities. Patch reefs develop on the sand, mud and rock substrate of the Straits of Florida where light, nutrient, and current conditions are favorable and where the bottom is protected from nutrients and sediment circulating from Florida Bay. Bank reefs of the Florida Reef Track occur at or near the shallow shelf break at the edge of the Straits of Florida, where they are bathed by the warm waters of the Florida Current.

Bare sand substrate is known to occur adjacent to the Keys' shoreline in the vicinity of tidal channels of the Lower Keys and in the nearshore region of Boca Chica Key, Big Munson Island, Bahia Honda Key, Ohio Key and Grassy Key (Marszalek, 1984)

Ambient Water Quality Conditions

There is a common public perception in the Florida Keys that water quality has deteriorated in recent years and that the documented decline in coral reef and seagrass biological communities is the result of water contamination from anthropogenic sources. Researchers looking at nearshore and confined waters have documented deteriorated water quality conditions and identified various human activities which appear to be causing these impacts. There is agreement that a range of human activities are discharging contaminants into the nearshore waters of the Keys. There is not agreement as to the specific loadings associated with these activities and their effects on offshore seagrass and coral communities.

The waters of the Florida Keys are largely included within the limits of the Florida Keys National Marine Sanctuary (FKNMS). The purpose of this sanctuary designation, and the water quality and general management programs required as a result of this designation, are discussed in more detail below. Presently, the EPA, DEP, the National Oceanic Atmospheric Association (NOAA), South Florida Water Management District (SFWMD), Monroe County, and the City of Marathon are working cooperatively on a Water Quality Protection Program for this latest of National Marine Sanctuaries. An initial goal of this effort is to reach consensus among researchers and regulators as to the condition of the Florida Keys nearshore and offshore waters, and to agree as to the extent to which existing data can confirm relationships among human activities, water quality, and the evident decline in seagrass and coral reef communities within the Sanctuary.

Overview of Studies Evaluating Present Status and Trends in Water Quality

Comprehensive long-term water quality monitoring data are not available for Florida Keys waters. In a recent DER report, the state ranked Monroe County's waters as the least studied in the state, with over 90 percent of its waters still unassessed for water quality (Florida DER, 1988 c).

Phase I of the FKNMS Water Quality Protection Program (CSA, 1991) confirms this finding, stating that:

> "The studies summarized not only provide an overview of the water quality in the [FKNMS], but they also indicate the relative paucity of data presently available to assess the water quality of the Keys. Insufficient data were available to demonstrate temporal changes in water quality because well designed, long-term studies have not been conducted."

Past water quality studies have been limited by-and-large to short-term (one year or less) water quality monitoring, usually comparing impacted or developed sites to undeveloped or offshore control sites. Impacted sites typically have included artificial water bodies such as canals.

Since 1985 there have been three water quality studies of a larger scale undertaken in the Florida Keys:

Florida Department of Environmental Regulation. 1985. Proposed designation of the waters in the Florida Keys as Outstanding Florida Waters. DER, Tallahassee, Florida 56 pp. plus appendices.

Florida Department of Environmental Regulation. 1987d. Florida Keys monitoring study, water quality assessment of five selected pollutant sources in Marathon, Florida. DER, Marathon, Florida. 196 pp.

Lapointe, B.E. and M.W. Clark. 1990a. Final report: Spatial and temporal vairablity in tropic state of surface waters in Monroe County during 1989-1990. Florida Keys Land and Sea Trust, Marathon, Florida. 81pp.

CSA (1991) identified several additional studies which provide data on water quality in the Florida Keys including: Applied Biology, Inc., 1985; Bader et al., 1971; DER 1991b; Nnaji, 1987; Schmidt et al., 1978; Skinner et al., 1986; Skinner et al., 1989; and Szmandt, 1991.

DER, 1985

In 1985, DER undertook a comprehensive review of water quality conditions in the Florida Keys. The purpose of this study was to determine eligibility of the Florida Keys waters for designation as "Outstanding Florida Waters" (OFW). The evaluation of water quality focused on findings from previous studies as well as ambient water quality data collected from a special one-time sampling from 81 stations (49 ambient; 32 artificial waterways) on the Oceanside of the Keys and from 84 stations (46 ambient and 38 artificial waterways) on the bayside of the Keys. Ambient stations were located approximately ¼ mile offshore. Artificial waterways sampled included canals, boat basins and marinas adjacent to trailer parks, single and multiple family dwellings, and commercial operations.

The data pertinent to Marathon from the historical water quality surveys evaluated during this study are briefly summarized below. In addition to the studies listed, DER maintained a permanent monitoring station at John Pennekamp and secondary monitoring stations at Angelfish Creek, Lignumvitae, Bamboo Keys, Wisteria Island, and Flamingo, from 1976 through 1985. DER summarized findings from these studies as follows (excerpted from DER, 1985):

1. Special studies done by various consultants, the state, and EPA have demonstrated that canal construction severely affects water quality, especially dissolved oxygen;
2. Point source dischargers have not been shown to be a major problem. However, trend data may show subtle effects when sampled for long period;
3. Sources such as septic tanks and boreholes may significantly affect water quality;
4. Some studies of construction projects, such as the bridge replacement program, have not documented any post-construction water quality problems;
5. Several studies have pointed to a need for centralized wastewater treatment;
6. The available water quality data show few violations of water quality standards. However, the fragility of the coral reef and mangrove communities probably require stringent controls on pollution sources. Subtle changes in coral rings may reflect changes in water quality that are difficult to measure. Although large masses of water such as the Gulf Stream and Florida Current provide a buffer against rapid change by man, the long-term effects of rad and other construction, boating and recreation, and sewage disposal require more study.

Results of the ambient water quality survey completed by DER in 1985 as part of the OFW designation study are summarized as follows (Florida DER, 1985):

1. The overall water quality survey indicated that all the ambient waters in the Florida Keys met or exceeded the standards for Class III waters. Waters within artificial waterways (canal, marina and boat basins), frequently appeared impacted and degraded;

3. The dissolved oxygen (DO) standard was the most frequently violated in the artificial waterways;
4. Bayside impact stations exhibited the highest number of DO violations, with 6 occurring at the surface, 6 at mid-depth and 8 at the bottom. (This represents a 17.6% and 23.5% occurrence in bayside artificial waterway, while ambient waters displayed zero violations);
5. Oceanside stations reflected similar results with no violations at ambient stations, while 4 surface, 6 mid-depth and 4 bottom measurements fell below the standard at impact stations;
6. A wider range of DO levels also occurred in artificial waterways, with some canals in compliance and others severely degraded. (DO levels of 0.0 mg/l were recorded at the Bahia Shores Subdivision canal station);
7. A majority of impact stations had higher levels of total phosphorus (P-TOT), total Kjeldahl nitrogen (TKN), ammonia (NH_2+NO_3-N). (The highest recorded for any parameter was 1.150 mg/l TKN at the Lake Surprise Estates waterway station);
8. Normal ambient bayside TKN levels ranged between 0.128 and 0.693 mg/l; and
9. The mean values for all nutrient parameters of both bayside and Oceanside impact stations were all significantly elevated above ambient stations.

DER, 1987d

In 1987, DER undertook additional study of Florida Keys waters. The study was initiated to establish a water quality data base designed to assess the relative impacts of the following major pollution sources (Florida DER, 1987d):

1. Raw sewage and petroleum hydrocarbon discharges from boats, specifically live-aboard boats in marinas;
2. Discharge from seafood processors and commercial fishing operations, including wastewater, fish wastes, and waste oil from trap-dipping operations (this process was prohibited in July 1990);
3. Discharges from stormwater collection systems;
4. Treated effluent from sewage treatment plants; and
5. Septic tank leachate through groundwater seepage.

Most of these sources throughout the Keys discharge into canals or enclosed basins and are not subject to rapid mixing with offshore waters (Florida DER, 1987d).

The goals of the monitoring study were (1) to assess the degree of water quality deterioration for each source; (2) to identify the cause(s) of that degradation; and (3) to recommend wastewater disposal solutions that would improve water quality, with particular consideration given to centralized wastewater treatment facilities in the Marathon area (Florida DER, 1987d.)

A total of 32 water quality parameters were monitored at 12 stations for one year beginning in February 1984. Five primary stations were located at the discharge site of a pollutant source. Five secondary sites were situated in areas adjacent to the canal entrances of each corresponding primary station to monitor dilution of pollutant concentrations by open water. Two control stations were located in ambient waters one mile offshore.

Water quality monitoring results for the five sources were as follows (excerpted from DER, 1987d):

1. Faro Blanco Marina
   Water quality parameters which were significantly impacted in comparison with ambient conditions included DO, Ph, coliform bacteria, TKN, and total phosphorus. Sediments in the marina basin also exhibited substantial accumulations of coprostanol, heavy metals, and petroleum hydrocarbons.
2. National Fisheries
   The boat basin at City Fish Market experienced consistent severe deterioration of water quality due to discharges form the seafood processing plant and fishing boats. Only 5 of the 22 monitored parameters (temperature, suspended solids, nitrite, nitrate, and mercury) were not significantly impacted within the basin.
3. Winn-Dixie (Office Depot) Stormwater Drainage System
   The canal system receiving stormwater drainage from the shopping center parking lot suffered few of the impacts normally associated with input of contaminated stormwater. A partially occluded effluent pipe and inefficient drainage of the parking lot apparently minimized the amount of stormwater discharged to the waterway. Thus, significantly degraded water quality parameters at the outfall were limited to DO, Ph, phosphorus, total coliform bacteria and heavy metals. Only Ph was significantly affected at the canal mouth.
4. Key Colony Beach Sewage Treatment Plant Outfall
   No significant bacterial contamination or nutrient enrichment was apparent near the outfall, probably due to its location in an open, tidally influenced embayment. Those water quality parameters at the outfall that differed significantly from ambient conditions, did not severely stress environmental quality.
5. 90^{th} Street Canal
   The 90^{th} Street canal suffers from fecal contamination and high levels of mercury, lead, zinc, copper, and hydrocarbons in the sediments. Iron levels, much higher than ambient levels, are indicative of septic tank leachate and stormwater runoff.

Lapointe and Clark, 1990a

Lapointe and Clark (1990a) described and analyzed the spatial and temporal variability in the existing trophic state of nearshore waters in Monroe County. The study was conducted between 9/12/89 and 9/19/90 at 30 sites throughout the nearshore waters of the County. Sites included six bank reef sites, four patch reef sites, seven seagrass/macroalgae meadows, 13 canal/contiguous bay sites. Sampling was designed to assess spatial variability of water quality within each site and thus to better detect potential nutrient impacts from adjacent land uses. At each site, three sampling stations were selected along a transect of variable length perpendicular to the adjacent shoreline, canal system or reef system. The findings are summarized below:

1. Variability in Dissolved Oxygen
   Site accounted for most of the variability in dissolved oxygen, with typically higher values at the bank reef sites compared to lower values in nearshore waters, especially canal systems and seagrass beds of Florida Bay.

Dawn DO concentrations were generally lower during the summer, when 13 out of the 30 stations (primarily developed canal sites and seagrass sites in Florida Bay) failed state standards for minimal DO concentrations.

Extremely hypoxic conditions (<1 mg/l DO) were observed during the summer at Rabbit Keys, Flamingo, Garfield Bight, Glades Canal, Boot Key Harbor, Doctor's Arm and Ocean Shores.

2. Variability in Nutrients, Chlorophyll and Turbidity
   Site accounted for most of the variability in dissolved and particulate nutrient concentrations, with consistently low concentrations on the bank reef sites when compared to nearshore waters.

   Ammonium, nitrate plus nitrite, SRP and total dissolved phosphorous concentrations were elevated in developed canal sites and Florida Bay sites when compared to the reef bank sites.

   Higher concentrations of particulate carbon, nitrogen and phosphorous occurred in canals and Florida Bay sites, with generally higher values during winter.

   Turbidity was primarily affected by time and was much higher during winter.

3. Variability within Canal Sites
   In contrast to developed canals, undeveloped "sub pens" canal system has less than half of the mean SRP concentration of the four developed canals and also had significantly greater DO.

   SRP concentrations at the "sub pens" were the same inside the canal system as at the adjacent station in OFW's, indicating no significant SRP enrichment within the canal.

4. Variability in Sediment Metals
   Metal concentrations in sediments varied significantly among stations, with concentrations of copper, iron, lead, zinc, and cadmium being highest in developed canal systems of the Keys and sites in upper Florida Bay.

Summary of Conclusions from Phase I of the Florida Keys National Marine Sanctuary Water Quality Protection Program

The Water Quality Assessment (Task 2) (CSA, 1991) completed for Phase I FKNMS Water Quality Protection Program describes the point and non-point sources of pollutants and the status of water quality in the Sanctuary. Findings are based upon a review of the available scientific data and literature including the referred literature, Florida State agency reports, and examination of Florida and Federal Agency records. The summary of finds regarding the status of water quality taken from the Phase I study (Task 2) (CSA, 1991) is as follows:

> "The studies…of the water quality in the Florida Keys National Marine Sanctuary…indicate the relative paucity of data presently available to assess the water quality of the Keys. Insufficient data were available to demonstrate temporal changes in water quality because well designed, long-term studies have not been conducted.
>
> Nearshore-offshore trends were very evident in all of the studies reviewed…Artificial waterways and canals in developed areas are subjected to nutrient load and the commensurate changes in increased organic matter and reduced dissolved oxygen concentration. For the most part, nearshore Outstanding Florida Waters are not subjected to the same level of nutrient loading as artificial canals and waterways. In areas of development, however, the data do indicate that some nutrient loading may be occurring. The studies reviewed do not indicate that offshore Outstanding Florida Waters are currently being subjected to degradation. Overall, the data indicate that areas that are well flushed (e.g, by exchange of water with the offshore oceanic region) tend to have good water quality. In nearshore areas where adequate flushing does not occur (i.e. areas subjected anthropogenic influx or nutrients), the water quality tends to be poor.
>
> This determination agrees with the water assessment performed by DER as part of the 305(b) study (Florida DER, 1990b). During this study, water quality was examined through an inventory of the STORET data base for the period to 1980 to 1989. It was determined that water quality in the Florida Keys was generally good in areas that wee well flushed because of exchanges with the Gulf of Mexico and Atlantic Ocean. Reduced flushing, however, exacerbated water quality problems in many manmade canals and marinas."

Known Existing Point and Non-Point Source Pollution Problems

Point sources Affecting Water Quality

Point sources of water pollutants are defined as wastewater discharges from facilities which flow directly into surface water. In Marathon these include sanitary wastewater treatment plants, water supply treatment plants and desalinization plants.

Inventory of Permitted Point Sources

Through the Federal Clean Water Act (33 United States Code), the USEPA requires the Florida DEP to control the Total Maximum Daily Load (TMDL) in all impaired waters. Pursuant to the 1998 303(d) list, the Florida Keys are listed as impaired waters, and are therefore federally required to operate under a National Pollutant Discharge Elimination System (NPDES). In March 2004, pursuant to Title 40 of the Code of Federal Regulations, Part 123.35 and Rule 62-624 F.A.C. , DEP designated the City of Marathon as a regulated municipality under Phase II of the NPDES. The City has a MS4 designation determined by criteria set forth in Rule 62-624.800 F.A.C.

All point sources are required to operate under a NPDES Permit issued by DEP, pursuant to the Florida Air and Water Pollution Control Act (Title XIX Chapter 403, Part I, F.S.). Phases 1 & 2 of the NPDES program require the City to obtain an NPDES permit, begin a stormwater utility and develop a basin management program. During phases 3 and 4 (year 2011) of the watershed

management cycle, DEP and the City of Marathon will jointly develop strategies to reduce the number of existing point source pollutant permits.

Non-Point Sources Affecting Water Quality

Non-point sources of water pollutants are defined as discharges made directly or indirectly to overland flow or groundwater. Non-point sources include domestic wastewater (package treatment) facilities, on-site wastewater disposal systems, abandoned and inactive landfills, marinas, live-aboard vessels, application of mosquito pesticides, and urban runoff.

Wastewater (Package Treatment) Facilities

DEP records indicate that there are 72 wastewater treatment facilities with operating permits in the City. These facilities provide wastewater treatment and disposal for schools, hospitals, restaurants, hotels/motels, trailer parks, campground, condominiums, resort complexes, and shopping centers. Most of these dischargers are small package plants (Type III), having a typical capacity of from 10,000 to 20,000 gpd; the few larger facilities with average daily flow of from 40,000 to 75,000 gpd primarily serve resorts (CSA, 1991).

Package treatment plants in the Keys discharge to groundwater via Class V injection wells, referred to as boreholes. Boreholes range in depth from 60 to 90 feet, with casing depth ranging from 30 to 60 feet. DEP now requires boreholes to be drilled to a depth of 90 feet and cased to a depth of 60 feet.

All permitted dischargers are required to submit monthly monitoring data to DEP reporting various water quality parameters. Although reports must include effluent for total Nitrogen and Phosphorus, there are no current maximum values required. In the year 2010, maximum limits will be established though DEP.

DEP undertook two studies to evaluate the impacts of borehole disposal of treated domestic effluent in the Keys. Merchant et al (1988) concluded that the secondarily treated domestic sewage being disposed of via Class V injection wells (boreholes) in the Keys is of relative good quality for disposal into Class G-III groundwater (CSA, 1991). This study did not address nutrient loading.

Outstanding questions remain regarding the effectiveness of nutrient removal from domestic wastewater by secondary package treatment plants and the impacts of nutrient loading on groundwater. Saarinen (1989) reports that typical removal efficiencies for secondary treatment were 10 to 20 percent of effluent concentrations for nitrogen and phosphorus (CSA, 1991). To address these concerns, DEP initiated a long-term monitoring study in April 1989, to more thoroughly determine the impact of domestic effluent discharges into boreholes (CSA, 1991). Data to date indicate that there has not been nutrient enrichment in and around the boreholes monitored in the study (CSA, 1991).

On-site Wastewater Disposal (OSDS) Systems

Pursuant to the DOH at this time Marathon has 7,623 developed lots with approximately 1,789 unknown systems, 1,279 cesspits and 853 substandard septic systems. Florida Bay is more subject to eutrophication from nutrient loading than is the Atlantic Ocean. Nutrient loading in

the Bay is caused by natural factors such as seagrass die-off and sediment transport and related degradation of the Everglades ecosystem, in addition to point and non-point discharges from wastewater systems. Water quality is addressed in depth in the biological natural resources section that follows.

Septic tank effluent contains varied concentrations of nitrogen, phosphorus, chloride, sulfate, sodium, toxic organics, detergent surfactants, pathogenic bacteria and viruses (CSA, 1991). When properly installed and maintained, on-site disposal systems (OSDS) units can function adequately in the Keys in terms of fecal coliform and suspended solids removal as required by DEP regulations in Chapter 10D-6, FAC (SCA, 1991). All soils in the city, exclusive of Urban Land (which are largely developed) are rated by the USDA as having severe limitations for septic tank absorption fields (USDA, 1989). Porous rock-soil conditions combined with tidal influences work to reduce the effectiveness of septic tanks frequently to the degree that virtually untreated sewage can be leached into canal waterways (Snedaker, 1990).

No data or studies are available regarding effluent nutrient data for OSDS units. Additionally, there are very few studies that have investigated nutrient uptake by the soils, movement of nutrients within groundwater and entry of these nutrients into nearshore waters (CSA, 1991). Conventional and mound systems are not designed to remove nutrients. Consequently only a minimal amount of nutrient reduction occurs through phosphorus absorption and precipitation in the natural soil system.

The treatment effectiveness of aerobic units has been studied by DEP. From 1987 to 1989 DEP monitored aerobic units in the Keys. Data indicated that many of the systems were not functioning in compliance with standards of the National Science Foundation (Burnaman, 1991; CSA, 1991). In addition aerobic units do not remove any nutrients from the waste stream (CSA, 1991). Studies by Bicki et al (1984) and Lapointe et al (1990b) have researched the link between OSDS discharges and nearshore water pollution. Definitive conclusions concerning the exact relationship between septic tank effluent and nearshore water quality degradation have not been supported to date by findings of these studies (CSA, 1991).

Inactive Landfills and Abandoned Dumps

Marathon does not have any active landfills receiving solid waste for on-site disposal. In December 1990, Waste Management Inc (WMI) began to haul wet garbage, yard waste and construction debris out of the County. The City of Marathon currently collects curb-side pick up under the Monroe County contract with Mid-Keys Waste which is doing business as Marathon Garbage. This contract will end in May 2009 and shall either be renewed or a new carrier will be used.

Prior to 1992, Monroe County operated municipal landfills at Long Key Landfill, Cudjoe Landfill and Key Largo Landfill. The Long Key facility, which serves the City, operates under a DEP Consent Order. All three facilities are not in the final stages of obtaining a DEP closure permit. Under the current disposal arrangements Monroe County has with WMI, waste is still hauled by contract collectors to the Long Key facility, dumped onto the tipping floor, and then collected, compacted and reloaded onto WMI trucks for transport out of the County.

EPA has identified five abandoned dump sites in Monroe County, one of which is located on Boot Key. The Boot Key site is privately owned and was operated by Monroe County as a landfill from 1951 to 1977.

The Boot Key facility did not have an impervious liner in place during construction. Consequently there is the potential for downward migration of potentially hazardous leachate into the underlying strata. The underlying strata are either the Miami Oolite or Key Largo Limestone, both of which are highly porous and permeable and subject to saltwater intrusion and mixing (CSA, 1991). Leachate, when introduced to this type of substrate, can migrate off-site through a number of subsurface cavities, fracture zones, or cavernous zones (CSA, 1991). Conditions favor the migration of material that tend to upwell a considerable distance away (e.g. at an offshore location)(CSA, 1991).

Adequate data are generally not available to assess whether or not landfill leachate from any inactive facilities are affecting nearshore water quality (CSA, 1991). The number of monitoring wells as well as their design and placement, appear to be insufficient to accurately monitor the percolation or migration of leachates through the landfills and into the groundwater (CSA, 1991).

Commercially Valuable Minerals

Marathon has no identifiable commercially valuable minerals nor are there any active mining operations. However, mineral commodities that are available for production in South Florida generally include sand, limestone, and oil (Lane, 1981).

A. **Limestone.** In the Florida Keys, the resource extraction industry had historically been limited to limestone mining. Over most of the Keys, limestone occurs at the surface or at relatively shallow depths. Material was mined by blasting and by shovel removal. Abandoned limestone mining pits, or "borrow pits" can be found in the City and throughout the Keys. Because of the low relief, these are typically filled with water. Generally water is not pumped from these mining pits. There are currently no limestone mining operations in the City. Excavated material was used in the construction trades for fill, landscaping, cement manufacture, road construction, and shoreline protection. (Monroe County 2010 Comprehensive Plan)

B. **Sand.** Compared to the rest of Florida, there is very little quartz sand on the Keys (Lane, 1986). Some offshore sand extraction has been undertaken by the Florida Department of Transportation to obtain fill for local improvements to US 1. (Monroe County 2010 Comprehensive Plan)

C. **Oil.** A total of seven oil wells have been drilled in Florida state waters of the South Florida Basin near the Florida Keys from 1947 through 1983 (Lloyd, 1991). One of these wells (drilled in 1959), located north of the Marquesas Islands, had a significant oil show (Lloyd, 1991). No commercial production was ever undertaken. No further drilling or geophysical oil exploration activity has occurred in the vicinity of the Keys. Effective July 1990, all oil drilling activity was prohibited in Florida state waters. There have been no sales of federal oil and gas leases in the Straits of Florida Planning Area (Lloyd,

1991). This area encompasses the Straits of Florida on the Atlantic side of the Keys and the Florida Bay extending offshore from the Keys to the "Three League Line". (Monroe County 2010 Comprehensive Plan)

Soil Erosion

Due to the City's relatively flat topography and limerock substrate, soil erosion is not a significant problem. In construction areas, exposed surfaces cleared of vegetation prior to building and final landscaping, are subject to wind or water erosion. Unprotected altered shorelines and beaches are also subject to erosion. Beach erosion is addressed in more depth in the Biological Natural Resources section that follows.

Biological Natural Resources

The ecological communities, dominant and diminishing flora and fauna within the City are addressed in this section. Ecological communities are classified according to the predominant flora, fauna, soils, proximity to open water and elevation characteristic to each. Upland, Wetland, Coastal and Marine biological natural resources are discussed below and are shown on *Map 4: Habitat Types*. Many areas of native vegetative communities and wildlife habitats exist in their natural state within Marathon.

Upland Ecological Communities

Two upland vegetative communities are recognized within the Florida Keys, tropical hardwood hammocks and pinelands. Only the tropical hardwood hammock community occurs within the City. Tropical hardwood hammocks constitute the climax terrestrial community of South Florida and the Keys. This community is rich in diversity with approximately 100 species of wide tropical occurrence. Many of these species occur nowhere else in the continental United States.

The drier climate and well-drained soils of the Keys relative to the mainland allows establishment of well-developed stands of tropical hardwoods. Hammock vegetation in the Keys may include a high proportion of species which are rare on the mainland (e.g. Milbark, *Drypetes diversifolia*; Lignumvitae, *Guaiacum sanctum*; and Princewood, *Exostema caribaeum*) and many tropical species are restricted to the Keys (e.g., Roundleaf Pisonia, *Pisonia rotundata;* Maidenbush, *Savia bahamensis;* and Cinnecord, *Acacia choriophylla*) (Tomlinson, 1980). The 'soil' of these hammocks consists mostly of a thin layer of partially decomposed organic matter resting directly on the porous limestone substrate. This humus layer allows increased substrate moisture relative to other vegetative communities in the Keys. Hammocks are a colonizing flora. Many hammock trees can grow without leaf litter and generate the litter layer themselves, thus preparing the substrate for other species (Wayne Hoffman, 1997). The closed canopy of hammocks is insulative, moderating thermal extremes and reducing the loss of substrate moisture (Olmstead and Loope, 1984). Hurricanes periodically have impacts on hammocks resulting in an interruption of hammock succession. This produces the effect of hammocks or parts of hammocks in various stages of succession. The ability of some trees to root after having been toppled may be a characteristic developed from periodic hurricane impacts.

Hammocks have been subcategorized as high hammocks and low hammocks based on their vegetation and structure. High hammocks occur on slightly elevated and drier ground, while low hammocks are typically on lower ground and usually have a substrate which may retain water

longer than surrounding areas (Tomlinson, 1980). In the Keys, low hammocks occur at approximately one to two meters (3.3 to 6.6 feet) above sea level and high hammocks occur a approximately two to five meters (6.6 to 16.4 feet) (Karen Achor in Monroe County, 1986). Floristically the two hammock types differ considerably since the tolerance of species to wet substrate varies considerably. However, there is also a great deal of variation in floristic composition that seems independent of substrate conditions (Tomlinson, 1980). A detailed and complete map of hammocks in the Keys has not been completed to date; however, some of the larger hammock systems have been documented as to location (Weiner, 1979; Kruer, 1991).

A. **High Hammocks.** High Hammocks occur primarily in the Upper Keys and are rare elsewhere. A typical high hammock canopy ranges from four to ten meters (13 to 32.8 feet) with some taller trees protruding, sometimes up to seven meters (23 feet) above the canopy. Some high hammocks may have smaller species forming a discontinuous understory or shrub layer, but generally the understory is fairly open. Ground covers are sparse due to shading.

B. **Low Hammocks.** Low Hammocks tend to have smaller trees and a more dense forest structure. Although the structure may vary from a fairly open and easily passable understory to an extremely dense impenetrable canopy as low as two meters (6.6 feet). Although many subcategories of low hammock, such as "stopper thicket" and "thorn scrub" or "scrub hammock" are locally recognized by biologists, only three categories have been documented and are formally recognized. These include Cactus Hammock, Palm Hammock, and Berm Hammocks. Species commonly found in both Cactus and Palm Hammocks do occur within Hardwood Hammocks. Species such as the Barbed Wire Cactus (*Cereus pentagonus)*, Prickly Pear Cactus (*Opuntia spp.)*, Florida Thatch Palm (*Thrinax radiata*) and Keys Thatch Palm (*Thrinax morrisii*) can often be found in Hardwood Hammocks; others such as Prickly Apple Cactus *(Opuntia spp.),* Tree Cactus *(Cereus robinii)* and Silver Palm (*Coccothrinax argentata*) are rare.

Tables 4-2 and 4-3 list many of the woody plant species normally occurring in tropical hardwood hammocks. The Institute for Systematic Botany in a joint effort with the University of South Florida and the Florida Center for Community Design and Research provides, by County, a comprehensive Atlas of Florida Vascular Plants.

Table 4-2:
Dominant Species Representative of Tropical Hardwood

Common Name	Species Name	High	Low
Torchwood	*Amyris elemifera*	I	I
Marlberry	*Ardisia esca1anioides*	I	I
Crabwood	*A teramnus lucidus*	I	I
Saffron Plum	*Bumelia celastrina*	I	I
Willow Bustic	*Bumelia salicifolia*	I	I
Gumbo limbo	*Bursera simaruba*	I	I
Locustberry	*Byrsonima cuneata*	I	

Table 4-2:
Dominant Species Representative of Tropical Hardwood

Common Name	Species Name	High	Low
Spicewood	*Calyptranthes pallens*	I	
Wild Cinnamon	*Canela winterana*	I	I
Limber Caper	*Capparis flexuosa*	I	I
Snowberry	*Chiococca alba*	I	
Pigeon Plum	*Coccoloba diversifolia*	I	I
Buttonwood	*Conocarpus erectus*	I	I
Milkbark	*Drypetas diversifolia*	I	I
Black Torch	*Erithalis fruticosa*	I	I
White Stopper	*Eugenia axilaris*	I	I
Spanish Stopper	*Eugenia foetida*	I	I
Everglades Velvetseed	*Cuettarda eliptica*		I
Black Ironwood	*Krugidendron ferreum*	I	I
Wild lantana	*Lantana involucrata*	I	I
Wild Tamarind	*Lysiloma latisiliquum*	I	
Wild Dilly	*Manilkara bahamensis*	I	I
Poisonwood	*Metopium toxiferum*	I	I
Myrsine	*Myrsine floridana*	I	
Lancewood	*Nectandrea coriacea*	I	
Jamaican Dogwood	*Piscidia piscipula*	I	I
Cockspur	*Pisonia rotundata*	I	
Black Bead	*Pithecellobium uadalupense*	I	I
Long Stalked Stopper	*Psidium longipes*	I	
Wild Coffee	*Psychotria nervosa*	I	I
Indigo Berry	*Randia aculeata*	I	I
Darling Plum	*Reynosia septentrionalis*	I	I
Maidenbush	*Savia bahamansis*	I	
Bahama nightshade	*Solanum bahamense*	I	
Mahogany	*Swietenia mahogoni*	I	I
Tallowwood	*Ximenia americana*	I	
Wild lime	*Zanthoxylum fagara*	I	I
Source: Weiner, 1979			

Table 4-3:
Additional Dominant Species of Tropical Hardwood Hammocks not included in Weiner's Original Published List

Common Name	Scientific name	High	Low
Blolly	Guapira discolor	I	I

Table 4-3:
Additional Dominant Species of Tropical Hardwood Hammocks not included in Weiner's Original Published List

Common Name	Scientific name	High	Low
Florida Thatch Palm	Thrinax radiata		I
Jamaica Caper	Capparis cyanophallophora	I	I
Keys Thatch Palm	Thrinax morrisii		I
Lignumvitea	Guaiacum sanctum	I	
Paradise Tree	Simarouba glauca	I	
Princewood	Exostema caribaeum	I	
Red Stopper	Eugenia rhombea	I	
Redberry Stopper	Eugenia confusa	I	
Rhacoma	Crossopetalum rhacoma	I	
Rough Strongbark	Bourreria radula	I	
Sabal Palm	Sabal palmetto		I
Satinleaf	Chrysophyllum oliviforme	I	
Seagrape	Coccoloba uvifera		I
Shortleaf Fig	Ficus citrifolia	I	I
Simpson's Stopper	Myricanthes simpsonii	I	I
Smooth Strongbark	Bourreria cassinifolia	I	
Soapberry	Sapindus saponaria		I
Stangler Fig	Ficus aurea	I	I
Wax Myrtle	Myrica cerifera		I
White Ironwood	Hypelate trifoliata	I	

Source: City of Marathon

FNAI Inventory of Significant Undisturbed Tropical Hardwood Hammocks

The Florida Natural Areas Inventory (FNAI) has identified 50 sites in the Florida Keys (excluding Dade County and Key West) which are characterized by large tracts of undisturbed tropical hardwood hammock vegetation (Kruer, 1991). These sites generally include parcels greater than 20 acres in size. Table 4-4 lists those sites specific to Marathon.

FNAI has identified these hammocks as the significant hammock remnants in the Keys. Because of their extremely limited distribution, these biological communities are considered by FNAI to be of state and national importance.

Table 4-4:
Inventory of Remaining Significant Undisturbed Tropical Hardwood Hammocks

Site #	Site Name	Ranking	Size (acres)	Ownership			Public/ Non-Profit Landowner
				Public	*Private*	*Non-Profit*	
MONR-14	Fat Deer Key	A	147	147	0	0	Florida DEP
MONR-19	Long Point	B	60	0	60	0	
MONR-21	Marathon Airport Hangar	C	71	0	71	0	
MONR-22	Crane Point Hammocks	C	51	0	13	38	Florida Keys Land and Sea Trust

A – Excellent
B – Good
C – Fair
Rankings are based on degree of disturbance, degree of exotic plant invasion, species diversity, structural diversity, relative size, and the extent edges are intact. Entire sites are given the same rank even though quality may not always be consistent throughout a site. Protection of the high quality portion of a site is dependent on protection of the perimeter or buffer.

Source: Derived from Kruer, 1991 (prepared for the Florida Natural Areas Inventory).

Existing Uses

Since the 1950's, development in coastal uplands of the Keys has resulted in the loss of considerable acreage of tropical hardwood hammocks. This development has occurred throughout the City of Marathon and the Florida Keys and has involved all types of residential, commercial, institutional and government uses.

Today, there are approximately 7,000 acres of undisturbed tropical hardwood hammock remaining in the Keys. Of these, approximately 6,360 acres (91 percent) are within 50 parcels, generally 20 acres or more in size (derived from Kruer, 1991). The other 640 acres are scattered throughout the Keys in a large number of smaller tracts. Land acquisition efforts have focused in recent years on the higher quality hammocks. Today, approximately one-half (736 acres) of the remaining significant tracts of hammock rated "excellent" quality are protected (derived from Kruer, 1991). Included in these hammocks is Curry State Park which is owned DEP. This is a 147 acres hammock on Fat Deer Key.

Known Pollution or Problems

Impacts that affect hammocks on the Keys are varied and include natural events such as hurricanes and fires. Man-induced impacts include activities such as land clearing, dredging, ditching, filling, and the introduction of exotic plants. Disruptive land uses have historically included hardwood and buttonwood logging (for charcoal), and clearing for railroad beds, roads, agriculture, commercial and residential development and public facilities (Kruer, 1991). Other

impacts have resulted from rock pit excavation, dredging of canals, mosquito ditches, plant theft, dumping (especially piles of vegetative and organic debris), mosquito spraying, and regular thinning or mowing of native groundcovers, shrubs and trees (Kruer, 1991). The nature of these impacts depends on the integrity and size of the hammock. Recovery from the impacts depends on the condition, size, and amount of surrounding hammocks and wetlands, or the type of development on adjacent land or on-site mitigation.

Hurricanes are the most important natural force that impacts terrestrial ecosystems in the Keys. The degree of disturbance varies with hurricane intensity. Severe hurricanes can devastate hardwood hammocks so that many years or even decades may be required for recovery. Fires also can alter hammocks for long periods since they may destroy the shallow organic soil that is essential for the structure and function of the hammock ecosystem. Usually natural fires result from lightning strikes during the wet season when most humus is less likely to burn extensively. Following fire, successional changes will reestablish the species assemblage characteristic of the original system. This is attributable largely to the fact that such natural catastrophes are recurring phenomena to which species have evolved. The cumulative result of these adaptations generates a regular and orderly successional recovery following such events.

Several hundred acres are estimated to have been lost since 1980 in Marathon and other parts of the Keys. Despite these losses, the most critical potential impact related to tropical hardwood hammocks is the tremendous potential for continued piecemeal loss of the Keys' natural habitats to single family residential development (Kruer, 1991).

Many of the remaining large tracts of tropical hardwood hammock documented by FNAI are ranked fair ("C") in quality usually as a result of disturbed edges, fragmentation, and proliferation of exotic vegetation typically Brazilian pepper and Australian pine, all resulting from proximity to development (Kruer, 1991). With additional development and fragmentation these hammocks will continue to decline in quality (Kruer, 1991). An aggressive local program to remove invasive exotic plants could limit this disturbance and gradually restore values to these disturbed hammocks (Kruer, 1991).

Filling in uplands occurs for a variety of reasons including fill for roads, septic tank drainfields, and elevation of structures above flood levels. Because of the differences in substrate, it is likely that recolonization of abandoned fill sites will result in a species assemblage that differs from the biota of the original hammock.

Mosquito control activities also result in the degradation of hammocks. Mosquito ditches provide avenues for saltwater intrusion and invasion by exotics. Mosquito spraying may affect pollinators as well as mosquitoes. Many mosquito ditches are being refilled and returned to natural habitat.

Road construction has seriously affected hammocks, both directly and indirectly. In addition to the direct destruction of hammock acreage, road construction dissects and fragments hammock systems. The increased access thus provided to hammocks results in further indirect environmental damage by increasing storm damage, invasion of exotics, soil dessication, collecting, illegal dumping, fire and vandalism.

Removing the understory and ground cover from hammocks is becoming a common practice in the Keys. This practice of grubbing out provides visual access, increased airflow, and space for planted colorful exotics. This severely degrades hammocks by direct elimination of smaller plants (including the young of canopy species), reduction of wildlife habitat, and increased exposure to the desiccating influences of wind and light.

The extensive introduction of exotic plants further complicates the prospects of recovery from natural or human-caused impacts, since many of these tend to out compete and eventually replace some native species that are links in the seral recovery sequence that would otherwise generate a hammock climax. Brazilian Pepper, Australian Pine, Lead Tree, Queensland Umbrella, Seaside Mahoe and Leatherleaf are particularly prolific. In recent years these species have invaded virtually all sites on keys adjacent to US 1 (Kruer, 1991). While they typically have difficulty establishing themselves in unmodified hammocks, they rapidly invade altered hammock areas and may delay or even prevent recovery depending on the severity of disturbance. In part, the vulnerability of hammocks is attributable to the easily destroyed thin soil layer that is the edaphic foundation of its fragile trophic structure. This vulnerability is further attributable to the hammocks isolation and discontinuity, which can make recruitment of successional forms difficult and thereby retard or prevent reestablishment of a hammock climax.

Brazilian pepper is a particular invasive species common on disturbed substrates and debris piles and whose seeds are easily spread by birds and mammals, even into the interior of some out-islands (Kruer, 1991). Initial colonization of disturbed sites by Brazilian pepper may be the primarily the result of largely illegal dumping of vegetative and land clearing debris (Kruer, 1991). Although requirements for removal of Brazilian pepper on private lands is now attached to Development Orders, problems of enforcement, long-term maintenance, and extensive undeveloped private lands with exotics limits effectiveness (Kruer, 1991).

Conservation and Protection

Public acquisition is the most expeditious means of protecting the remaining large tracts of tropical hardwood hammock in the Keys. Government acquisition of hardwood hammocks in the Keys began approximately 12 years ago. While these efforts have led to preservation of 3,681 acres of hammock, increased effort is required to protect further losses. Efforts are needed to coordinate and expand the ongoing acquisition activities of the City of Marathon, Monroe County, SFWMD, DEP, the USFWS, and non-profit conservation organizations. Within the City 12.1% of the land, or 576.92 acres, is native. Table 4-5: Vegetation Acreage presents a breakdown by acreage of the vegetation present in the City. Table 4-6: Habitat Acreage presents a breakdown by acreage of the habitats present in the City. *Map 4: Habitat Types* illustrate these tables.

Table 4-5:
Vegetation Acreage

Classification	Acres	% Of Total Acreage
Disturbed/Developed	2,159.05	45.2%
Native	576.92	12.1%

Table 4-5: Vegetation Acreage		
Classification	**Acres**	**% Of Total Acreage**
Water	127.45	2.7%
Wetland	1,912.20	40.0%
Total	**4,775.61**	**100.00%**
Source: City of Marathon GIS, 2004		

Table 4-6: Habitat Acreage		
Classification	**Acres**	**% Of Total Acreage**
Developed	2,010.94	42.1%
Exotics	148.11	3.1%
Dune	5.50	0.1%
Hammock	571.41	12.0%
Buttonwoods	195.11	4.1%
Freshwater Hardwoods	1.74	0.0%
Mangroves	1,531.77	32.1%
Salt marsh	81.56	1.7%
Scrub Mangroves	102.01	2.1%
Water	127.45	2.7%
Total	**4,775.61**	**100.0%**
Source: City of Marathon GIS, 2004		

The Crane Point Tropical Hardwood Hammock (64.62 acres) on Key Vaca is an example of a well-preserved hammock along with Curry Hammock State Park (578.87 acres) on Fat Deer Key, Long Point Key, Little Crawl Key and Deer Key, and the Blue Heron Preserve (55.66 acres) on Key Vaca.

While public acquisition is likely to protect some of the most sensitive of the remaining tropical hardwood habitat, it is unrealistic to expect that adequate funds will become available to permanently protect all that remains in the Marathon or the Keys. In order to protect the lower quality and smaller remnants of hardwood hammock, it will be necessary to adopt land use policies and land development regulations which further protect these areas from loss, fragmentation, disruption of natural drainage, pollution, and invasive plants.

Future development in the City should be directed to the maximum extent possible away from high quality hammocks. This should be accomplished through land use policies of the Comprehensive Plan and its implementing land development regulations. Sites ranked "high quality" through habitat evaluation should be considered to have low intrinsic suitability for

development. In developing the Permit Allocation System for implementation of the Plan, consideration should be given to assigning minor points to developments proposed in hammock which is ranked high quality by evaluation of the habitat (see Future Land Use Element Section Policy 1-3.5.4).

The City of Marathon currently utilizes a "Habitat Evaluation Index (HEI)" as a means of ranking the habitat value of low hammocks and high hammocks. This ranking is used to establish open space requirements and applicability of environmental design criteria, summarized as follows:

- low hammock (high quality) 80 percent
- low hammock (moderate quality) 60 percent
- low hammock (low quality) 40 percent

No refinements to these open space requirements are deemed necessary at this time.

While the open space requirements for hammock habitat continue to be appropriate, the City of Marathon Biologist has recommended that revisions be made to the HEI procedure. These are recommended to make the HEI procedure more scientifically defensible and ecologically meaningful. In particular, revisions are needed to more effectively discriminate among high, moderate and low quality low hammocks.

Cactus hammocks and palm hammocks are not subject to the HEI; the open space requirement for these habitats is 90 percent, regardless of condition. Disturbed hammocks are also exempt from the HEI; the open space requirement is 20 percent. No refinements to these open space requirements are deemed necessary at this time.

The Land Development Regulations currently require clustering on the lowest quality habitat within a proposed development site until maximum allowable density is reached; further development must then occur on the next lowest quality habitat until maximum allowable density is reached, and so on. To prevent unnecessary fragmentation of sites which are characterized entirely by hardwood hammock vegetation, development permitted on the lowest quality habitat within the site should also be clustered within that portion of the site. Bulk regulations should also be revised to allow greater flexibility for clustering.

Clearing activities during construction frequently disturb areas outside of construction fences, sometimes affecting areas within required open spaces. Stronger clearing restrictions, coupled with site inspections and fines for violations of land development order conditions pertaining to clearing are required. Disturbances should not be permitted to the ground surface and vegetation within required open space areas.

In tropical hardwood hammocks on both public and private lands, there is a need for management activities focused on removal of invasive exotic species. City of Marathon currently requires as a condition of development orders that invasive plants be removed from at least a portion of the development site. These conditions should be retained and expanded to the maximum extent legally possible. A city-wide program is also needed to restore and maintain

disrupted native upland vegetation systems on public lands. Particular emphasis is needed on land management of private lands adjacent to public lands. Actions of private landowners which provide opportunities for colonization by invasive plants can compromise the management activities of the City as well as the USFWS, DEP and other public and non-profit conservation organizations undertaking invasive plant removal on protected lands.

Wetland Ecological Communities

Recognized wetland communities within Marathon include mangroves, salt marsh and buttonwood associations. Wetlands provide diverse biological functions including protection of water quality and the provision of wildlife habitat.

Table 4-7 lists the most common wetland plant species found within the City. The "Vegetative and Hydric Soil Field Indicators Lists for Chapter 62-340, F.A.C." as compiled by the State, is a comprehensive tool to identify and categorize wetland plant species. The vegetative wetland species found within the City are included in this list.

Table 4-7:
Most Common Wetland Plant Species Within The City

Common Name	Scientific Name
Black Mangrove	*Avicennia germinas*
White Mangrove	*Laguncularia racemosa*
Red Mangrove	*Rhizophora mangle*
Bay Cedar	*Suriana maritime*
Sea Lavender	*Limonium carolinianum*
Sea Purslane	*Sesuvium protulacastrum*
Key Grass	*Monanthochloe littoralis*
Cord grass	*Spartina spp.*
Buttonwood	*Conocarpus erectus*
Saltwort	*Batis maritima*
Sea Blite	*Suada linearis*
Salt Grass	*Distichlis spicata*
Dropseed	*Sporobilus virginicus*
Fringe-Rushes	*Fimbristylis spp.*
Glasswort	*Salicornia spp.*
Sea Daisy	*Borrichia spp.*

Mangroves

Four major factors limit the distribution of mangroves and determine the extent of mangrove ecosystem development (Odum, et al. 1982). These are climate, salt water, tidal fluctuation and substrate. Mangroves do not develop where the annual average temperature is below 66 degrees F or where water temperatures exceed the 107 to 113 degree F range. Mangroves are facultative halophytes but generally do not develop in freshwater environments because they are not able to compete successfully with other plants in that environment. Mangroves are a pan-tropical species occurring on seventy-five percent of the world's tropical coastline (McGill, 1959). In Florida, the largest mangrove forests (90 percent) are located in the more southern areas of the state, primarily in Lee, Collier, Dade, and Monroe Counties. Monroe County encompasses approximately 234,000 acres (95,000 ha.) of mangroves, the majority lying within the boundaries of Everglades National Park and the small islands in Florida Bay (Florida DNR, 1991). The major environmental conditions that characterize mangrove communities are loose, wet, saline soil; periodic tidal submergence; and low-energy wave and current regimes interrupted by periodic tropical storms and hurricanes.

In South Florida and within Marathon three species of mangroves occur, Red, Black and White. Red Mangroves (*Rhizophora mangle*) have characteristic stilt, prop and aerial roots and bear the cigar-shaped, viviparous seedlings. Black Mangroves (*Avicennia germinans*) have pneumatophore breathing roots and gray-green leaves encrusted with excreted salts. White Mangroves (*Laguncularia racemosa*) have rounded leaves with a pair of salt glands on the petiole. Well-developed mangroves and adjacent shallow flats characterize the natural margins of the Florida Keys and Marathon.

Mangrove wetlands stabilize shorelines, support the food chain, and provide nursery areas for marine life. The dense roots of the black and red mangroves supports diverse populations of marine algae and various attached invertebrates, including sponges, mollusks, hydrozoans and tunicates; and provide protective cover to a variety of fish and mobile invertebrates. Invertebrates and fishes found in the mangrove communities include pink shrimp, stone crab, spiny lobster, jacks, grunts, grouper, seabass, snapper, mullet, red drum, ladyfish, and spotted sea trout. Wading birds, shore birds, white-crowned pigeons, and birds of prey nest, feed, and roost in mangroves.

Lugo and Snedaker (1974) have classified mangrove systems into six types based upon their physical structure. Four types of mangrove systems occur in the Florida Keys and within Marathon. These are the overwash forest, fringe forest, basin forest and the scrub or dwarf forest.

A. **Overwash Mangrove Forests.** Overwash Mangrove Forests are found on small keys or peninsulas. In many cases the Overwash Forest is the only community on a small island. These forests are so named because they are regularly overwashed by tides and often contain no land that rises above mean high water. All three species of mangrove may be present but red mangroves are usually dominant, with a canopy height ranging from 20 to 25 feet. Because of the regular tidal sheet overflow, litter does not readily accumulate and organic export rates are high.

B. **Fringe Mangrove Forests.** Fringe mangrove forests form along upland shorelines of low-energy tidal and wave action. Low tide and current velocities allow for colonization by mangroves and for the import and subsequent accumulation of sediments. The prop roots of red mangrove and the pneumatophores of black mangrove are particularly effective in sediment accumulation. These forests are variable in width and canopy height with trees typically widely spaced and medium to large (ranging from 20 to 30 feet in height). They exhibit traditional zonation patterns. Fringing forests that face open bodies of water to the north accumulate vast amounts of detritus, much of which is generated by productive nearshore seagrass communities. The organic sediments that accumulate within the fringe forest are often strongly anaerobic, comprised of a mixture of organic sediments and coarse, calcareous sand. In these soils black mangroves tend to dominate. In fringe forests dominated by black mangroves, populations of succulent salt tolerant plants such as Saltwort and Glasswort often form a dense ground cover.

C. **Basin Mangrove Forests.** Basin forests typically occur in the Keys where large shallow depressions in the cap rock foster the accumulation of detritus and channelize tidal flow. Basin forest structure is similar to over wash forests. The occurrence of black and white mangroves becomes more frequent with increasing elevation and diminishing tidal influence.

D. **Scrub or Dwarf Mangrove Forests.** These communities lack the canopy height and high productivity characteristic of the other forest types. Both the scrub and the dwarf associations are characterized by small trees with an understory of salt tolerant shrubs, herbs and graminoids. The scrub community generally contains all three species of mangrove but is usually dominated by the black mangrove. Most trees are widely spaced and stunted. Dwarf mangrove associations contain trees less than five feet in height, with less distance between trees than in scrub forests. Both the scrub and dwarf forests occur in intertidal areas that do not experience daily tidal flushing. Dwarf red mangroves appear to occur on slightly lower elevations than scrub black mangroves. The oolitic cap rock is emergent in these areas, providing limited opportunity for soil accumulation. Where soils do occur, they are characteristically thin, saline marls within shallow cap rock depressions. Due to the lack of regular tidal flushing, soils become hypersaline during the dry season and dilute during the wet season.

Existing Uses

Non water-related uses (exclusive of utility pilings) are not permitted in mangroves in Marathon. Sections 9.5-262 and 9.5-343 of the Marathon Land Development Regulations (LDR's) establish a 100 percent open space requirement for all native areas vegetated with mangroves, with an allocated density (du's/acre) and maximum net density (du's/buildable acre) of zero.

Section 9.5-345 of the LDR's provides further protection to mangroves by specifying the types of water-related and utility structures allowed. These Environmental Design Criteria are as follows:

a. "only piers, docks, utility pilings and walkways shall be permitted on mangroves; and
b. all structures on mangroves shall be designed, located and constructed such that:

i. all structures shall be constructed on pilings or other supports; and
ii. bulkhead and seawalls shall be permitted only to stabilize disturbed shorelines or to replace deteriorated existing bulkheads and seawalls."

Disturbances to shoreline fringing mangroves on unaltered shorelines are not permitted by Section 9.5-286 of the LDR's. A shoreline setback is required as follows:

> "All building other than docks, utility pilings, walkways, nonenclosed gazebos and fences and similar structures shall be set back fifty (50) feet from natural water bodies with unaltered shorelines or unlawfully altered shorelines, measured from the landward limit of mangroves, if any, and where mangroves do not exist, from the mean high tide line."

Known Pollution or Problems

Until 1975, mangroves in Marathon and the Florida Keys were filled routinely for purposes of providing dry land for development. In 1986 Monroe County and subsequently the City of Marathon adopted its current Land Development Regulations which effectively stopped such activities in the Marathon and the Keys.

Pollution problems and other concerns related to mangroves, which remain today, include:

a. problems related to mangrove trimming by private landowners;
b. problems related to removal of fringing shoreline mangroves for construction of shoreline structures, particularly docks; and
c. problems related to water quality deterioration in the nearshore environment as a result of existing population levels and practices.

Homeowners and business owners in mangrove areas throughout the City and the Keys believe that mangrove trimming is not detrimental and continue to request permits from DEP to trim the trees to maintain marine access as well as water views (Florida DNR, 1991e). DEP routinely issues these permits. While there is some disagreement over the effects of mangrove trimming, most biologists believe that severe trimming of mangroves (e.g. 33 percent of canopy) will kill some trees and affect reproduction (Florida DNR, 1991e). Red mangroves are especially sensitive to trimming. There is a need for further research to evaluate the impacts of this trimming and refinement to mangrove trimming regulations based upon the findings of this research.

Fringing shoreline mangroves occur along much of the City's and the Keys' unaltered open water shorelines as well as along altered shorelines and shorelines of artificial waterways. Where mangroves are growing in partially built-out residential subdivisions, they provide biological functions locally beneficial to nearshore water quality and wildlife. Typically, when development occurs on lots with shoreline mangroves, the developer/landowner seeks to stablize the shoreline, to backfill, and to construct shorelines structures or structures over the water, such as docks. Where existing federal, state and local regulations have allowed some of these types of activities to occur there has been loss of valuable biological functions in already stressed environments.

To date there have been no major mangrove losses in the Keys because of water quality (CSA, 1991). Mangroves are relatively insensitive to nutrient loading and are not adversely affected by highly eutrophic waters (CSA, 1991; Odum and Mcivor, 1990). However, some studies have revealed sensitivities to certain contaminants. Mangroves, particularly red mangroves, are highly susceptible to herbicides (CSA, 1991; Teas and Kelly, 1975). Petroleum and petroleum byproducts have deleterious effects on mangroves due to the toxic effects of prevention of aeration caused by clogging of root lenticels and pneumatophores (CSA, 1991; Lewis 1980; de la Cruz, 1982). Mangroves can also be killed by heavy suspended loads of fine, flocculent material, which clog root lenticels and pneumatophores (CSA, 1991).

Conservation and Protection

The Florida Keys National Marine Sanctuary (FKNMS) Management Plan will provide the basis for future federal, state and local conservation activities affecting the resources of the Sanctuary, including its mangrove forests. The Plan will identify the regulatory strategies and alternative institutional responsibilities for resource protection. It will include a plan for public education regarding mangrove conservation, as well as recommendations for a mangrove research program.

As part of the FKNMS Management Plan, the FKNMS Water Quality Protection Program will:

a. adopt or revise water quality standards to assure protection of marine resources, including mangroves;
b. adopt pollution control measures and methods to eliminate or reduce pollution from point and non-point sources, including those which are found through future research to affect marine resources, including mangroves; and
c. establish a comprehensive water quality monitoring program.

The Monroe County Department of Marine Resources will be responsible for implementing regulations and management guidelines at the FKNMS Management Plan and FKNMS Water Quality Protection Program at the local level. This will be undertaken through a memorandum of agreement with NOAA, EPA, SFWD and DEP, to be executed upon adoption of the FKNMS Management Plan and the FKNMS Water Quality Protection Plan.

Transitional Wetlands

The type of transitional association that develops is a function of tide and topography. The inundation of the transitional zone is effected by factors including wind direction and velocity, shoreline exposure, slope, elevation and microrelief compounded by the low tidal amplitude (3 feet). The position of individual species within the transitional zone reflects a response to a complex set of environmental gradients. Transitional habitats of the Keys may contain species representative of both the adjacent mangrove and the upland communities. Salt Marsh Wetland and Buttonwood Association Wetlands are recognized transitional wetlands. On a relatively steep slope to the upland, the transitional zone is quite narrow. Large salt marsh or buttonwood association habitat areas may develop in expansive areas with little or no elevation change.

A. **Salt marshes.** Salt marshes are the lower elevation transitional wetland. In the lowest sub-zone of transitional areas, scrub mangrove communities typically occur dominated by small Red and Black Mangroves with a ground layer of Glasswort (*Salicornia spp*.),

Salt Grass (*Distichilis spp.*), Key Grass (*Monanthochloe littoralis*) and Sea Daisy (*Borrichia spp.*). Salt marshes are dominated by salt-tolerant herbs, shrubs and grasses, and are distinguished from adjacent mangroves or buttonwood associations by their low stature and lack of wood vegetation. Open marshes are important hunting grounds for migrating birds of prey and wading birds. Marsh grasses help maintain water quality by filtering sediments and runoff from adjacent uplands.

B. **Buttonwood Association.** Buttonwood (*Conocarpus erectus*) associations generally are the higher transitional wetland where there is a change to a more diverse plant community with fewer mangroves. Buttonwood becomes abundant and is often associated with an understory of Sea Daisy, Dropseed, Sea Ox Eye, Cordgrass, Chestnut Sedge, Christmas Berry and other small shrubs, herbs and graminoids. Epiphytic orchids and bromeliads (*Tillandsia spp.*) frequently are found on the buttonwoods. Moving upland, the transitional zone then grades into hammock. The most landward sub-zone generally contains the most diverse flora because of its proximity to rich upland hammocks. Small pockets of low hammock may occur within the transitional zone.

Existing Uses

Like mangroves fringes and forests in the Florida Keys, transitional wetlands were routinely filled for purposes of providing dry land for development. In 1986, Monroe County adopted its current Land Development Regulations effectively stopping such activities.

Single family residential development is the primary developed use which is currently found and permitted in salt marsh and buttonwood wetlands in Marathon. Undisturbed salt marsh and buttonwood wetlands are generally located within the "Sparsely Settled," "Native Area," and Suburban Residential" land use districts. Section 9.5-262 of the City of Marathon Land Development Regulations (LDR's) allows densities of 0.5, 0.3, and 1.0 units per buildable acre. Section 9.5-343 establishes an open space requirement of 85 percent for undisturbed salt marsh and buttonwood wetlands.

Section 9.5-345(b) of the LDR's provides protection to undisturbed salt marsh and buttonwood wetlands by restricting fill to a maximum of 5,000 square feet or 10 percent of the total area of salt marsh and buttonwood wetlands, whichever is greater. Filling is subject to further restrictions designed to minimize impacts on adjacent wetlands and habitat areas. Roads and structures cannot disturb natural drainage patterns. Wastewater must be treated by a waterless toilet or by an OSDS which is located in or discharges into upland area.

DEP regulates placement of fill in salt marsh and buttonwood wetlands subject to Chapter 17-312, F.A.C., title "Additional Criteria for Dredging and Filling with Outstanding Florida Waters in Monroe County." Permits are issued on a case-by-case basis for placement of fill in salt marsh and buttonwood wetlands in instances where the activity is "in the public interest" and where adequate mitigation can be accomplished.

Other agencies which may have jurisdiction in salt marsh and buttonwood wetlands, depending upon the size and location of the wetland and the possible presence of protected species, include

the ACOE, SFWMD, FWC, and USFWS. DOH may consider wetlands when permitting sewage disposal systems and, in some cases, may prohibit on-site disposal systems.

Disturbed salt marsh and buttonwood wetlands in Marathon generally occur on disturbed residential lots in Improved Subdivision (IS), Commercial Fishing Village (CFV), and Urban Residential Mobile Home (URM) zoning districts. Generally one house is permitted per lot in these districts. Section 9.5-343 of the LDR's establishes an open space requirement of 20 percent for disturbed salt marsh and buttonwood wetlands.

Section 9-5-345(o)(4) of the LDR's provides protection to disturbed salt marsh and buttonwood wetlands by prohibiting disturbances to natural drainage patterns by roads and accessways, and by requiring wastewater treatment using a waterless toilet or by OSDS that is located in or discharges into an upland habitat area.

Permitting procedures for placement of fill in disturbed salt marsh and buttonwood wetlands are similar to those described in the previous section for undisturbed salt marsh and buttonwood wetlands.

Known Pollution or Problems

On-site wastewater disposal systems serving development sites in or adjacent to salt marsh and buttonwood associate wetlands, which are likely to function improperly due to soil wetness and flooding, are the primary source of pollution in salt marsh and buttonwood association wetlands in the Keys. Uses disruptive to this habitat include the placement of dredge spoils or fill, the clearing of native vegetation, introduction of aggressive invasive exotic vegetation, blockage of or drainage of surface waters and restriction of tidal circulation. The placement of fill disrupts the local natural drainage pattern and creates open areas that are highly susceptible to colonization of invasive exotic vegetation. Homeowners typically introduce non-native plant material in residential landscaping and, with time, expand the area of disturbance further into adjacent wetlands.

Other pollution problems and concerns related to salt marsh and buttonwood wetlands include:

a. illegal dumping;
b. damage from off-road vehicles; and
c. disruptive activities at the fringe of salt ponds caused by the proximity to developed land uses.

Illegal dumping is a problem along the perimeter of and within salt marsh and buttonwood wetlands, particularly where there is vehicular access. This is of special concern due to the potential dumping of uncontained hazardous wastes which can leach into the soil and enter groundwater.

Due to ease of access many areas of salt marsh and buttonwood wetlands in the Keys also suffer disturbances from off-road vehicles and heavy equipment. Salt marsh plants have shallow root systems that form a rhizosphere only a few inches below the soil surface. Shallow marl soils tend to compress under loads. As a result, persistent tracks are easily formed by vehicles where

vegetation has been killed and soil conditions are unfavorable for recolonization of wetland plants.

Close proximity of developed land uses to salt marsh associations tend to adversely affect perimeter areas of the wetland. These impacts are typically direct physical effects caused by landowner dumping of yard debris at the perimeter of residential lots and the cumulative impacts of homeowners through the years caused by yard improvements, such as perimeter clearing, minor spot filling, and planting of non-native plant materials.

Conservation and Protection

In general, future development in the City should be directed to the maximum extent possible away from wetlands. This should be accomplished through land use policies of the Comprehensive Plan and its implementing land development regulations. In developing the Permit Allocation System for implementation of the Plan, consideration should be given to assigning minor points to developments proposed in disturbed (see Future Land Use Element Policies 1-3.5.4 and 1-3.5.8).

Detailed mapping of wetlands, including disturbed wetlands, in the Florida Keys was completed through a joint program of the EPA and the ACOE, in cooperation with the FWS, SFWMD, FFWCC, and Monroe County. This program, known as the Florida Keys Advance Identification of Wetlands Program (ADID), created an inventory and map of wetlands in the Keys utilizing a Geographic Information System (GIS). *Map 4* identifies these. Participants in the ADID Program developed a wetlands functional assessment protocol, referred to as the Florida Keys Wetlands Assessment Protocol or KEYWEP.

Restoration of disturbed wetlands in the Marathon should be undertaken to restore biological functions. The City of Marathon Biologist in consultation with the EPA, ACOE, SFWMD, FWC and USFWS should identify priority sites for wetlands restoration in the City. In the future, any monies collected as impact mitigation fees from parties permitted to fill in disturbed wetlands should be paid into a wetlands restoration fund to be used by the City for restoration of publicly-owned wetlands. Fines collected for wetlands violations by the Environmental Crimes Task Force should also be deposited in the City Restoration Fund. Restoration on private lands should be encouraged through landowner education and required as a condition of land development orders.

Shoreline Ecological Communities

In addition to the wetland communities described above which may occur along shorelines, the Beach Berm Community and Coastal Rock Barren are also recognized shoreline communities.

Beach Berm Community

In the beach berm community the most seaward component is the “beach” which is material, usually sand, that extends from the upper berm to the low water mark (Clark, 1977). The berm is a mound or ridge of unconsolidated sand landward of, and usually parallel to, the shoreline and beach. The berm is higher in elevation than the beach and sometimes higher than the area landward of the berm. Distinct beach/berm formations occur infrequently in the Florida Keys.

Beaches, and more particularly berms, tend to be formed and shaped by catastrophic storm events rather than by normal wave and wind action.

In the Keys, natural beaches are typically 15 to 25 feet in width and found from Upper Matecumbe Key southward. Within Marathon naturally formed beaches occur between mile marker 60 on Grassy Key to MM 48 on Boot Key along the Atlantic shoreline. Four distinct beach zones are generally recognized in the Florida Keys. Moving landward from the shoreline, these include the strand-beach, strand-dune, strand-scrub, and strand-hammock. This generalized zonation occurs with some variation.

A. **Strand-Beach Association.** The strand-beach association is dominated by plants that are salt tolerant, germinate from seed rapidly, root quickly and can withstand wave wash and shifting sand. Commonly found species include the Sea Purslane (*Sesuvium potula-castrum*), Railroad Vine (*Ipomoea pes-caprae*), Beach Grass (*Panicum amarulum*), Sea Oats (*Uniola paniculata*), Sea Lavender (*Toumefortia gnapholodes*), Coastal Ragweed (*Ambrosia* spp.) and Bay Cedar (*Suriana maritima*).

B. **Strand-Dune Association.** The strand-dune association begins with a steep and distinct increase in slope upward from the beach. The foreslope of the berm, or beach ridge, is vegetated primarily by species found in the strand-beach association. Proceeding land-ward, these pioneer species are joined by others, such as Chaff Flower (*Altemanthera maritima*), Sea Daisy (*Borrichia frutescens*), Cordgrass (*Spartina spp*.), Beach Orach (*Atriplex arenaris*), Spider Lily (*Hymenocallis latifolia*), and Sea Rocket (*lanceolata*). On a number of beaches, Australian Pines (Casuarina equisetifolia) have become established in this zone. Another exotic, Leatherleaf (*Colubrina asiatica*), has also become established, forming dense thickets in the seaward portion of the berm.

C. **Strand-Scrub Association.** The strand-scrub association is generally considered a transition zone between strand-dune and hammock forest. Shrubs and occasional trees occur more frequently and become more abundant moving landward. Species often found include Seagrape (*Coccoloba spp*.), Wild Sage *(Lantana involucrata*), Seven-year Apple (*Casasia clusiifolia*), Blolly (*Guapira discolor*) Gray Nicker (*Caesalpina spp*.), Black-bead (*Pithecellobium guadalupense*), Nightshade (*Solanum bahamense*), and the Prickly Pear Cactus (*Opuntia* spp.).

D. **Strand-Hammock Association.** The strand-hammock association contains larger trees including Buttonwood (*Conocarpus erectus*), large Seagrape (*Coccoloba uvifera*), Blolly (*Guapira discolor*), Gumbo Limbo (*Bursera simaruba*), and Jamaica Dogwood (*Piscidia piscipula*). An understory layer of vegetation may occur in this area including many of the species mentioned above.

Coastal rock barren. The Coastal Rock Barren is a very rare eco-tonal community occurring in small patches along rocky shorelines in the Keys (Kruer, 1991). Where beaches, mangroves or wetlands are not present, this shoreline is characterized by exposed, pitted and pinnacled lime-stone. What infrequent vegetation occurs is typically very stunted.

DNR Beach/Berm Inventory

DNR has recently completed an inventory of the beaches of the Florida Keys. Findings of this inventory indicate that beaches are not common in the City of Marathon (see Table 4-7). In general, beach frequency increases to the southwest, with the largest percentage of land mass composed of beach found on Bahia Honda Key, the outer islands west of Key West (Sand Keys), the Marquesas Keys, and the Dry Tortugas (Florida DNR, 1990b). There are approximately 5.2 miles of beach in Marathon (see Table 4-7). *Map 4: Habitat Types* shows the areas within Marathon that are the beach/berm areas.

FNAI Inventory of Significant Undisturbed Beach/Berm Communities

The Florida Natural Areas Inventory (FNAI) has identified 12 coastal berms, 5 beach dunes, and 4 coastal rock barrens in the Florida Keys (excluding Dade County and Key West) which are characterized by relatively undisturbed upland vegetation. (Kruer, 1991). These parcels range in size from one to 85 acres. There are no undisturbed Coastal Berms or undisturbed beach dunes within the City of Marathon. There is an undisturbed coastal rock barren located within the City on Valhalla which is approximately seven acres in size and in good condition. It is under private ownership at this time. (Kruer, 1991)

FNAI has identified these communities as the significant undisturbed coastal berms, beach dunes, and coastal rock barrens in the Keys. Because of their extremely limited distribution, these biological communities are considered by FNAI to be of state and national importance.

Table 4-7:
City of Marathon Natural Beach Inventory

Map Unit	Beach Location		Total Length (ft.)	Average Width (ft.)	Net Sediment Transport Direction	Ownership
710G	Grassy Key	Shoreline fronting Florida Straits	6800	15	southwest	Private
710H	Crawl Key	Peninsula known as Valhalla	600	15	northeast	Private
710I	Little Crawl Key	Eastern half	1200	15	west	Public
710J	Fat Deer Key	Coco Plum Beach	7500	25	southwest	Private and City of Marathon
710K	Boot Key	Sunrise Isle Beach	2000	15	north	Private
710L	Boot Key	Sombrero Beach	1600	25	east	City of Marathon
710M	Vaca Key	East shore Vaca Key (adjacent to Sister's Creek	800	15	north	Private
710N	Boot Key	Shoreline fronting Florida Straits	7000	25	indeterminate	Private

Source: Florida DNR, 1990b

Existing Uses

Map 2: Existing Land Uses (Zoning) illustrates the existing land uses found within the shoreline ecological communities. Shoreline development has occurred throughout the Upper, Middle and Lower Keys and has involved all types of commercial, residential, recreational, institutional, and governmental uses.

Developed uses on natural beaches in the Keys are generally limited to single family homes and condominiums. In some locations, most notably at Holiday Isle in Islamorada, hotel owners have built beaches which are used for or in support of tourist commercial uses.

Several beaches inventoried by DNR (Florida DNR, 1989b) are protected through public ownership and are available for public recreation purposes (see Table 4-7). These include:

- Curry Hammock State Park (beach fronting Florida Straits) - owned by DEP
- Sunset Bay Subdivision Beach (beach fronting Florida Bay on Grassy Key) – owned City of Marathon
- Coco Plum Beach – owned by City of Marathon
- Sombrero Beach – owned by City of Marathon

Known Pollution or Problems.

Pollution problems and disturbances related to beach/berm communities in the Keys include the following:

(a) general loss of beach/berm habitat to developed land uses;
(b) clearing of berm vegetation for land development;
(c) establishment of exotic vegetation;
(d) beach erosion due to human use and off-road vehicles; and
(e) natural beach erosion.

Marathon permits a variety of uses as-of-right, and as minor and major conditional uses in beach/berm areas. Section 9-5.343 of the Land Development Regulations (LDR's) establishes open space requirements of 90 percent and 20 percent for undisturbed beach/berm and disturbed beach/berm, respectively. In addition the LDR's protect beaches through a shoreline setback requirement, as follows:

> (a) fifty (50) feet from natural water bodies with unaltered shorelines or unlawfully altered shorelines, measured from the landward limit of mangroves, if any, and where mangroves do not exist, from the mean high tide line; and
>
> (b) fifty (50) feet from any shoreline area which is known to serve as an active nesting or resting area for marine turtles, terns, gulls and other birds.

Because most beaches in the Keys are narrow, the shoreline setback effectively restricts development activities on beaches. However, development is permitted on berms, subject to environmental design criteria which limit clearing, impervious surfaces, lighting, excavations, fill and landscaping.

Since adoption of the LDR's in 1986, these regulations have reduced the amount of habitat loss which would have otherwise occurred. Development, however, has continued to take place on undisturbed beach/berms throughout the Keys. With this development there has been not only direct habitat loss, but introduction of increased human activity. This places further stresses upon the remaining undisturbed beach/berm habitat retained as open space in development projects as well as adjacent undeveloped areas.

As a condition of Development Orders for projects in beach/berm areas, the City requires that measures be taken to prevent disturbance to areas to be retained as open space. Despite this, it is not uncommon for site disturbances to occur outside the approved construction area. The result is typically loss of native beach/berm vegetation, with replacement by non-native landscaping materials or, where disturbed areas are left bare, invasion by exotic plants. This loss of native beach/berm material directly threatens the immediate area by destabilizing the loose sand substrate, which then is subject to rapid erosional loss, especially under storm conditions and colonization by invasive plants.

In general, widespread establishment of exotic vegetation has placed Keys beach communities under stress. The most invasive species are Australian pine (Casuarina equisetifolia) and leatherleaf (Colubrina asiatica), both of which are very competitive with native plants. Brazilian pepper (Schinus terebinthefolius) and Seaside Mahoe (*Thespesia populnea*) may also be a problem in some areas, but is not nearly as widespread on beaches in the Keys.

Beach erosion is typically due to natural causes, exacerbated by human activities (walking, off-road vehicles, and disturbances associated with adjacent development) which have disturbed natural beach vegetation, facilitated colonization by invasive plants, and weakened the sandy beach substrate. DNR has identified seven beaches in the Keys which are experiencing natural beach erosion (Florida DNR, 1989b) (see Section 3.10.5 below). Beach erosion due to human activities has been greatest, although not a significant problem, on Coco Plum Beach and Grassy Key Beach.

Generally there is not a serious problem with use of off-road vehicles (ORV's) and all-terrain vehicles (ATV's) on beaches in the Keys due to their limited size and extent, difficulty of access, and unstable substrate. ORV and ATV use and associated damage on natural beaches is most evident on Coco Plum Beach and Grassy Key Beach.

Past Trends in Beach Erosion and Accretion

Past trends in beach erosion and accretion in the Florida Keys have not been well researched. Historical studies of beach erosion exist only for the south shores of Key West and Bahia Honda Key. Documentation of erosion control efforts is also unavailable.

General Beach Accretion Trends

In general, beach formation in the Keys is limited by reduced wave action in the Straits of Florida coupled with a lack of sand available for transport. The southward net transport of sand along the Atlantic barrier beaches of Florida, which builds and renourishes the beaches of South Florida north of the Keys, diminishes substantially at the southern end of Dade County. While quartz sand deposits do exist in shoals south of Key Biscayne, there is little southward sand

transport from there to Soldier Key. There are a number of physical reasons for the lack of sand transport between the barrier islands and the Florida Keys. Little Bahama Back and Great Bahama Bank provide substantial protection to the shoreline from Atlantic Ocean swell. As a result, wave action needed to transport sand to the shore is greatly diminished in the Straits of Florida. Furthermore, in offshore areas any sand which may exist is influenced by the strong northward current of the Gulf Stream which blocks any southward sediment transport (Florida DNR, 1989b).

As a result of these conditions, the narrow beaches characteristic of the Keys are created by an interaction of low wave energy and coarse sand. The berms or sand ridges result from storm waves which transport sand from the shallow submerged bottoms and beach zones landward. The sands that form the beaches and berms of the Keys are of carbonate origin derived from the erosion of limestone, from aragonite particles precipitated from seawater, and from the fragmented remains of corals, cast-off shells, and calcareous algae. These fragmentary particles are generally coarse and angular, in contrast to the fine particles of silica that form the sands of most northern beaches. This coarse fraction of sediments is sorted from the fine by the action of waves and currents. Coarse material is deposited in the higher energy areas such as beaches and slope tops of channels, whereas the fine muds end up in quiescent areas such as mud banks, shallow embayments, and mangrove fringes.

Subsequent to deposition of this material on the beach, it is either carried upward to the berm by storm waves or transported offshore by nearshore currents. Because of its relatively large size and angularity, this sand is not readily transported by the wind as are the siliceous sands of mainland beaches. This explains the absence in the Keys of the shifting or high dunes characteristic of beaches on the middle Atlantic shore.

Beach Erosion Trends

The primary causes of beach erosion in the Keys are major storm events, onshore and alongshore sediment budget deficits, historical development trends, and long-term sea level rise. Several beach areas in the Middle and Lower Keys have experienced or are currently experiencing severe erosion. Approximately 23,100 linear feet of the beaches (22 percent) are described by DNR as having erosion problems. Of these, 8,990 linear feet are classified as critical and 14,090 linear feet are classified as noncritical. The following is a general description of the beach erosion problems documented beaches in Marathon (Florida DNR, 1989b):

Coco Plum Beach (Fat Deer Key)(Florida DNR, 1989b, p.20)

Approximately 7,500 feet of shoreline along Coco Plum Beach is experiencing noncritical erosion. A terminal rock groin has been constructed at the east end of the beach and two rock groins have been constructed at the west end. The net sediment transport direction is to the southwest, as seen by the severe erosion west of the eastern groin and by the accretion at the west groins.

Sombrero Beach (Vaca Key)(Florida DNR, 1989b, p.20)

The eastward transport of beach sediment off Sombrero Beach and into the adjoining canal to the east has resulted in critical erosion. At least one beach nourishment effort was conducted in

1975 when about 60 to 70 cubic yards of sand were brought in by truck. The construction of a terminal groin is needed at the eastern end of the beach to prevent continued erosion losses and to stabilize beach nourishment.

Effects of Coastal or Shore Protection Structures on Beach/Berm Communities

Coastal protection structures have been used throughout the Keys for purposes of reducing shoreline erosion, including erosion on beaches. Groins have been successfully used at Bahia Honda State Recreation Area Beach and Coco Plum Beach to slow erosion processes (Florida DNR, 1989b). The DNR has not specifically identified any instances of adverse impacts on beaches associated with shoreline protection structures, such as groins, breakwaters, riprap and bulkheads (Florida DNR, 1989b).

Existing and Potential Beach Renourishment Areas

The DNR has identified one beach in Marathon where beach renourishment has occurred (Florida DNR, 1989b):

> Sombrero Beach (Vaca Key)(Florida DNR, 1989b, p.20):
> In 1975, approximately 60 to 70 cubic yards of sand were brought in by truck to renourish Sombrero Beach on Vaca Key.

There are no ongoing beach renourishment projects in the Keys.

Recommendations for identified beach erosion areas in the Middle and Lower Keys, included in "Florida's Beach Restoration Management Plan" (Florida DNR, 1989b), call for development and implementation of beach restoration plans for Long Key State Recreation Area Beach, Sombrero Beach and Bahia Honda State Recreation Area Beach. Beach renourishment, although not specifically recommended, would be considered as a restoration option for all three beaches. Table 4-8 lists the beaches in Marathon with erosion problems and recommendations for restoration.

Table 4-8:
Marathon Beach Erosion Problem Areas

Map Unit	Beach Location	Total	Critical	Non-	Recommendation for Beach

		Length (ft.)	Length (ft)	Critical Length (ft.)	Restoration
710J	Fat Deer Key Coco Plum Beach	7500	0	3170	1. Implement beach management plan
710L	Boot Key Sombrero Beach	1600	1600	0	1. Complete marine habitat study 2. Complete sand source study 3. Develop and implement restoration plan, as appropriate (pending findings of studies), probably including construction of a terminal groin.
Source: Florida DNR, 1989b.					

Conservation and Protection

The Federal and State governments have protected many of the most significant marine and terrestrial biological communities found in the Florida Keys through acquisition. The majority of the Atlantic Ocean shoreline within the City is not only beach berm community but is also recognized marine turtle nesting habitat and as such State and Federal agencies along with the provisions detailed in City Code Article 4, Chapter 13, Sections 61 – 67, provide protective measures.

Acquisition is the most direct means of preserving remaining undisturbed beach/berm habitat areas in the Keys. This can be accomplished for some high priority beaches, particularly those which are suitable for recreation use, such as Coco Plum Beach. For many other beach/berm areas, acquisition is not a viable alternative due to lack of purchase funds.

Future development in the City should be directed to the maximum extent possible away from undisturbed beach/berms. This should be accomplished through land use policies of the Comprehensive Plan and its implementing land development regulations. In developing the Permit Allocation System for implementation of the Plan, consideration should be given to assigning minor points to developments proposed in undisturbed beach/berms (see Future Land Use Element Policies 1-3.5.4 and 1-3.5.8).

When development is permitted in undisturbed beach berm areas, there should be strict enforcement of the 90 percent open space requirements. The City should develop a set of construction standards for development in undisturbed and disturbed beach/berm areas which address clearing and actions to protect beach/berm vegetation outside of the construction site. These should be attached as conditions to Development Orders and should be strictly enforced by site inspections and fines levied for violations.

Restoration of beach/berm areas should be encouraged through both mandatory restoration as a condition of Development Orders, as well as through voluntary landowner action. A list of invasive exotic plants is on record with the City Biologist. All plants on this list should be removed from the development site (including sites on both undisturbed and disturbed beaches) as a condition for issuance of a Certificate of Occupancy. All areas disturbed during

construction should be immediately restored to stable condition. Only native plants should be used for restoration and landscaping.

ORV and ATV impacts on beaches should be reduced through improved posting of regulations and by stepped-up enforcement of these regulations by the Environmental Crimes Task Force.

Marine Ecological Communities

The waters surrounding Marathon include extensive seagrass beds and are part of the only coral reef tract in the continental United States. These and other benthic marine ecological communities in the Keys have been thoroughly mapped as part of the Florida Keys National Marine Sanctuary Management Plan. Shoreline mangroves, coral reefs, and seagrass beds provide an important habitat for many species of fish. Some fish species are dependent on mangroves during their juvenile stage and then migrate to seagrass beds and/or coral reefs after maturing. Other fish species use these resources on a seasonal basis. These resources provide abundant food and shelter for marine fauna. Coral reefs located in waters near Marathon reduce wave impacts experienced during storm events, while seagrass beds surrounding Marathon stabilize the coastal floor and reduce wave impacts that enhance beach erosion.

Coral Reefs

Coral reefs are created from colonies of very small organisms that produce protective exoskeletons from calcareous materials produced from calcium and carbonate ions they remove from saltwater. Coral polyps live in these naturally formed chambers. Upon the death of a polyp, a new polyp grows on the skeletal remains, which can withstand time exceeding hundreds of years. Millions of coral polyps together with skeletal remains existing for thousands of years create a coral reef. Though coral reefs have been in existence for millions of years, they are a highly delicate marine resource that have an extremely slow rate of growth, typically two to three inches per year for elkhorn and staghorn coral but less for larger subspecies. Coral reefs are often referred to as "living" or "dead" communities. Those that no longer produce polyps are considered dead.

Reefs commonly develop in elongated rows referred to as tracts. Differences in the physical environments are reflected in the differing morphologies of coral species and the dominance of various species. The reefs of the lagoon area live in shallow water that is more strongly influenced by wave action that can increase turbidity, and by weather changes that can result in a range of thermal variations not present in the deeper waters of the outer reef. As a result, massive boulder-shaped corals whose morphology is better able to withstand high wave energy and turbidity dominate this reef system. By comparison, the corals along the outer reef do not experience such stressful conditions where the thermal condition is stabilized by the influence of warm Florida currents and sediments that could contribute to turbidity are instead transported into the ocean's depths by sand channels. As a result in part, many corals with branched and plated morphologies characterize the outer reef. Patch reefs, Transitional reefs, Bank reefs and Hardbottom are recognized types of marine resources in Marathon's aquatic environment.

1) **Bank Reefs.** Bank reefs are located at or near the shallow shelf break. The elongated reefs form a discontinuous belt that is best developed seaward of Key Largo and the Lower Keys. This community receives the most beneficial nutrients, displays the most diverse

associations, and exhibits the most highly developed super-structure (Florida DNR, 1991a). Many of the massive, reef building corals in the reef banks do not occur in the other coral community types. Representative biota of these outer reefs include Mustard Hill Coral (*Porites astreoides*), Lettuce Coral (Agricia lamarcki), Elkhorn Coral (*Acropora palmata*), and Staghorn Coral (*Acropora Cervicomis).*

2) **Transitional Reefs.** Between bank reefs and patch reefs there is frequently a coral community with fauna found in both communities, referred to as the transitional reef. Under more favorable conditions (higher sea level), the transitional reef may in time develop into the more diverse reef bank (Florida DNR, 1991a). It also occurs on artificial substrates, such as sunken ships or other debris used to construct artificial reefs (Jape, 1984).

3) **Patch Reefs.** There are over 6,000 patch reefs between Miami and the Marquesas (Schomer & Drew, 1982). Most occur in areas of sand, mud or rock substrate located in a band two to four miles from the islands between Hawk Channel and the outer reefs (Marszalek, et al., 1977). Colonization occurs where light, water temperature and nutrient conditions are favorable and where patch reef organisms are protected from the excessive sediments, temperature and salinity fluctuations of water circulating from Florida Bay. Patch reef development in nearshore waters (landward of Hawk's Channel) is known to occur in only a few locations in the Keys (Florida DNR, 1991a). There are two basic types of patch reefs, dome and linear (Marszalek, et al, 1977; Jape, 1982).

   a) Dome patch reefs usually occur in clusters in water depths of less than 30 feet and vary in size from a few meters to more than 700 meters (Schomer & Drew, 1982). They are typically circular or elliptical and are surrounded by a halo of substrate. The community's biota varies greatly depending on reef age and environmental condition (Jape, 1982), but typically consists of stony corals (*scleractinian* and *alcyonarian).* Other coelenterates, mostly erect sponges, echinoderms, crustaceans, mollusks, red and green algae, and a variety of fishes also occur. Species diversity and density generally increase in proportion to the size of the patch reef (Florida DNR, 1991a). Jones (1977) described a successional sequence for dome patch reefs in which the pioneer corals are likely to be *Porites porites, Siderastrea radians, Manicinia areolata, Cladocora arbuscula* and *Fava fragum*. These forms are replaced by primary reef building corals like the Starlet Coral (*Siderastrea siderea*), the Brain Coral (*Diploria labrinthifomis* and *D. strigosa*), the Star Coral (*Montastrea annularis* and *M. cavemosa*), the Finger Coral (*Pontes furcata*) and *Colpophyllia natans*.

   b) The coral assemblage of linear patch reefs is similar to that of dome patch reefs, but Elkhorn Coral (*Acropma palmata*) joins Star Coral *Montastrea annularis* as a principal reef builder. Linear patch reef usually occurs seaward of dome patch corals and lie roughly in a chain parallel to the outer reefs. Both types of reefs commonly have algae, numerous erect sponges, bivalves; gastropods, spiny lobster, stone crab, echinoids, ostracods, bryozoans, and fishes (Enos, 1977; Multer, 1977; Jape, 1982).

4) **Hardbottom.** Hardbottom communities occur on large portions of the Atlantic sea floor and smaller portions of the lagoon bottom, extending from less than 1 meter depth to depths

greater than 30 meters. Marine grass beds, sand, and mud bars are usually intermittently mixed with the hardbottom occupying shallow depressions in the limestone (Florida DNR, 1991a).

Hardbottom habitat supports a diverse invertebrate and vertebrate fauna, dominated by algae and invertebrate species such as soft corals, sponges, and small stony corals. The distribution of macrofauna is generally scattered in random patterns and is never as compact or diverse as are grass beds or coral reefs (Florida DNR, 1991a). The soft corals are visually dominant. The most common species are the Sea Whip (*Pterogorgia spp*.), Sea Fan (*Gorgonia spp.*), Sea Rod (*Pelxaura spp*.), and Sea Plume (*Pseudopterogorgia spp*.)(Florida DNR, 1991a). Stony corals found in the hardbottom community include Clubbed Finger Coral (*Porites porites*), Porous Coral (*P. asteroides*), Starlet Coral (*Siderastrea radians*), Rose Coral (*Mana areolata*), Lobed Star Coral (*Solenastrea hyades*), and Smooth Star Coral (*S. boumoni*) (Florida DNR, 1991a).

Sponges are dominant in some areas of the lagoon, with the most prevalent species including the Chicken Liver Sponge (*Chondrilla nucula*), Vase Sponge (*Ircinia campana*), Cake Sponge (*L. etherea*), Stinking Sponge (*I felix*), Blue Heavenly Sponge (*Dysidea etherea*), Large Loggerhead Sponge (*Spheciospongia vespana*), and Tube Sponge (*Aplysina cauliformis* and *Callispongia spp*.) (Florida DNR, 1991a).

Algal species are well represented by the calcareous greens, *Acetabularia, Batophora, Halimeda,* and *Udotea spp*. (Florida DNR, 1991).

5) **Seagrass Beds.** Marathon is surrounded by dense seagrass beds, except for natural hard bottom areas where seagrass is sparse and areas where dredging has occurred, such as in channels and bights. Covering more area than any other vegetative or aquatic community within the Keys, this aquatic ecosystem provides an abundance of food and habitat for a vast number of commercially and recreationally important fish and invertebrates. Another important function that seagrass provides is the stabilization of sand and mud that are susceptible to erosion from shore currents or wave surge. The seagrass community is a highly productive, faunally rich system that covers a larger area than any other ecosystem in Monroe County. Of the 10,000 square kilometers (sq km) of seagrass in the Gulf of Mexico, over 8,500 sq km are in Florida waters, primarily in Monroe County (Zieman, 1982). Seagrasses cover over 80 percent of the sea floor in the area bounded by Cape Sable, north Biscayne Bay and the Dry Tortugas, an area of over 5,500 sq km (Zieman, 1982). Grassbed distribution is determined primarily by factors influencing light intensity, current velocity, and sediment depth.

Seagrass beds surrounding Marathon stabilize the coastal floor and reduce wave impacts to beach ecosystems. Seagrass beds also are important in stabilizing sediments that would otherwise exist as shifting sand and mud. As such, they represent a critical element in preventing or at least retarding the loss of continental materials that would otherwise be lost by erosion to the ocean.

Seagrass beds in Monroe County are dominated by three species: Turtle Grass (*Thalassia testudinum*), Manatee Grass *(Syringodium filiforme*), and Shoal Grass (*Halodule wrightii*). These

species form large, complex, and extremely significant biological habitats that persist from year to year in the same general location.

Turtle grass is the most robust and widespread of the seagrasses, forming extensive meadows throughout its range. It is a climax species and as such, is considered the primary producer of the seagrass community. Manatee grass is more surficially rooted than turtle grass and rarely forms extensive meadows, occurring most commonly mixed with other species or in small dense monospecific patches. Shoal grass is found primarily in disturbed areas that are devoid of turtle grass or manatee grass and is an important early colonizer of such sites. Of the principal seagrass species, shoal grass, thrives in water too shallow or too deep for the other species and is the most tolerant to variations in temperature and salinity (Zieman,1982).

Less common seagrass species include three species of Halophila (Paddle-grass, *Halophila decipien;* Star-grass, *Halophila engelmanni;* and Johnson's Sea-grass, *Halophila johnsonii*). These are diminutive, vascular plant species, sparsely distributed in seagrass communities, which do not form permanent seagrass beds. Only a few types of benthic algae are capable of colonizing the bottom sediments, notably members of the genera *Halimeda*, *Penicillus*, *Caulerpa*, *Rhipocephalus*, and *Udotea*. These species are early colonizers of marine sediments acting to stabilize sediments so that seagrasses may become established. *Laurentia*, a species of drift algae, also commonly occurs in grassbeds. Seagrass leaves also provide substrate for numerous species of epiphytic algae (Ballantine and Humm, 1975).

Seagrass beds provide abundant food and shelter for a myriad species. They represent the richest nursery and feeding grounds in South Florida's coastal waterways. Faunal constituents of the marine grassbed community include a diversity of microscopic zooplankton, epiphytic biota, pelagic invertebrates, fishes, and mammals. Seagrasses provide vast amounts of energy via detritus that may cycle internally or be exported to mangrove or coral reef communities. Within the seagrasses, invertebrates include the pink shrimp, the queen conch, the spiny lobster, the stone crab, the Bahamian starfish, as well as sea urchins. Fishes species found in the seagrass beds include sea bream, sheepshead, grouper, redfish, various snappers, and the spotted sea trout. A number of species use the seagrass beds as a nursery area. Seagrass beds are also used by several sport fish species, especially tarpon, permit, and bonefish.

The only reptile for which seagrass constitutes a principal feeding habitat is the Green Sea Turtle (*Chelonia mydas*). Two aquatic mammals know commonly to use seagrass communities are the Caribbean Manatee (*Trichechus manatus*) and the Bottlenose Dolphin (*Tursiops truncatus*). While Bottlenose Dolphins are common in South Florida waters, generally they are not especially common in shallow seagrass meadows in Florida Bay because the extreme shallowness precludes extensive utilization by such a large mammal.

A large number of birds feed extensively in shallow seagrass meadows (see Table 4-9).

Table 4-9: **Birds Using Seagrass Flats In The Florida Keys**		
Common Name	**Species Name**	**Feeding Tide**

Table 4-9:
Birds Using Seagrass Flats In The Florida Keys

Common Name	Species Name	Feeding Tide
Great Blue Heron	*Ardea herodias*	low
Great White Heron	*A. herodias*	low
Great Egret	*Casmerodius albus*	low
Snowy Egret	*Egretta thula*	low
Little Blue Heron	*E. caerulea*	low
Tri-colored heron	*E. tricolor*	low
Reddish Egret	*Egretta rutescens*	low
White Ibis	*E. Udocimus albus*	low
Roseate Spoonbill	*Ajaja ajaja*	low
Black-bellied Plover	*Plavialis squatarola*	low
Wilson's Plover	*Charsdrius wilsonia*	low
Semipalmated Plover	C. *semipalmatus*	low
Willet	*Catoptrophorus semipalmatus*	low
Ruddy Turnstone	*Arenaria interpres*	low
Red Knot	*Calidris canutus*	low
Western Sandpiper	C. *mauri*	low
Least Sandpiper	C. *minutilla*	low
Dunlin	C. *alpina*	low
Short-billed Dowticher	*Limnodromus griseus*	low
Horned Grebe (winter only)	*Podiceps auritus*	high
American White Pelican (winter only)	*Pelecanus erythrorhynchos*	high
Double-crested Cormorant	*Phalacrocorax auritus*	high
Red-breasted Merganser	*Mergus serrator*	high
Brown Pelican	*Pelecaus occidentalis*	high
Osprey	*Pandion aliaetus*	high
Bald Eagle	*Haliaeetus leucocephalus*	high
Laughing Gull	*Larus atricilla*	high
Ring-billed Gull (winter only)	*L. delawarensis*	high
Herring Gull (winter only)	*L. argentatus*	high
Royal Tern	*Sterna maxima*	high
Forster'sTern (winter only)	S. *forsteri*	high

Table 4-9: **Birds Using Seagrass Flats In The Florida Keys**		
Common Name	**Species Name**	**Feeding Tide**
Least Tern (summer only)	S. *antillarum*	high
Source: Monroe County Department of Resource Management		

Existing Uses

Recreational boating, snorkeling, SCUBA diving, and fishing are the primary activities which occur in the marine communities of the Florida Keys. Over one million people visit the Florida Reef Tract annually (Miller, 1988).

Known Pollution or Problems Related to Marine Resources

In general, the coral communities of the Keys are affected by a number of factors, both natural and man-induced. Findings of the Research Planning Workshop for the FKNMS (NOAA and RSMAS, 1991) identified the following major stresses on coral communities as:

A. **Water Quality:** groundwater, reduced light, suspended sediments, chronic nutrients, temperature extremes, allocthonous bacteria and viruses, pesticides and hydrocarbons;

B. **Global Change:** sea level rise, temperature increases; and

C. **Physical:** anchoring, marine debris, diver impact, collection damage, fishing gear, large and small vessel groundings.

Perhaps the most frequently cited stress on coral communities is anthropogenic water pollution resulting in elevated nutrient loading to the offshore waters of the Florida Reef Tract. In an effort to understand the natural and man-induced factors affecting the vitality of coral communities in the FKNMS, Phase I of the FKNMS Water Quality Protection Program includes a Coral Community Assessment (Task 3) (CSA, 1991). The assessment presents a review of available scientific data and literature on the Keys' coral communities, as well as conversations with acknowledged coral community experts. Findings from this study indicate that the Florida Reef Tract is declining; both natural and anthropogenic factors are responsible for the decline; and adequate data is not available to document the extent of the problem and the specific natural and man-induced factors responsible for the decline. (CSA, 1991)

Direct damage to coral reefs caused by human activities is not specifically addressed in the Coral Assessment (CSA, 1991). Physical damage to corals is widespread throughout the Keys due to the high level of recreational activity, estimated at over one million users annually (Miller, 1988). Researchers recognize direct damage to coral reefs associated with recreational activities as a significant threat (J. Porter, University of Georgia, personal communication, 1991; NOAA, 1988; NOAA and RSMAS, 1991).

Seagrass habitat losses in the Florida Keys National Marine Sanctuary have been directly related to natural habitat destruction by hurricanes and tropical storms. Seagrass communities are well

adapted to these disturbances and typically recolonize shortly afterward. Research suggests that hurricanes may function to remove accumulated organic matter and sediments, particularly in Florida Bay (Zieman, et ah, 1989).

To date there have been no major losses of submerged or emergent vegetation within the FKNMS, which can be unquestionably attributed to man-induced, water quality degradation (CSA, 1991). Quantitative data is not available either to determine the true extent of water quality degradation throughout the Sanctuary, or to definitively state whether seagrass bed deterioration is presently occurring in the Sanctuary (CSA, 1991). Despite this, there are disturbing signs observable today that suggest that the submerged vegetative community in nearshore areas in the Sanctuary may be coming under increasing stress due to water quality deterioration (CSA, 1991).

Dredging in seagrass beds has historically caused the greatest amount of man-induced direct damage to nearshore-submerged vegetation. Since the turn of the century, an estimated 2,000 hectares of seagrass beds have been lost by mechanical destruction, primarily dredging on submerged lands within the Sanctuary, representing a loss of approximately 0.35 percent of the total seagrass acreage (CSA, 1991). Dredged areas are rendered unsuitable for seagrass recolonization for long periods or permanently in locations where dredged depths exceed those tolerated by seagrasses (Zieman, 1975). Cuts from boat propellers are today the most common type of man-induced direct damage to seagrass beds in South Florida (Zieman, 1975). Boat mooring and dock construction near seagrass beds has the potential for adverse impacts on seagrasses through bottom disturbances and shading, and indirectly through pollutant discharges from vessels.

The indirect causative mechanisms for the loss of seagrass beds in the Sanctuary are not well known. Typically, losses are attributed to the general development of the watershed and the coastline that influences the seagrass beds (CSA, 1991). It is difficult to precisely identify the exact pollutants and mechanisms, which may be impacting submerged vegetation because human activities tend to alter many water quality characteristics simultaneously (CSA, 1991). Water quality factors that have been implicated in declines o~~i~~n submerged vegetation include: alterations in the physical parameters of temperature, salinity and sediment stability; toxic substances (such as herbicides, detergents and petroleum products), and reduction of the quantity and quality of light that reaches seagrasses (CSA, 1991).

Conservation or Protection

The Florida Keys National Marine Sanctuary (FKNMS) was established in recognition of the conservation, recreational, commercial, ecological, research, educational and aesthetic values that render the Florida Reef Tract and its surrounding marine environments a resource area of national significance. The FKNMS encompasses all of the submerged lands and waters of the Florida Keys extending from the mean high water mark to the offshore sanctuary boundary. This lies at the approximate 300-foot depth contour line (Public Law 101-965). All marine communities within these designated sanctuary boundaries are protected and subject to future management through the FKNMS Management Plan and the FKNMS Water Quality Protection Program. The FKNMS Management Plan will provide the basis for future federal, state and local conservation activities affecting the resources of the Sanctuary, including its coral communities. The Plan will identify the regulatory strategies and alterative institutional responsibilities for

resource protection. It will include a plan for public education regarding coral conservation, as well as recommendations for a coral research program.

The FKNMS Management Plan, now in preparation pursuant to Public Law Public Law 101-965, will identify and propose for adoption a management plan which is designed to protect the resources of the FKNMS and which manages human uses within it. As part of this process, NOAA as the lead agency, in cooperation with EPA, DEP, SFWMD and Monroe County is assessing alterative management strategies for marine resource protection. The most significant opportunity for the City to participate in the effort to conserve the marine communities of the Keys will be to implement the water quality protection policies, programs, and regulations of the Plan and the FKNMS Water Quality Protection Program.

Habitat Analysis

As a part of the Advanced Identification of Wetlands (ADID) program for the Florida Keys, Monroe County mapped natural resource habitats. The data provided to the City identifies Developed, Disturbed, Exotic, Hammock, Dune, Mangrove, Scrub Mangrove, Buttonwood, Salt Marsh and Water as specific habitat types that occur within the City. Tables 4-5: Vegetation Analysis and 4-6: Habitat Acreage, presents a breakdown by acreage of habitats present in the City. Developed, Scarified, Disturbed and Exotics have been consolidated into one category labeled Disturbed; Mangrove, Scrub Mangrove, Buttonwood and Salt Marsh have been consolidated into one category labeled Wetland; and Hammock and Dune have been consolidated into the category labeled Native. Ponds, enclosed canals, borrow pits and submerged lands with bay bottom deeds and specific parcel numbers are accounted for in the category labeled Water and the category labeled transportation accounts for the City owned roads within the Municipality.

Endangered Species

The State list of diminishing animal species are maintained by the FFWCC and categorizes the species on the degree of concern as endangered, threatened and of special concern, this constitutes Rules 68A-27.003, 68A-27.004 and 68A-27.005, respectively, F.A.C. The State list of diminishing plant species are categorized into endangered, threatened and commercially exploited, and are administered and maintained by the Florida Department of Agriculture and Consumer Services via Chapter 5B-40, F.A.C. The Federal list of diminishing animal and plant species are administered by the U.S. Fish and Wildlife Service and categorized into endangered and threatened, and are published in 50 CFR 17 (animals) and 50 CFR 23 (plants). The Florida Fish and Wildlife Conservation Commission (FFWCC) (formerly Game and Freshwater Fish Commission), Office of Environmental Services (OES), National Oceanic and Atmospheric Administration-National Marine Fisheries (NOAA-NMFS) and the US Fish and Wildlife Service (USFWS) provides and updates a chart that consolidates the lists administered by these State and Federal jurisdictional agencies. The City utilizes this chart as the identification tool to recognize those species within the City that merit special protection or consideration.

Occurrences of Threatened and Endangered Species

Biological communities in the Florida Keys have evolved in response to unique island environmental conditions characterized by salt water, hot sun, dry seasons and hurricanes. Extreme environmental conditions combined with the isolation of the island archipelago have

supported colonization and evolution of highly specialized plants and animals. Today, many are endemic to the Keys; others are limited to a relatively small geographic area on this continent. Populations of species in the Keys have evolved to the point of representing unique races or subspecies, existing nowhere else in the world (Ross, 1989).

Vertebrates of the Florida Keys largely represent a subset of those species that occur in temperate mainland North America, particularly the Florida Peninsula (Ross, 1989). In contrast, the plants of the Florida Keys exhibit a substantial floral component derived from the tropics (Lazell, 1984).

Table 4-10 presents a list of species designated as endangered, threatened or of special concern by the following organizations:

1. Florida Fish & Wildlife Conservation Commission (FWCC)
2. Florida Department of Agriculture and Consumer Services (FDOA)
3. United States Fish and Wildlife (USFWS)

A total of 27 vertebrates, 1 invertebrate and 60 plants are listed. The succeeding discussion generally identifies the types of habitat typically used by each species for feeding, resting and nesting, as well as the approximate range for each species within the Keys.

Those species listed as threatened or endangered by the U.S. Fish and Wildlife Service (U.S.FWS) which are known to inhabit the Florida Keys include the following:

Table 4-10:
Endangered and Threatened Species

Species Designated as Endangered by the FWS

Atlantic Green Turtle	*Chelonia mydas*
American Crocodile	*Crocodylus acutus*
Leatherback Turtle	*Dermochelys coriacea*
Atlantic Hawksbill Turtle	*Eretmochelys imbricata*
Atlantic Ridley Turtle	*Lepidochelys kempi*
Southern Bald Eagle	*Haliaeetus leucocephalus*
Wood Stork	*Mycteria americana*
Bachman's Warbler	*Vermivora bachmani*i
Key Largo Wood Rat	*Neotoma floridana smalli*
Key Deer	*Odocoileus virginianus clavium*
Silver Rice Rat	*Oryzomys argentatus*
Key Largo Cotton Mouse	*Peromyscus gossypinus allapoticola*
Lower Keys Marsh Rabbit	*Sylvilagus palustris hefneri*
Florida Manatee	*Trichechus manatus latirostris*
Schaus' Swallowtail Butterfly	*Heraclides aristodemus ponceanus*
Tree Cactus	*Cereus robinii*
Small's Milkpea	*Galactia smallii*

Species Designated as Threatened by the FWS

American Alligator	*Alligator mississippiensis*
Atlantic Loggerhead	*Caretta caretta*
Eastern Indigo Snake	*Drymachron corais couperi*
Piping Plover	*Charaduius melodus*
Arctic Peregrine Falcon	*Falco peregrinus tundrius*
Roseate Tern	*Sterna dougallii*
Stock Island Tree Snail	*Orthalicus reses*
Garber's Spurge	*Euphorbia garberi*
Johnson's sea-grass	*Halophila johnsonii*

Source: US Fish and Wildlife Service

Marathon has updated the mapping of threatened and endangered animals with *Map 19: Protected Species*, which was originally completed in June 1992. The updated maps include the data which has been accumulated over the last five years, and depicts the range, known habitat, probable habitat, and/or potential habitat for animal species listed as threatened, endangered, or as a species of special concern. The updated information was obtained primarily from the FWCC and Florida Natural Inventories (FNAI) data. The updated maps are based upon the latest official list of threatened and endangered animal species designated by the applicable state and federal agencies, which was dated January 29, 2004 (FWCC) and January 18, 2005 (USFWS). These updated maps, and the corresponding table of species codes, are incorporated by reference into this Comprehensive Plan, and are available for review through the Environmental Resources Department.

Wildlife

The Marathon and the Florida Keys encompass a variety of ecologically unique biological communities providing habitat to diverse wildlife populations, including many species endemic to the Keys, several of which are globally rare and endangered. As discussed above, the biological communities include:

Living Marine Resources:

- mangrove forests along the shorelines
- seagrass beds lying on both sides of the City and extending offshore to the Florida Reef Tract
- coral communities of nearshore and offshore waters, including the Florida Reef Tract

Wetlands:

- transitional wetlands lying landward of the mangrove fringe and seaward of upland communities
- beach/berms

Uplands:

- tropical hardwood hammocks, the climax terrestrial community

Wildlife of the Biological Communities of the Florida Keys

Wildlife Typically Inhabiting Mangrove Communities

The mangrove communities provide food, cover, spawning, nesting and resting habitat for many species of mammals, birds, reptiles, amphibians, fish and invertebrates. Many of these species are dependent upon these communities during all or part of their life cycle.

A number of food webs are based on primary production of the mangroves and their associated epiflora. Energy flows stemming from mangrove-derived carbon begin their movement through these food webs as detritus, dissolved organic compounds, or as the products of direct grazing. Other pathways involve bacteria, fungi, macroalgae and phytoplankton associated with mangroves.

A variety of insects and gastropods graze directly upon arboreal leaf material. Simberloff and Wilson (1969) list 200 species of insects that are associated with mangrove communities. Snails (*Littorina* sp., *Cerithidea* sp. and *Melampus* sp.), isopods (*Ligea* spp.), and fiddler crabs (*Uca* spp.) are especially plentiful on the forest floor (Odum et al., 1982).

Mangrove communities also provide feeding, nesting and roosting habitat for numerous wading and fish eating birds. Odum et al. (1982) provides a list of 181 species of birds that use mangroves in South Florida. Among these, the following species are a major component of the avifauna of the Keys:

Great Egret	*Casmerodius albus*
Snowy Egret	*Egreta thula*
Great White Heron	*Ardea herodias occidentalis*
Great Blue Heron	*Ardea herodias*
Reddish Egret	*Dichromanassa rufescens*
Tricolored Heron	*Hydranassa tricolor*
Green Heron	*Butorides striatus*
Black-crowned Night Heron	*Nycticorax*
Yellow-crowned Night Heron	*Nycticorax violcea*
White Ibis	*Eudocimus alba*
Roseate Spoonbill	*Ajaia ajaja*
Double-crested Cormorant	*Pyalacrocorax auritus*
Magnificent Frigatebird	*Fregata magnificens*
Osprey	*Paudion haliaetus*
Mangrove Cuckoo	*Coccyzus minor*
Kingbirds	*Tyranus* spp.
Black-whiskered Vireo	*Vireo altiloquus*
Warblers	*Dendroica* spp.
Brown Pelican	*Pelecanus occidentalis*
White Crowned Pigeon	*Columba leucocephala*

All of these species nest in mangroves, usually on overwash islands.

A number of terrestrial and aquatic reptiles, amphibians, and mammals utilize mangrove habitat. Of the several species of marine turtles that inhabit mangroves, the Atlantic Loggerhead (*Caretta*) is relatively common and may use mangroves as nursery areas (Odum et al, 1982).

The Atlantic Hawksbill (*Eretmochelvs imbricata*) and the Atlantic Green Turtle (*Chelonia mydas*) are known to feed upon mangrove roots and leaves (Ernst and Barbour, 1972; Carr and Goin, 1955). Other reptiles include several species of snakes and anoles, and the Mangrove Terrapin. Of the snakes, only one, the Mangrove Water Snake (*Nerodia fasciata compressicauda*) is entirely dependent upon mangrove areas (Florida DNR, 1991c). Amphibians which inhabit mangroves include those which are suitably adapted to reproduce during brief rainy periods and/or which can use brackish pools for reproduction. Two introduced species; the Giant Toad (*Bufo marinus*) and the Cuban Treefrog (*Hyla septentrionalis*) have expanded their range considerably in mangrove areas in the last several decades (King and Krakauer, 1966; King and Krakauer 1968; and Krakauer, 1970).

Mammals which most commonly inhabit mangrove association include the Virginia Opossum (*Didelphis virginian*) and the Raccoon (*Procyon lotor*). Generally the opossum is confined to small populations in close proximity to human habitations. Both species are extremely versatile omnivores and are known to forage mangrove habitats (Layne, 1974). Other naturally occurring and introduced mammals which may frequent mangroves include the marsh rabbit (*Sylvilagus palustis paludicola*) and several species of rodents.

The most diverse group of organisms inhabiting the mangrove association are the marine organisms. Detritus and plankton are primary food sources for a large number of invertebrate fauna that attach themselves to prop roots, live in adjacent muds, or swim in the water (Florida DNR, 1991c).

Wildlife Typically Inhabiting Salt Marsh and Buttonwood Wetland Communities

Transitional wetlands support a fauna somewhat different from that of mangrove systems, although a number of animals feed in both tidal areas. The most frequently observed invertebrates are various species of insects, molluscs, and crustaceans. The Fiddler Crab (*Uca* spp.) is often found where there is adequate soil for burrowing. The White Peanut Snail (*Cerion* spp.) is often found in large numbers on the marsh floor or climbing through the low-lying vegetation. Ram's Horn Snails and the gastropods Cerithidea and Melampus are also very common in the marsh.

A number of reptiles and mammals rely on transitional wetlands habitat. Of these, several are designated as rare, endangered or of special state concern, including:

Eastern Indigo Snake	*Drymachron Corais Couperi*
Red Rat Snake	*Elapha guttata.*

The importance of Keys' transitional wetlands to wading bird populations has long been recognized by wildlife biologists. Virtually every wading bird species resident in the Keys forages in tidal wetlands. These birds rely on the shallow water areas of the transitional wetlands for feeding during periods of the year when they are unable to feed in their usual feeding areas because the water is too deep for wading. During these periods, the undisturbed transitional wetlands are critical to the survival of many bird species. Among the most common wading birds that feed in transitional wetlands are:

Roseate Spoonbill	*Ajaja*
Great White Heron	*Ardea heriodias occidentalis*

Great Egret	*Casmerodius albus*
Little Blue Heron	*Egretta caerulea*
Snowy Egret	*Egretta thula*
Reddish Egret	*Egretta rufescens*
Tricolored Heron	*Egretta tricolor*
Green-backed Heron	*Butoredes veresceus*
White Ibis	*Eudocimus albus*
Black-crowned Night Heron	*Nycticorax*
Yellow-crowned Night Heron	*Nycticorax violacea*
Glossy Ibis	*Plegadis falcinellus*

Wildlife Typically Inhabiting Salt Pond Communities

Salt pond fauna is diverse when compared to its depauperate flora. Racoons, insects, snakes and a great diversity of migratory and resident birds utilize the food resources of salt ponds. Within the ponds there is a variety of small fish, crustaceans and mollusks. Mollusks found in considerable abundance include species of the genera Cerithium and Modulus.

Birds known to use salt ponds as feeding habitat include:

Great Blue Heron	*Ardea herodias*
Great White Heron	*A. herodias*
Great Egret	*Casmerodius albus*
Snowy Egret	*Egretta thula*
Little Blue Heron	*E. tricolor*
Tricolored Heron	*E. tricolor*
Yellow-crowned Night Heron	*Nycticorax violacea*
Reddish Egret	*Egretta rufescens*
White Ibis	*Eudocimus albus*
Roseate Spoonbill	*Ajaja*
Black-bellied Plover	*Pluvialis squatarola*
Semipalmated Plover	*C. semipalmatus*
Willet	*Catoptrophorus semipalmatus*
Western Sandpiper	*C. mauri*
Dunlin	*C. alpina*
Short-billed Dowitcher	*Limnodromus griseus*
Brown Pelican	*Pelecanus occidentalis*
Laughing Gull	*Larus atricilla*
Ring-billed Gull (winter only)	*L. delawarensis*
Herring Gull (winter only)	*L. argentatus*
Common Tern	*Sterna hirundo*
Royal Tern	*Sterna maxima*
Forster's Tern (winter only)	*S. forsteri*
Lesser Yellowlegs	*Totanus flavipes*
Greater Yellowlegs	*Totanus melanoleucus*
Blue-winged Teal	*Anas discors*
Green Heron	*Butorides striatus*

Several species of migratory waterfowl are also known to utilize salt ponds seasonally. Species of *Fundulus*, *Cyprinodon*, and *Poecilia* are the primary food fishes of the rare Roseate Spoonbill (*Eudocimus alba*)(Ogden, in Pritchard, v.2, 1978) and the White Ibis (*Ajaja*)(Kushlan, 1979). Similarly the rare Reddish Egret (*Egretta rufescens*) is reported to feed primarily on Killifish.

Wildlife Typically Inhabiting Beach/Berm Wetland Communities

A variety of terrestrial wildlife is associated with the beach and berm community. Beaches provide nesting areas for a variety of shorebirds, primarily terns, as well as important feeding areas for a variety of shorebirds. Invertebrates, such as insects, amphipods, isopods, crabs, mollusks and worms, which are food for shorebirds, utilize accumulated seaweed and other organic beach debris as habitat. Sea turtles have always been associated with the Florida Keys.

Wildlife Typically Inhabiting Tropical Hardwood Hammock Wetland Communities

The environment provided by the flora of tropical hardwood hammocks is a major determinant of the assemblage of animal species that inhabit these communities. Because of their uniqueness and restricted occurrence, tropical hardwood hammocks provide habitat for many endemic or very restricted species, including several species listed as rare, endangered or of special concern.

While amphibians are not abundant in Keys hammocks, many reptiles may be found. These include the Box Turtle (*Terrapene carolina bauri*), Key Mud Turtle (*Kinosternon bauri*), the endemic Keys Mole Skink (*Eumeces egregius*), Coral Snake (*Micrurus fluvius*), Eastern Diamondback Rattlesnake (*Crotalus adamanteus*), Key Ringneck Snake (*Diadophis punctatus acricus*), Eastern Indigo Snake (*Drymarchon corais couperi*), Florida Brown Snake (*Storeria dekayi victa*), Miami Black-headed Snake (*Tantilla oolitica*), the Florida Ribbon Snake (*Thamnophis sauritus sackeni*) and the Rosy Rat Snake (*Elaphe guttata*). While some of these reptiles apparently occur throughout the Keys, others are restricted to only a few Keys, such as the coral snake which is limited to the Upper and Middle Keys.

Many species of birds use tropical hardwood hammocks. Those known to nest in Keys hammocks are:

Red-shouldered Hawk	*Buteo lineatus*
Osprey	*Pandion haliaetus*
Mourning Dove	*Zenaidura macroura*
Ground Dove	*Columbigallina passerina*
Mangrove Cuckoo	*Coccyzus minor*
Yellow-billed Cuckoo	*Coccyzus americanus*
Screech Owl	*Otus asio*
Chuck Will's Widow	*Caprimulgus carolinensis*
Pileated Woodpecker	*Dryocopus pileatus*
Common Flicker	*Colaptes auratus*
Red-bellied Woodpecker	*Centurus carolinus*
Gray Kingbird	*Tyrannus dominicensis*
Great-crested Flycatcher	*Myiarchus crinitus*
Carolina Wren	*Thryothorus ludavicianus*
Mockingbird	*Mimus polyglottus*
Brown Thrasher	*Toxostoma rufum*

White-eyed Vireo	*Vireo griseus*
Black-whiskered Vireo	*Vireo altiloguus*
Red-winged Blackbird	*Agelaius phonicius*
Common Grackle	*Quiscalus quiscula*
Cardinal	*Richmondena cardinalis*

Within the Keys, the range of some of these bird species is quite limited. The pileated woodpecker and Carolina wren, for instance, are known only from Key Largo.

Mammals that use Keys' tropical hardwood hammocks include the following:

Opossum	*Dildelphis marsupialis*
Gray Squirrel	*Sciurus carolinensis matecumbei*
Racoon	*Procyon lotor*
Marsh Rabbit	*Sylvilagus palustris hefneri*
Hispid Cotton Rat	*Sigmodon hispidus*
Least Shrew	*Cryptotis parva*
Bobcat	*Felis rufus*
Key Largo Wood Rat	*Neotoma floridana smalli*
Key Largo Cotton Mouse	*Peromyscus gossypinus allapaticola*
Key Vaca Raccoon	*Procyon lotor auspicatus*
Key Deer	*Odocoileus virginianus clavium*

Offshore Island Bird Rookeries

The backcountry area of Florida Bay contains a large number of bird rookeries, mostly on isolated mangrove islands. These islands are used by a variety of wading birds, shorebirds and marine turtles, including several species designated by the State and/or FWS as threatened, endangered or of special concern.

The Great White Heron National Wildlife Refuge and the Key West National Wildlife Refuge were established to protect many of these islands, recognizing their wildlife habitat. Approximately 60 islands, not connected by US 1, in the Keys remain in private ownership. These range in size from one acre to several hundred acres. An additional unknown number of offshore islands in Keys' waters are sovereignty lands owned by the State of Florida. A partial inventory of offshore island bird rookeries is mapped on *Map 19: Protected Species*, included in this Comprehensive Plan by reference in Policy 205.2.12. Offshore islands which are designated as known habitat for any of the endangered or threatened nesting birds are rookeries.

Issues related to offshore islands in the Keys focus on the nature of permitted development uses on private lands and conflicts among user groups on publicly-owned islands.

Protection of wildlife habitat on offshore islands should be accomplished by a prohibition of development on all offshore islands documented as rookeries. The offshore islands designated as known habitat for nesting birds indicated on *Map 19: Protected Species* should be immediately prohibited from development. The list of islands which are considered rookeries should then be updated by the City of Marathon Biologist in cooperation with the National Audubon Society Research Department, NPS, NOAA, FWC, DEP, and USFWS. Sand beaches

on offshore islands which are used by marine turtles would be subject to the Environmental Design Criteria of the Land Development Regulations applicable to beach/berms.

Existing Commercial, Recreational and Conservation Uses of Biological Communities

Existing uses in each of the biological communities in the Keys are generally discussed in preceding sections of the Conservation and Coastal Management Chapter, as follows:

Mangroves
Seagrass Beds
Coral Communities
Salt Marsh and Buttonwood Wetlands (transitional wetlands)
Salt Ponds
Beach/Berms
Tropical Hardwood Hammocks
Offshore Islands

Known Pollution Problems and/or Issues Related to Wildlife Communities

Problems and issues related to wildlife in the Keys can be categorized as follows:

- destruction or modification of habitat;
- predation and/or destruction of native wildlife populations;
- direct and indirect disturbances caused by human activities which alter the distribution and behavior of native wildlife populations.

Destruction and modification of habitat has occurred in every biological community in the Keys. The known pollution problems and/or issues related to each community are discussed in preceding sections of the Conservation and Coastal Management Chapter, as follows:

Mangroves
Seagrass Beds
Coral Communities
Salt Marsh and Buttonwood Wetlands (transitional wetlands)
Salt Ponds
Beach/Berms
Tropical Hardwood Hammocks
Offshore Islands.

In general, habitat losses and degradation include the following:

- loss of wetland and upland habitats to development
- degradation of nearshore water environments due to dredge and fill, water pollution, and recreational boating activities
- habitat contamination due to widespread aerial application of mosquito control chemicals

Predation and/or destruction of native wildlife occurs as a result of a variety of factors, many of which are common to all habitat types. These include:

Natural Destruction:

- hurricanes
- fires

Predation by Native Populations:
- nesting site predation, particularly by raccoons
- hatchling predation, particularly by raccoons
- adult predation

Predation by Non-Native Wildlife Populations:
- nest destruction by free-roaming pets and invasive species
- destruction of young and adults by free-roaming pets and invasive species

Predation by Humans:
- egg collecting
- deliberate nest destruction
- deliberate human persecution (shooting/trapping/vandalism)
- commercial exploitation for the pet trade
- overcollection
- poaching

Accidental Death:
- boat collisions
- incidental catch, particularly due to net fishing in Florida Bay
- entanglement in fishing gear
- highway mortality
- accidental drowning in artificial waterbodies (canals and mosquito control ditches)

Activities Altering Distribution and Behavior:
- hand feeding resulting in loss of fear for man and vehicles
- human disturbances during courtship and nesting periods.
- installation of fencing
- general human harassment on land (by residents and visitors) and on the water (by divers, boaters, swimmers, fishermen and snorkelers).

Potential for Conservation, Use or Protection of Wildlife Communities

The potential for conservation, use or protection of habitat in each of the biological communities in the Keys are discussed in preceding sections of the Conservation and Coastal Management Chapter, as follows:
- Mangroves
- Seagrass Beds
- Coral Communities
- Salt Marsh and Buttonwood Wetlands (transitional wetlands)
- Salt Ponds
- Beach/Berms
- Tropical Hardwood Hammocks

- Offshore Islands

Other actions which could be taken by Marathon to generally protect its wildlife populations include the following:

- adoption of a requirement for an environmental impact assessment for all major development proposals (see Section 3.13.2.C below)
- revisions to the Habitat Evaluation Index in the current Land Development Regulations (Monroe County BOCC, 1990) to better reflect the abundance and diversity of wildlife populations on development sites in pinelands and tropical hardwood hammocks
- revisions to the clustering requirements of the Land Development regulations (Monroe County BOCC, 1990) to prevent unnecessary fragmentation of native upland sites
- prohibition of development on offshore islands documented as bird rookeries
- establishment of a one-hundred (100) percent open space requirement for undisturbed salt marsh and buttonwoods
- stepped-up enforcement of animal feeding laws
- adoption of an exotic wildlife species ordinance (see Section 3.13.2.G below).

Hazardous Waste Management.

Monroe County currently manages a hazardous waste monitoring program in cooperation with State and Federal authorities. This program requires the registration of hazardous materials generators. Hazardous materials generators are divided into two categories: small quantity generators and large quantity generators. The County has not identified any large quantity hazardous materials generators within Marathon.

Current and Projected Water Needs (§9J-5.013(1)(c), F.A.C.)

This section provides an inventory of the current and projected water needs and sources to the year 2020. The projections are based on present water consumption demands placed on the Florida Keys Aqueduct Authority and population projections derived in the Future Land Use Element.

The City receives all of its potable water service from Florida Keys Aqueduct Authority (FKAA), which draws water from the Biscayne Aquifer on the Florida mainland near Florida City. No potable water is drawn from aquifers beneath Marathon. The South Florida Water Management District (SFWMD) establishes water conservation policy for the region.

Existing and Projected Potable Water Demand

For the year 2001, the FKAA has an annual rated maximum daily capacity of 19.15 MGD and an annual maximum daily demand of 15.64 MGD, for an available capacity of 3.51 MGD. Using the estimated population data, the existing and projected potable water demand can be estimated. Monroe County has adopted an overall level of service of 100 gallons per capita per day. The City has adopted a residential level of service of 66.50 gallons per capita per day, a non-residential level of service of 0.35 gallons per capita per day and an overall level of service of 100 gallons per capita per day. Table 4-11 indicates the projected potable water demand in Marathon.

Table 4-11:
Existing And Projected Potable Water Demand For Marathon

Year	Population	Gallons/ Capita/Day	Average Demand (MGD)
2000	10,067	66.5	0.66
2005	10,275	66.5	0.67
2010	10,496	66.5	0.68
2015	10,720	66.5	0.69
2020	10,941	66.5	0.70

Source: Florida Keys Aqueduct Authority

Marathon has no significant agricultural uses and is not anticipating any substantial increase in water demands from commercial and industrial uses.

Water Conservation Strategies
Water conservation strategies in use or under consideration in the Keys focus upon leak detection and repair; metering to detect unaccounted-for water; reuse of wastewater; and reduction of consumption through a conservation-oriented rate structure, distribution of water conservation kits, adoption of a Xeriscape Landscape Ordinance, adoption of plumbing fixture efficiency standards, and reuse of wastewater.

The ten-year (2002) water need projection accounts for the FKAA Leak Detection Program, which has a goal of 13 percent unaccounted for water.

Identification of the Coastal Area
Pursuant to the requirements of Rule 9J-5.012, F.A.C., the general coastal area (Cross-reference: Rule 9J-5.003(15), F.A.C.) shall be defined as the entire City. Rule 9J-5.003(17), F.A.C. defines the Coastal High Hazard Area (CHHA) as including the evacuation zone for a Category 1 hurricane as established in the regional hurricane evacuation study. Under the South Florida Regional Planning Council's Hurricane Evacuation Plan, all of Monroe County, including Marathon is identified as being within the Category 1 evacuation zone. The City meets the definition of the Coastal High-Hazard Area (CHHA) as presented in Rule 9J-5.003(17), F.A.C.

It should be noted that some of the issues addressed in the Conservation and Coastal Element are influenced by factors outside the designated 'coastal area' such as traffic circulation, hurricane evacuation, and infrastructure. Similarly, some sub-areas within the coastal area are more environmentally sensitive than others. This is particularly true in the areas designed as Conservation on the City's *Future Land Use Map* (FLUM). This Element documents characteristics of environmentally sensitive lands and shoreline uses.

Existing Land Use and Shoreline Conflicts (§9J-5.012(2)(a), F.A.C.)
The entire City is located within the coastal area. The existing land uses within the City are identified on *Map 2: Existing Land Uses (Zoning).* Activities that generate income and employment are referred to as economic base activities. In the City the economy is dominated

by the tourism industry. Numerous recreational opportunities and beautiful weather attract many seasonal and short-term visitors to the City. Many of the City's permanent residents work in tourist related fields, ranging from fishing guides to the hospitality industry.

Rule 9J-5.003(137), F.A.C defines water dependent uses as activities that can be carried out only on, in, or adjacent to water areas because the use requires access to a water body. Within the City, uses include marinas, boat ramps, beaches, piers, public or private waterfront parks, and others. Rule 9J-5.003(139), F.A.C defines water related uses as activities which are not directly dependent upon access to a water body, but which provide goods and services that are directly associated with water dependent uses. Water related uses include: boat storage, marine repair, retail boat and trailer sales, marine industrial (boat building, boat yards, hull work and painting, marine construction), tropical fish collection and sales, fish houses (wholesale and retail fish sales, processing, packaging and shipping), commercial fishing support (trap storage, repair and construction), ship stores, bait and tackle stores, and shops to arrange charter fishing, private fishing guides, snorkel and dive trips.

The diminishing supply of shoreline development sites is a major source of conflict among competing land uses. The demand for waterfront property comes not only from functional water dependent and water related uses, but also from economic and aesthetic drives for commercial, residential and tourism related uses attracted to the shoreline. The physical beauty of the waters surrounding the Keys induces a preference for shoreline rather than inland locations. The geography of the City as well as the development of manmade canals has created a situation where a large percentage of parcels have water access. However, the growth and importance of the tourism industry and the arising seasonal and permanent residential population has increased the demand for waterfront sites for residential, recreational, and tourist-related commercial development that may not be functionally water dependent. In addition, public agencies have increased efforts to acquire and preserve shoreline areas for recreation and conservation uses. Finally, increasingly stringent environmental regulations have limited the areas available for shoreline development.

The land use conflicts related to shoreline uses revolve around new development, re-development patterns and recreation activities.

a. New Development. Shoreline development has often contributed to the destruction or decline of natural shoreline habitat and the surrounding marine resources. This impacts the commercial fishing industry and recreational fishing, along with the dive, snorkel and tourism industry that is the economic base for the City.
b. Re-development. The economic and aesthetic demand for shoreline and near shore property has driven a trend for re-development that may not necessarily be focused on water related and water dependent uses. Thereby, increasingly, the supply of shoreline area that is necessary for water related and water dependent uses, is diminishing.
c. Recreation Activities. The marine and shoreline resources are the foundation of the tourism industry that is the economic base of the City. Increased marine and shoreline activities, both commercial and private, that drive and support the economy, may negatively impact the sensitive environmental resources necessary to support the community.

Despite the extensive shoreline of the Keys, the supply of shoreline development sites cannot satisfy the demand. In this competitive market, water-dependent/water-related uses are often supplanted by more profitable non- water-dependent or water-related uses. Tourism, which continues to dominate the local economy in terms of employment, depends heavily on access to the shoreline for recreational uses. The increasing number of recreational boats has heightened the competition for suitable marina sites between commercial fishing and recreational marina operators.

Some of the decline in the number of commercial fishing vessels can be attributed to less dock space, higher dockage fees and the rising cost of living in the Keys. During the period 1980-1990, the number of commercial fishing boats declined 6 percent while the number of pleasure boats have increased 67 percent. This increased demand for recreational marinas has squeezed the supply of commercial fishing marinas and increased the pressure to redevelop commercial fishing marinas for recreational marina use.

Conflicts also occur where adjacent shoreline uses are incompatible. The potential for conflict is greatest among water-dependent or water-related uses which may be perceived as nuisance producing (commercial fishing and support facilities, boat storage, marine repair, marine industrial, fish houses) and uses reliant on the scenic quality and amenity provided by a shoreline location (recreational, residential, tourist-related services). The noise, smells and visual character of some water-dependent/water-related uses may be undesirable to adjacent tourist, residents, and recreation users. Often, existing water-dependent/water-related uses do not become troublesome until newer residential and commercial uses locate on adjacent sites. The entrance to Coco Plum Drive and the harborside area in Marathon are two of many existing locations where conflicts result from residential uses sited adjacent to commercial fishing uses.

As *Map 4: Habitat Types* indicates, aside from the conservation areas, land within the City has primarily been developed. Therefore, the issue of a diminishing supply of shoreline property and the heavy demand for shoreline and near shore development must focus on limiting and providing shoreline protective measures for new development, protection of shorelines for water related and water dependent uses at new and existing sites and best management practices for the recreational uses of the marine resources that are the foundation of the economic base. Table 4-12 provides an inventory of water-dependent or water-related uses in the City of Marathon.

Table 4-12:
Water-dependent and Water-related Uses

Location	Name	Facilities							Parking	Public Access	Ownership
		Marina	Boat Ramp	Fishing Pier	Commercial Fishing Dock	Beach	Waterfront Park	Other			
Grassy Key	Bonefish Harbor/Gulfside 59	1	1								Private
Grassy Key	Coco Palma's	1									Private
Grassy Key	Jolly Roger Travel Park	1	1			1					Private
Grassy Key	Lion's Lair	1	1			1		Boardwalk			Private
Grassy Key	Pelican Motel	1	1								Private
Grassy Key	Rainbow Bend Resort	1	1			1					Private
Grassy Key	Dorrsett Subdivision		1						1		Private
Fat Deer Key	Bonefish Marina	1									Private
Fat Deer Key	Coco Plum Marinas				1						Private
Fat Deer Key	Coral Lagoon Resort	1									Private
Fat Deer Key	Driftwood Harbor	1						Boat Repair	1	1	Private
Fat Deer Key	Hawaiian Village Hotel	1	1								Private
Fat Deer Key	Marie's Yacht Harbor	1						Pump Out			Private
Fat Deer Key	MM 54		1								FDOT
Fat Deer Key	The Boat House	1						Fish Camp			Private
Marathon	Anchor Lite Botel	1							1	1	Private
Marathon	Aviation Boulevard		1						1	1	City
Marathon	Banana Bay	1	1								Private
Marathon	Becker Marine	1									Private
Marathon	Blackfin Resort	1									Private
Marathon	Blue Waters	1									Private
Marathon	Boot Key Marina	1	1						1	1	Private
Marathon	BP Surfside Gulf (Ramsay)		1						1	1	Private
Marathon	Buccaneer/Tranquility Bay	1				1		Boardwalk			Private
Marathon	Captain Hooks Marina	1							1	1	Private
Marathon	Capatain Pip's Marina	1							1	1	Private
Marathon	Coast Guard Station	1						Docks			Federal
Marathon	Coconut Cay (Dodge Lake)	1									Private
Marathon	Coconut Cay	1									Private
Marathon	Crane Hammock Subdivision		1			1					Private
Marathon	Faro Blanco Marine Resort	1	1								Private
Marathon	Fisherman's Pointe				1						Private
Marathon	Galway Bay Mobile Home Park	1	1								Private
Marathon	Gulfstream Trailer Park	1									Private
Marathon	Hammocks at Marathon	1	1						?	?	Private
Marathon	Harborside Marine	1							1	1	Private
Marathon	Hawk's Cay (?)	1	1(?)								Private
Marathon	Hidden Harbor Motel	1	1						1(?)	1(?)	Private
Marathon	Key Lime Resort & Marina	1									Private
Marathon	Key Trailer Court	1	1								Private
Marathon	Key Vaca Marina	1						Boat Rental	1	1	Private
Marathon	Keys Boat Works	1						Boat Repair	1	1	Private
Marathon	Kingsail Motel	1	1								Private

Table 4-12:
Water-dependent and Water-related Uses

Location	Name	Facilities							Parking	Public Access	Ownership
		Marina	Boat Ramp	Fishing Pier	Commercial Fishing Dock	Beach	Waterfront Park	Other			
Marathon	Marathon Boat Yard	1						Boat Yard	1	1	Private
Marathon	Marathon Boot Key Harbor Marina	1						City Marina	1	1	City
Marathon	Marathon Seafood				1						Private
Marathon	Marathon Trailerama	1									Private
Marathon	Marathon Yacht Club	1	1						1	1	City
Marathon	Ocean Isle Fishing Resort	1	1					Boardwalk			Private
Marathon	Ocean Isle Fishing Village		1			1					Private
Marathon	Oceanside Marina Services	1						Boat Repair	1	1	Private
Marathon	Old Seven Mile			1					1	1	County/State
Marathon	Seashore Lagoon Resort	1									Private
Marathon	Seascape	1									Private
Marathon	Sombrero Resort & Marina	1							1	1	Private
Marathon	Sombrero Beach/Switlik Pakr					1	1		1	1	City
Marathon	The Reef Resort	1	1								Private
Marathon	Vaca Cut Botel	1	1								Private
Marathon	Winner Docks	1							1	1	Private
Hog Key	Hog Key Marina		1					Boat Yard	1	1	Private
Knight's Key	7 Mile Marina		1					Boat Rental	1	1	Private
Knight's Key	Hawk's Nest	1									Private
Knight's Key	Knight's Key Resort & Marina	1	1			1					Private

Increased shoreline development, which may contribute to the destruction of marine habitats and a decrease in fish populations, conflicts with commercial fishing activities which are dependent on marine resources and conservation uses which attempt to protect and preserve marine resources. Some active recreational activities (motor boating, water-skiing and jet-skiing) can potentially damage marine resources valued by other recreational activities (scuba/snorkeling, recreational fishing) as well as commercial fishing. Water-dependent recreation uses present a different conflict. Friction between active and passive recreational uses can occur where shared recreational facilities do not allow adequate separation.

Live-Aboards

A live-abroad is defined as an individual(s) whose continuous residence is a boat, not necessarily at a fixed location, for a period of more than two months. Live-aboards use their boats as private, primary or secondary residences for extended periods. The total number of live-aboards boats in the Keys is estimated to be 1,410 boats, housing some 3,000 residents. Live-aboards include a large number of permanent and seasonal residents. The most common type of live-aboard boat is a sailing vessel comprising 69 percent of the total. Approximately 70 percent of live-aboard vessels are found at shoreside sites (marinas, clubs, boat yards, piers, seawalls) while 30 percent of live-aboards anchor in coastal waters. Shoreside live-aboard sites are found throughout the Keys while anchorage's tend to be concentrated. Over half of the anchorage's are in Boot Key Harbor in the Middle Keys. Other major anchorage locations are Cow Key Channel and Christmas Tree Island in the Lower Keys, which account for 27 percent of the anchorage's.

Service Demands of Live-Aboards

Although live-aboards technically reside on water, they rely on a number of dockside services (dockage, toilets, showers, laundry, telephone, mail, ice, refrigeration, parking, dingy dockage, and pump-out), commercial services (stores, restaurants), and community services (medical, dental, fire, police and education). According to a survey of live-aboards, services most often sought include:

- improved dockside facilities;
- showers and restrooms;
- sewerage pump-out facilities;
- recreation; and
- public dingy dockage (Antonini et. al., 1990)

Conflicts between Live-Aboards and Land Residents

There are two locations where single family homes are located in close proximity to concentrations of live-aboards: Boot Key, and Coco Plum. Escalating conflicts in Boot Key Harbor area, where there is a high concentration of live-aboards, led to harbor blockades by live-aboards and boarding of live-aboards vessels by law enforcement agencies (Antonini et. al.., 1990).

Live-aboards are commonly perceived by shore residents as transients who degrade the coastal environment and contribute little to the coastal community. Live-aboards complain of the noise

generated by recreational boaters and restricted access to the shore. Major areas of conflict include:

- access from the live-aboard boats to the shoreline;
- disposal of kitchen (grey water) and sanitary wastes (black water);
- abandonment of vessels;
- location, crowding, and appearance of live-aboard vessels;
- live-aboard settlement rights and preemptive uses of water space;
- surveillance of live-aboard activities by local authorities;
- general impact of live-aboards on the scenic and ecological qualities of the waterfront;
- and, appropriate fees for live-aboards services.

Both shore residents and live-aboards rank sewerage as the number one waterfront problem. Sanitary waste is disposed of by one or more methods: overboarding by flushing, holding tank storage and shoreline pump-out, and/or onboard pretreatment and discharge. It is estimated that less than 10 percent of the live-aboards use sewerage pump-out facilities. In 1983, Monroe County attempted to address the sewerage problems caused by live-aboards. The Marine and Port Advisory Board designated Boot Key Harbor as a water management area and attempted to attract a private company to provide the following for-fee services to live-aboards: pump-out, garbage collection and showers. The program could not be implemented because no bids were received (Antonini et. al., 1990). Table 4-13 provides an inventory of Floating Structures in Marathon as of March 2004.

Table 4-13:
City of Marathon Floating Structure Inventory, March 9, 2004

Location	Number of Structures
Marathon Marina	2
Palm Island	1
Harbor cay Club	1
Faro Blanco Resort and Marina (Gulf side) (commercial use)	1
Faro Blanco Resort and Marina (Boot Key Harbor)	12
Blue Waters Motel	1
41st Gulf (Balch Property)	1
43rd Street Gulf (Smith Property)	11
47th Street Gulf (Pierce Property)	2
Sombrero Resort and Marina	1
2913 Sombrero Boulevard (private residence)	1
Coconut Cay Resort	1
Sea Cove Motel	9
72 Coco Plum	2
Fat Dee Key Marina	1
Marie's Yacht Harbor	2
Total Floating Structures	49

Source: City of Marathon, March 2004

Need for Water-Dependent and Water-Related Uses

Currently, the County has insufficient information available to estimate the need for appropriate sites for water-dependent and water-related uses. The inventory contained in Table 4-12 does not include information needed to estimate current or projected future demand.

Marinas, Boat Ramps and Commercial Fishing Docks

In order to determine the need for additional marinas and boat ramps, the County must establish the capacity of the existing facilities. The City of Marathon is in the process of completing a city-wide Marina Siting Plan. The Plan will identify following information for each of the marinas, commercial fishing docks and boat ramps listed in Table 4-12.

The information included in the Marina Siting Plan is:

- number of wet and dry slips;
- usage rates of wet and dry slips;
- breakout of slips by boat size;
- on-site amenities including the number of parking spaces;
- surrounding uses and any known or potential compatibility problems;
- availability for public use (recreational marinas only);
- number of boats provided and the boat lanes for each ramp;
- conditions of facilities;
- existing DEP-accepted documentation of water quality trends
- availability of pump-out facilities; and
- potential for marina expansion according to siting criteria (see below).

In general, marinas should be sited where the optimum physical characteristics are maximized and impacts on marine resources are minimized. Therefore, the City should develop specific criteria for marina siting which are consistent with DER Rule 17-312 F.A.C., DNR Rule 18-21.004 F.A.C., and regulations of the US Corps of Engineers.

The marina siting criteria should consider:

- benthic vegetation and faunal assemblages;
- adequacy of circulation and tidal flushing;
- access to deep water through existing channels of adequate depth;
- minimal shoreline modification necessary;
- quality and size of upland area and degree of alteration necessary;
- ability to restore and enhance marina resource values at sites subject to past alteration;
- and, location of propeller dredging problem areas.

Live-Aboard Study

In the future Monroe County, with the assistance of the Marine and Port Authority, will need to address the following items in order to resolve the conflicts created by the live-aboard lifestyle, not only in Boot Key Harbor, but throughout the Keys:

- criteria for siting live-aboards mooring areas;
- potential locations of live aboard mooring areas;
- sanitation requirements;
- maximum vessel allowances in live-aboard mooring areas;

- registration, fee structure and method of fee collection for live-aboard moorings;
- propose definitions of live-aboard status
- identify pollutant loadings from live-aboards;
- identify need for private and public pump-out facilities; and
- developing permitting, inspection and enforcement procedures to reduce pollutant discharges in surface waters.

Shoreline Priorities Plan

Ultimately, the detail information provided by the Marina Study and marina siting criteria, docking facilities siting criteria, the Public Access Plan and the Live-Aboard Study can be used in the development of a Shoreline Use Priorities Plan which will address issues related to water-dependent and water-related uses. The Shoreline Use Priorities Plan should:

- assign higher priority to water-dependent and water-related uses of shoreline sites than to other uses;
- establish performance standards for shoreline development;
- identify vacant or redevelopable sites where the maximum physical advantages exist for water-dependent/water-related uses and where no unreasonable or excessive impacts are foreseen on marine resources;
- recommend strategies for reserving such sites for water-dependent and water-related uses to satisfy the estimated need for such sites;
- recommend strategies to eliminate conflicts among existing shoreline uses and to encourage mixed use development which includes water-dependent/water-related uses that are compatible with existing land uses; and
- maintain existing commercial fishing operations as conforming uses

Natural Coastal Resources (§9J-5.012(2)(b), F.A.C.)

Maps 2 and 4 illustrate the existing land uses and natural systems found within the City. The identification and discussion of the natural resources systems, including vegetative, wetland, beach berm, marine habitats along with dominant flora, fauna and listed species, that occur in the City are presented in the Data Inventory and Analysis Section of the Conservation Element. Additionally, floodplains are discussed in detail in the Conservation Element. The National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA) has determined that all land within the City is subject to flooding from a 100-year storm. The areas of the City most threatened by flooding are the immediate waterfront properties. Within the City, the threat to property and human life from flooding is from tidal inundation and storm surges associated with severe storm events, not from upstream drainage conditions.

Effect of Future Land Uses on Natural Systems

A balance must be maintained between the tremendous growth pressures in the area and the need to protect the coastal and natural resources that attracted people. No change in the effect of land use on natural systems is anticipated in the future since future land use patterns have been established by existing development. The negative effects of existing land use patterns are expected to be ameliorated by implementation of the City's Land Development Regulations and Plan, in particular by enhancements to landscaping requirements, surface water management and wastewater systems. Additionally, water-dependent and water-related uses shall be located in

areas least sensitive to alteration, conservation areas shall be preserved to ensure the productivity and viability of the natural resource systems, and adequate recreational and open space shall be provided.

Natural systems in the City are affected by land uses located elsewhere in the Keys and South Florida. Effects, negative or positive, may be increased or reduced, depending on a number of factors, including the regulatory actions of neighboring communities, State, Federal and regional regulatory agencies.

Impacts of Development and Redevelopment on Historic Resources (§9J-5.0012(2)(c), F.A.C.)
The National Register of Historic Places is the Federal list of recognized historic structures and places, generally having significant historic value. Development and redevelopment will have little to no impact on these historic resources since they are protected by Federal regulations. However, in reviewing projects on adjacent properties, the City shall minimize the negative impacts on these historic sites from any proposed development or redevelopment. The Florida Master Site File (FMSF) is a database of known, recorded archaeological or historic sites and structures. The Florida Department of State, Bureau of Historic Preservation maintains the Florida Master Site File. A review of the FMSF showed only nine structures or archaeological sites within the City, listed in Table 1-15, in the Future Land Use Data Inventory and Analysis. The potential for designation as an archeological or historic site or structure shall be considered as knowledge of these sites becomes available through the development review process.

Inventory and Analysis of Estuarine Areas (§9J-5.0012(2)(d), FAC)
The only estuarine area within Marathon waters is Florida Bay. Florida Bay functions as an estuary only during high rainfall years when rainfall exceeds evapotranspiration. This function of Florida Bay changes when evapotranspiration exceeds rainfall, then the Bay functions as a highly saline tropical lagoon. The Florida Bay is discussed in detail under the Water Resources and Quality heading in the Data Inventory and Analysis section of the Conservation Element.

Natural Disaster Planning Concerns (§9J-5.012(2)(e), FAC)
The most catastrophic threat to public safety in coastal areas of Florida is the potential loss of life and property from storm surge, flooding and high winds associated with hurricanes. Marathon is situated in the Florida Keys along the Atlantic coast, which has been identified by the National Oceanic and Atmospheric Administration as the area of the United States most vulnerable to hurricanes. This section discusses the City's natural disaster preparedness effort.

1. **Hurricane Evacuation Planning.** Rule 9J-5.003(17), F.A.C. defines the Coastal High Hazard Area (CHHA) as including the evacuation zone for a Category 1 hurricane as established in the regional hurricane evacuation study. Under the South Florida Regional Planning Council's Hurricane Evacuation Plan, all of Monroe County, including Marathon is identified as being within the Category 1 evacuation zone. In the event of a Category 1 or 2 hurricane, the residents of Marathon are instructed to go to one of the designated hurricane evacuation structures. By State Statute, all persons are to evacuate to the mainland during a Category 3, 4 or 5 hurricane. The shelter on the mainland, located at Florida International University on S.W. 8th Street in Miami.

Within the City, 6,791 households or approximately 10,067 permanent residents would need to be evacuated. Seasonal visitors may be defined as transient persons residing in the City less than six months per year. Seasonal households are attracted to Marathon during the winter months due to the warm, dry climate occurring at that time. Additionally, seasonal visitors include persons staying overnight in Marathon at hotels/motels, or staying with friends or relatives. The formula used to calculate the 2000 seasonal population was as follows: (# transient units) X (occupancy rate) X (# of persons per party) = # overnight tourists lodging at hotel/motel accommodations. A total of 2,829 transient units are located in Marathon. The average party size of visitors to Monroe County is 2.92, according to the Monroe County Tourist Development Council (TDC). The TDC also indicated that Monroe County transient units have an average yearly occupancy rate of 59.7%. For Marathon the seasonal population is 4,931 persons (2,892 X 0.597 X 2.92).

The special needs population includes the disabled, infirm and elderly. The City in cooperation with the County maintains specialized equipment to help meet the needs of these people in case of hurricane evacuation or other emergency. The Florida Keys Electric Cooperative, the Department of Children and Family Services and other relevant agencies and service providers distribute hurricane preparedness information to their clients.

Marathon residents will primarily use US 1 to evacuate to one of the shelters in the City or on the mainland. Marathon residents going to the Florida International University (FIU) shelter would travel US 1 and/or Card Sound Road to the Florida Turnpike, then follow the Florida Turnpike to Exit 25, SW 8th Street and follow the signs to FIU and the Shelter.

The *Future Land Use Map* indicates that the current land use pattern will continue into the future. The City anticipates that the majority of future development will be residential in nature. Therefore, the impact of future land uses on hurricane evacuation will be minimally restricted to a limited increase in the number of people needing to evacuate.

2. **Hurricane Shelters.** Within the City, Switlick Elementary School located at 3400 Overseas Highway, is the only hurricane shelter. The other hurricane shelters that are within the Keys but outside of the City are the Harvey Government Center and Glenn Archer School at MM 1 in Key West; the Sugarloaf Elementary School at MM 19 on Sugarloaf Key; the Island Christian School at MM 83.4; Plantation Key Elementary and Coral Shores High School at MM 90 in Islamorada; Key Largo Elementary School Cafetorium at MM 105 and St. Justin Martyr Catholic church at MM 105.5 in Key Largo. Florida International University in Miami is the designated out of County hurricane shelter for Keys residents.

3. **Post-Disaster Redevelopment.** The City will cooperate with the Florida Department of Community Affairs to coordinate damage assessments with assistance from other Federal, State, Regional and local agencies. The City has complied with the requirements of Chapter 161.56 (1), F.S. regarding the adoption of a building code, which regulates construction in the coastal area. Any redevelopment that would be done following a natural disaster would comply with all applicable regulations.

4. **Coastal High-Hazard Area (CHHA).** Rule 9J-5.003(17), F.A.C. defines the Coastal High Hazard Area (CHHA) as including the evacuation zone for a Category 1 hurricane as established in the regional hurricane evacuation study. Under the South Florida Regional Planning Council's Hurricane Evacuation Plan, all of Monroe County, including Marathon is identified as being within the Category 1 evacuation zone. Infrastructure components in the CHHA include roads, water and wastewater lines and drainage facilities as described in the Traffic Circulation and Infrastructure Elements. At this time, it is not anticipated that any infrastructure will need to be relocated due to a severe storm event. The public infrastructure, as identified above, could sustain damage from a natural disaster. Relocation of infrastructure is not a viable solution since the existing infrastructure is necessary to protect the health and safety of the residents of Marathon.

Public Access Facilities (§9J-5.012(2)(g), F.A.C.)
Within the City the public has access to the water via beaches, piers, marinas, boat ramps and waterfront parks. The City owned water access facilities include Sombrero Beach, Coco Plum Beach, Morton Street Sunset Bay Park, the City Community Park and Marina, and two boat ramps, one at the corner of Aviation Boulevard and Harbor Drive and the other at the end of 33rd Street Gulf. Although not currently developed for public access, numerous City streets terminate on open water along both the Florida Bay and the Atlantic Ocean and have the potential to be developed as limited public access points.

Florida DOT maintains one boat ramp to the Florida Bay along US 1 and the State owned Curry Hammock Park on Little Crawl Key provides camping and water access on the Atlantic Ocean. Within the City, US 1 has several points where the Atlantic Ocean, the Florida Bay, or both is visible providing scenic overlooks to the surrounding natural resources.

As a tourist based economy founded on the natural marine resources, the waterfront is extensively developed with resort, restaurant, marina or other commercial tourist or marine related uses that although privately owned, are available to the public. Table ~~4-8~~ 4-12 provides a list of marinas in the City.

~~**Table 4-10:**~~
~~**Marinas in Marathon**~~

~~**Marina**~~	~~**Address**~~
~~7 Mile Grill~~	~~1240 Overseas Hwy.~~
~~Abaco Sails & Marine~~	~~11215 Overseas Hwy.~~
~~Banana Bay Marina~~	~~4590 Overseas Highway~~
~~BlackFin Resort & Marina~~	~~4650 Overseas Hwy.~~
~~Blue Waters Resort Motel~~	~~2222 Overseas Hwy.~~
~~Boat House, The~~	~~12411 Overseas Highway~~
~~Bonefish Marina~~	~~97 Coco Plum Drive~~

~~Table 4-10:~~
~~Marinas in Marathon~~

~~Marina~~	~~Address~~
~~Boot Key Harbor City Marina~~	~~800 35th Street (Ocean)~~
~~Buccaneer Lodge Resort~~	~~2600 Overseas Hwy.~~
~~Burdines Water Front~~	~~1200 Ocean View~~
~~Cannon Marine & Harbor Point~~	~~4681 Overseas Highway~~
~~Captain Hook's Marina~~	~~11833 Overseas Highway~~
~~Captain Pip's Marina & Hideaway~~	~~1410 Overseas Hwy.~~
~~Coats Steve & Deloris~~	~~600 107th Street~~
~~Coco Plum Marina & Storage Inc.~~	~~66 Coco Plum Dr. 139~~
~~Coconut Cay Resort & Marina~~	~~7196 Aviation Blvd.~~
~~Coconut Cay Resort & Marina~~	~~7200 Aviation Blvd.~~
~~Coconut Palmas Inc.~~	~~59740 Overseas Hwy.~~
~~Coral Lagoon Resort & Marina~~	~~12399 Overseas Hwy.~~
~~Crystal Bay Resort & Marina~~	~~4900 Overseas Hwy.~~
~~Driftwood Marina & Storage~~	~~13900 Overseas Hwy~~
~~Faro Blanco Marina Resort~~	~~1996 Overseas Highway~~
~~Faro Blanco Resort Oceanside~~	~~1996 Overseas Highway~~
~~Faro Blanco Resort Gulfside (Upper Deck)~~	~~1996 Overseas Highway~~
~~Galway Bay Trailer Park and Marina~~	~~1361 Overseas Hwy.~~
~~Grassy Key Marina of Marathon~~	~~59073 Overseas Hwy.~~
~~Gulfstream Village Marina~~	~~880 37th Street Gulf~~
~~Hampton Inn & Suites / Best Western~~	~~1688 Overseas Hwy.~~
~~Harbour Cay Club Inc.~~	~~1466 Overseas Hwy.~~
~~Hawks Cay Marina~~	~~61 Hawks Cay Blvd~~
~~Hidden Harbor~~	~~2396 Overseas Hwy.~~
~~Holiday Inn~~	~~13201 Overseas Hwy.~~
~~Key Lime Resort & Marina Club~~	~~11600 1st Avenue Gulf~~
~~Keys Boat Works Inc.~~	~~700 39th Street~~
~~Keys Fisheries Inc.~~	~~3502 Gulfview Dr.~~
~~Keys Fisheries Market & Marina~~	~~3309 Gulfview Dr.~~

~~Table 4-10:~~
~~Marinas in Marathon~~

~~Marina~~	~~Address~~
~~Kingsail Resort Motel~~	~~7050 Overseas Hwy.~~
~~L&L Moving and Storage~~	~~2188 Overseas Hwy.~~
~~Marathon Boat Yard~~	~~2059 Overseas Hwy~~
~~Marathon Hanger Development Inc.~~	~~8000 Overseas Hwy.~~
~~Marathon Marina & Boat Yard~~	~~10211 11st Ocean~~
~~Marathon Yacht Club~~	~~825 33rd St. Gulf~~
~~Marie's Yacht Harbor & Marina, DBA CocoPlum Beach~~	~~150 Avenue I Coco Plum~~
~~Greater Marathon Resort~~	
~~Ocean Seafood~~	~~890 15th Street~~
~~Oceanside Marine Service, Inc.~~	~~1015 15th Street~~
~~Poncho's Fuel Dock & Marina~~	~~1280 Oceanview Ave.~~
~~Rainbow Bend Resort & Marina~~	~~57784 Overseas Hwy.~~
~~Sea Cove Motel~~	~~12685 Overseas Hwy.~~
~~Sea Horse Motel & Marina~~	~~7196 Overseas Hwy.~~
~~Sea Tow Marathon~~	~~51 Coco Plum Drive~~
~~Seaward Motel~~	~~8700 Overseas Hwy.~~
~~Seven Mile Marina~~	~~1090 Overseas Hwy.~~
~~Shelter Bay Marine DBA/INC~~	~~77 Coco Plum Drive~~
~~Sombrero Marina & Dockside~~	~~35 Sombrero Blvd.~~
~~Sombrero Resort Lighthouse Marina~~	~~19 Sombrero Blvd.~~
~~Turn Key Marina & Boat Yard~~	~~1100 Overseas Hwy.~~
~~Valhalla Beach~~	~~56243 Ocean Dr. MM 57~~
~~Wagner Harry J & Wagner Sharon~~	~~600 107th Street~~
~~Wild Bills~~	~~57478 Overseas Hwy.~~

~~Source: City of Marathon, 2004~~

Existing Infrastructure in the Coastal High-Hazard Area (CHHA) (§9J-5.012(2)(h), F.A.C.)
Infrastructure components in the CHHA include roads, water and wastewater lines and drainage facilities are described in the Transportation and Infrastructure Elements. At this time, it is not anticipated that any infrastructure will need to be relocated due to a severe storm event. The public infrastructure, as identified above, could sustain damage from a natural disaster. Relocation of infrastructure is not a viable solution since the existing infrastructure is necessary to protect the health and safety of the residents of Marathon.

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