August 2004

Final
Programmatic Environmental Impact Statement

Florida Keys Water Quality Improvements Program

U.S. Army Corps of Engineers
Jacksonville District

South Florida Water Management District

Final
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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ABSTRACT
FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT
for the
FLORIDA KEYS WATER QUALITY IMPROVEMENTS PROGRAM (FKWQIP)

Responsible Agencies: U.S. Army Corps of Engineers (Corps) and South Florida Water Management District (SFWMD)

Lead Agency: U.S. Army Corps of Engineers (Corps)

Abstract. This Programmatic Environmental Impact Statement (PEIS) presents the documentation necessary to compare three project alternatives for the FKWQIP. The FKWQIP is intended to implement wastewater and stormwater improvements that will alleviate the water quality degradation that has resulted from the discharge of inadequate and untreated wastewater and stormwater into nearshore waters of the Florida Keys National Marine Sanctuary (Sanctuary). The three project alternatives are the *No Action* alternative (Alternative 1), federal funding for the implementation of FKWQIP (*Proposed Action*), and pursue alternative funding for implementation of FKWQIP (Alternative 3).

Under Alternative 2, up to $100M in federal funds will be provided to implement a coordinated program for wastewater treatment and stormwater management improvements in the Keys. The proposed action is designed to reduce nutrient loadings to nearshore waters in the Keys, thereby improving water quality and protecting nearshore ecosystems in the Sanctuary. The proposed action is also anticipated to decrease the number of health advisories due to high bacteria levels associated with inadequate wastewater treatment. Alternative 2 will address regional water quality issues, reduce nutrient loadings and improve water quality throughout the Sanctuary, and facilitate compliance with federal and state regulatory water quality treatment standards in a timely manner. Alternative 2 also provides for the upgrade or replacement of outdated onsite treatment systems and implementation of central community wastewater collection and treatment systems in the more densely developed and highest ranked water quality *hot spot* areas. Project priority and implementation will be based on treatment effectiveness and projects designated as "ready to proceed", as agreed upon by local municipalities.

Under Alternative 2, construction of projects that will improve water quality in the Sanctuary would be expedited and project management and coordination would be more effective when compared with the *No Action* Alternative or Alternative 3. Potential adverse impacts due to implementation of Alternative 2 include those related to environmental justice and protected species. Over 25 percent of the population in the Keys is classified as low income or over 65 years of age living on a fixed income, and it would be difficult for these residents to afford the capital costs and monthly service fees associated with wastewater treatment and stormwater management improvements. Mitigation may be required for potential impacts to protected species as a result of habitat disturbance and/or loss.

Note: The official closing date for the receipt of comments is 30 days from the date on which the Notice of Availability of this Final PEIS appears in the *Federal Register*. This report is also available on our web site at: www.evergladesplan.org.

For Further Information contact: Ms. Barbara Cintron, U.S. Army Corps of Engineers, Jacksonville District, Planning Division, P.O. Box 4970 PD-ES, Jacksonville, Florida 32232-0019, Telephone (904) 232-1786, or by e-mail at Barbara.B.Cintron@saj02.usace.army.mil.

Executive Summary

The U.S. Congress has directed the U.S. Army Corps of Engineers (Corps) to assist local municipalities in Monroe County, Florida, in the planning and construction of wastewater and stormwater improvements designed to accomplish the goals listed below.

- Reduce nutrient loading to the nearshore waters of the Florida Keys National Marine Sanctuary (Sanctuary)
- Improve water quality throughout the waters of the Sanctuary
- Meet relevant federal and state regulatory standards

The Sanctuary boundaries encompass 2,800 square nautical miles of nearshore and marine waters from Miami, Florida, and extending to the Dry Tortugas (Figure ES-1). The Sanctuary is part of a complex ecosystem that includes the Everglades, Florida Bay, and adjacent areas. The Florida Keys (Keys) are a chain of more than 800 islands extending approximately 220 miles southwest from the southern tip of the Florida peninsula and through the Sanctuary. This Programmatic Environmental Impact Statement (PEIS) targets the portion of the Keys connected by U.S. Highway 1, a 110-mile stretch of roadway extending from Key Largo to Key West, and the remaining developed portion of the Keys.

Purpose and Need

Currently, most residents and commercial establishments in the Keys are not connected to advanced wastewater treatment systems; rather septic tanks and outdated onsite package plants. These systems, if not properly operated, allow bacteria and nutrients to leech into nearshore waters. In areas where testing is performed on nearshore waters, beaches are often posted for health advisories after moderate rainfall because fecal coliform bacteria have leeched into surface waters.

In recognition of the importance of improving water quality in the Sanctuary, the purpose of the FKWQIP is to assist Monroe County in implementing projects to reduce nutrient and bacteria loading, improve water quality in the Sanctuary, and meet relevant federal and state regulatory standards.

Within the Sanctuary are unique and nationally significant marine environments, including seagrass meadows, mangrove islands, and the only living coral barrier reef in North America. These marine environments support rich biological communities possessing extensive conservation, recreational, commercial, and aesthetic values, all of which give this area special national significance. The Sanctuary offers many opportunities for recreation, commercial fishing, and tourism based businesses that comprise a large portion of Florida's economy.

Numerous scientific studies have documented the contribution of failing septic tanks and cesspools to the deterioration of canal and nearshore water quality in the Keys. In addition, research has suggested that increased nutrient loadings from wastewater into canals and

nearshore waters are one of the major contributors to the decline of water quality within the Sanctuary.

In response to regulatory requirements governing water quality, and in the interest of protecting public health and natural resources, the FKWQIP was created. At the federal level, the Florida Keys National Marine Sanctuary and Protection Act of 1990 directed the USEPA and the state of Florida to develop a water quality protection plan for the Sanctuary. Locally, the *Monroe County 2010 Comprehensive Plan* mandates that nutrient loadings to the marine ecosystem be reduced by the year 2010 and that wastewater systems meet more stringent Florida Statutory Treatment Standards.

Decision to be Made

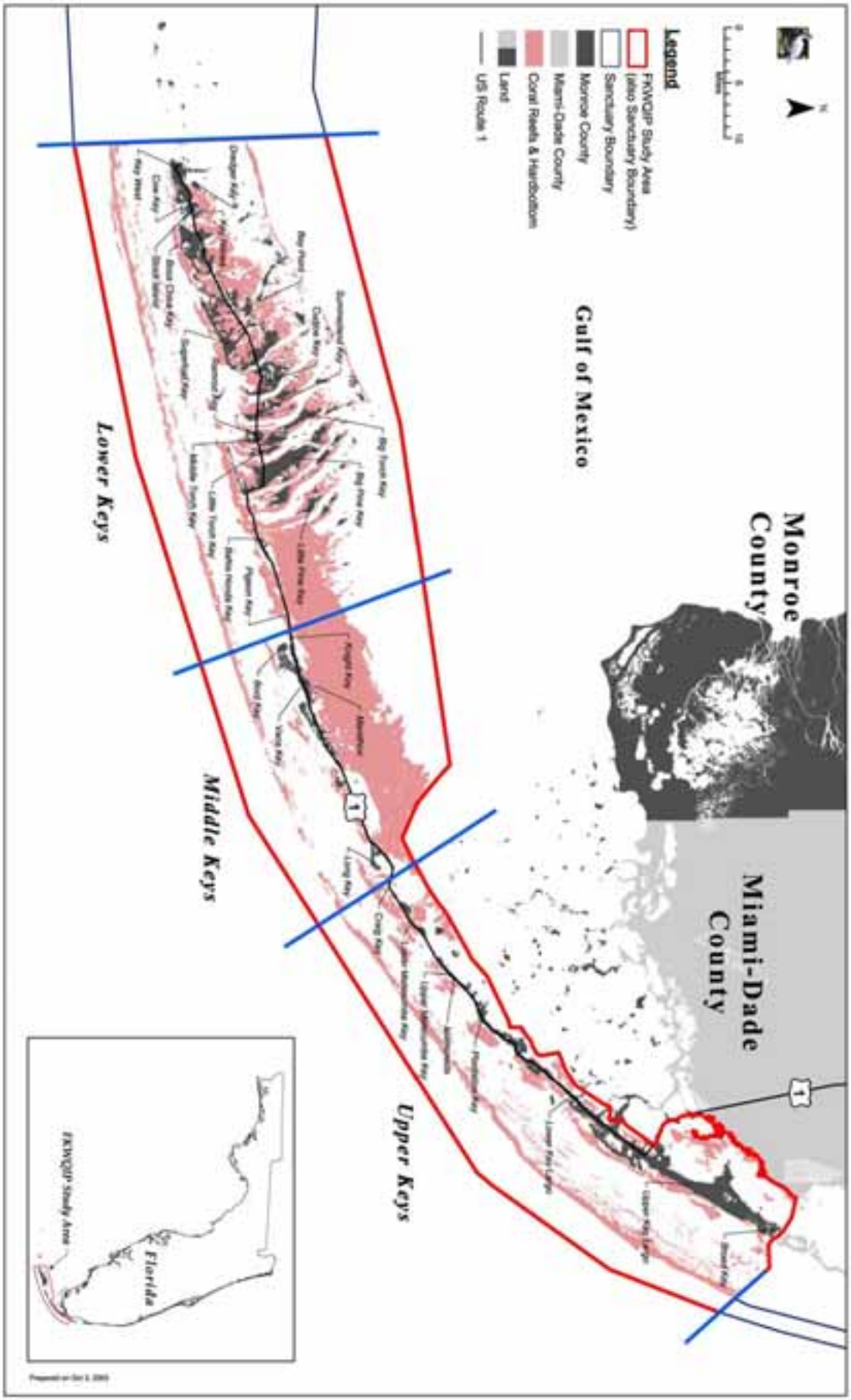
Due to the high capital cost of implementing the proposed water quality improvements, municipal governments in the Florida Keys have requested assistance from the federal government to develop and implement wastewater treatment and stormwater management improvements that will reduce nutrient loadings and improve water quality in the Sanctuary. Based on the potential benefits of the FKWQIP and the adverse effects on the natural and manmade environment if water quality improvements are not made, the federal government must determine the most favorable alternative to implement the FKWQIP Authorization. When the projects are completed, Keys residents and visitors can expect improved water quality in the Sanctuary and nearshore waters.

Description of Alternatives

Three alternatives for the FKWQIP are described and evaluated in the PEIS, providing the basis for the decision to be made. The three alternatives are listed below and discussed in the following sections.

- ***Alternative 1: No Action.*** Do not provide federal funding for projects designed to address state mandates to improve water quality in the Sanctuary. Inadequate treatment of wastewater, primarily through the use of cesspools and septic tanks, without the benefit of centralized wastewater collection and treatment.
- ***Alternative 2: Proposed Action.*** Provide federal funding to develop an integrated area-wide system of wastewater treatment and stormwater management improvements that are designed to address state mandates to improve water quality in the Sanctuary.
- ***Alternative 3: Pursue other Sources of Funding for Project Implementation.*** Identify and use other sources of funding to implement projects designed to address state mandates to improve water quality in the Sanctuary as no federal monies would be provided.

While other funding sources are currently being pursued to assist in implementing stormwater and wastewater improvements in Monroe County, the proposed federal funding for the FKWQIP will expedite the implementation of regionally managed projects with commensurate improvements in the water quality within the Sanctuary.



ES-1

Location of FKWQIP Study Area

As a result of the extensive planning efforts undertaken by Monroe County and associated municipalities, including the identification of potential alternatives and plan recommendations, additional plan formulation regarding individual water quality improvement projects for the FKWQIP was considered unnecessary for the purposes of this PEIS. A Program Delivery Team (PDT) was created to ensure that effective, coordinated actions are implemented and result in successful implementation of the FKWQIP. Membership of the PDT consists of one elected representative from each municipal government agency in Monroe County as well as state and federal agencies. The PDT is responsible for preparation of a Program Management Plan (PMP), which is intended to establish the framework for development of projects slated for implementation under federal authority. The PMP will describe the rationale used by the FKWQIP PDT to prioritize specific wastewater treatment and stormwater management projects contained within various master plans prepared by Monroe County or municipalities within Monroe County (See Table ES-1).

Table ES-1
Estimated Costs of Priority Projects for Each Government Entity

Government Entity	Wastewater Projects		Stormwater Projects		Total	
	Number	Estimated Cost[1]	Number	Estimated Cost[1]	Number	Estimated Cost[1]
Monroe County	34	$ 165,663,213	22	$ 6,332,641	56	$ 165,280,816
Village of Islamorada	7	$ 107,445,090	63	$ 52,069,268	70	$ 132,443,981
City of Key West	8	$ 20,671,000	99	$ 17,404,567	107	$ 38,075,567
City of Key Colony Beach	1	$ 335,000	0	$	1	$ 335,000
Key Largo Wastewater Board	14	$ 139,693,435	0	$	14	$ 130,001,711
City of Layton	1	$ 4,650,000	0	$	1	$ 4,650,000
City of Marathon	7	$ 101,634,979	0	$	7	$ 142,233,606
Totals	**72**	**$540,102,717**	**184**	**$ 75,806,477**	**256**	**$ 615,909,194**

[1]These costs are based solely on information provided in each of the respective plans or studies and have been updated based on information provided by the various PDT members or based on the Engineering News Record Construction Cost Index.

The FKWQIP PDT compiled a project master list based on previously prepared master plans and developed a ranking system to assign priority to individual projects and produce a project master list. An allocation system for the distribution of funds among the various municipalities for the projects was based on individual need relative to other municipalities. Although actual funding will depend on appropriations made by Congress, up to $100 million has been legislatively authorized for the FKWQIP. The project master list will be reevaluated on an annual basis and priority will be reassigned, based on the criteria listed below.

- Priority rank
- Available funding
- Readiness to proceed

Scoping Issues

Significant issues that were identified during the scoping process and discussion with regulatory agencies, stakeholders, and residents of the Florida Keys are listed below. These issues were also used to guide the preparation of this document. The symbols associated with each issue are assigned to facilitate discussion.

Issue 1. Water Quality. A number of recent scientific studies have documented the contribution of failing septic tanks and cesspools to the deterioration of canals and nearshore marine water quality in the Florida Keys. Scientists concur that a principal cause of water quality degradation in the Sanctuary is the elevated nutrients level in the surrounding canals and nearshore waters.

Issue 2. Facility Siting. Construction of wastewater collection and treatment facilities will require sizeable tracts of land (two to five acres) to host physical facilities. Vacant parcels of land are scarce in the Keys, particularly in urban areas.

Issue 3. Protected Species. The limited amount of undeveloped natural habitat in the Keys makes these areas and associated species vulnerable to development. Because there are so few remaining developable lands, any FKWQIP actions that result in the loss of natural areas is likely to impact protected species.

Issue 4. Effluent Disposal. Currently, treated effluent from WWTFs in the Florida Keys is disposed of in shallow injection wells. While FDEP rules require wells to be drilled to a depth of 90 feet and cased to 60 feet, many existing wells are less than 90 feet deep and/or are partially or wholly uncased, which increases the possibility of effluent leakage.

Issue 5. Tourism. The quality of life and economy in the Florida Keys depend on a healthy marine ecosystem and are therefore adversely impacted by water quality degradation in nearshore and marine waters. Water related activities, including snorkeling, diving, fishing, and other beach activities comprise 70 percent of tourism in the Keys. Tourism generates over $1.3 billion per year and supports over 21,000 jobs (English *et al*. 1996).

Issue 6. Environmental Justice. Low and fixed-income residents make up a significant portion of the Monroe County population and therefore affect the ability of the County to fund improvements to wastewater and stormwater facilities. About 10 percent of the population was below the poverty level in 1999 and over 15 percent of the population was over 65 years old in 2000.

Comparison of Alternatives

The alternatives examined as part of this PEIS were premised on the need to implement water quality improvement projects that will reduce nutrient loading and result in commensurate improvements in water quality to the Sanctuary. Environmental consequences of physical,

biological, and human issues are presented in comparative form in Table E-2 and are described in detail in *Section 4.0 Environmental Consequences* of the PEIS.

Proposed projects under Alternative 2 would: 1) address regional water quality issues, 2) reduce nutrient loadings and improve water quality throughout the Sanctuary, and 3) facilitate compliance with federal and state regulatory water quality treatment standards in a timely manner. Alternative 2 provides for the upgrade or replacement of outdated onsite treatment systems with advanced onsite wastewater treatment package units in cold spot areas, and implementation of central community wastewater collection and treatment system service areas in the more densely developed and highest ranked hot spot areas. Projects would be assigned priority based on a system agreed upon by local municipalities for distribution of monies approved by Congress. Also under Alternative 2, construction of projects would be expedited and project management and coordination would be more effective when compared with the *No Action Alternative* or *Alternative 3: Alternate Funding of the FKWQIP*.

Potential adverse impacts due to implementation of Alternative 2 include those related to environmental justice and protected species. Over 25 percent of the population in the Keys is classified as low income or over 65 years of age living on a fixed income, and it is difficult for these residents to afford the capital costs and monthly service fees associated with wastewater treatment and stormwater management improvements. Mitigation may be required for potential impacts to protected species.

Preferred Alternative

The preferred alternative, or *Proposed Action*, is Alternative 2. Under this alternative, priority projects would be implemented as an integrated area-wide water quality improvement program, rather than as a fragmented approach that would result in delayed funding implementation as well as fewer and smaller projects that may provide inadequate treatment. The projects are anticipated to accomplish the following:

- Goals of the Florida Keys Water Quality Improvements Act would be met.
- Individual water quality improvement projects that address regional water quality issues, based on need, design constraints, available technology, and funding would occur.
- Reduced nutrient loadings and commensurate increases in water quality in the Sanctuary.
- Attainment of federal and state regulatory water quality standards in a timely manner.

Areas of Controversy

Controversial issues associated with FKWQIP are the cost of program implementation, the means of recovering initial capital investment, and the means of generating revenues to support maintenance and operational activities.

Another prevailing issue, primarily within the scientific community, is whether the improvement of wastewater treatment and the installation of centralized sewers would improve the health of the coral reef within the Florida Keys National Marine Sanctuary. Conflicting scientific

evidence would seem to indicate that improving nearshore water quality would, at a minimum, have a positive, albeit indirect, impact on the coral reef.

Table ES-2
Comparison of Key Issues among Alternatives for the FKWQIP

Scoping Issue	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Alternative Funding
1. Water Quality	Adverse impacts due to continued untreated waste- and stormwater runoff and associated nutrients, toxins, bacteria, and viruses to canals and nearshore waters in the Sanctuary. State and federal mandates to improve water quality in the Sanctuary may not be addressed.	Benefits of centralized storm- and wastewater treatment include water quality improvements due to decreased nutrients and other contaminants into canals and nearshore waters of the Sanctuary. These improvements will address state and federal legislation.	Continued degradation of water quality is anticipated until funding is obtained to implement storm- and wastewater improvement projects. Piece-meal implementation of projects may not address priority water quality areas, e.g. pollutant *hot spots*.
2. Facility Siting	No impacts are anticipated. No lands will be required for the location and construction of storm- and wastewater facilities. Therefore, existing residences, fish and wildlife habitats, and land uses will not be disrupted or displaced.	Minor impacts expected to result due to lands required for the location and construction of treatment facilities. Facility land requirements may displace existing residents and encroach on sensitive lands and protected species. Centralized projects will allow coordinated land acquisition.	Similar to Alternative 2 except that implementation will occur over time and likely require smaller, but more numerous, parcels of land. Coordinated efforts for land acquisition will not occur.
3. Protected Species	Adverse impacts to protected species anticipated as a result of o continued runoff of untreated storm- and wastewater into canals and nearshore waters and subsequent water quality degradation. Because no new facilities would be required, no impacts to habitat for protected species are anticipated.	Minimal adverse impacts are due primarily to land required for facilities. Consultation with USFWS/ NMFS and FFWCC would occur for individual projects. Based on preliminary discussions, agency's support treatment and have provided input on sensitive areas. Major benefits include improved water quality as well as coordinated mitigation efforts.	Impacts similar to those described under Alternative 1 are expected due to delays in treatment implementation. In addition, the absence of coordinated efforts for land acquisition may result in smaller areas of mitigation for impacts due to loss of habitat for facility construction.
4. Effluent Disposal	Adverse impacts anticipated as a result of unchanged effluent disposal practices. Runoff from cesspools and septic tanks will continue to enter canals and nearshore waters in the Sanctuary. Elimination of cesspools will progress at a slow pace.	Benefits include reduced effluent discharges into Sanctuary as a result of more deep well injection of treated water from larger, centralized WWTFs. Construction of centralized sewers will expedite the removal of cesspools and associated pollutants in pollutant *hot spots* throughout the Keys.	Adverse impacts anticipated due to the absence of a centrally-managed WWT system. Fewer and smaller WWTFs may rely more heavily on shallow injection wells. Construction of sewers will be less effective due to fragmented approach. Delays in construction also anticipated.
5. Tourism	Increasing impacts anticipated related to water quality degradation. Continued beach health advisories would adversely affect immediate recreational and tourist opportunities, and long-term impacts could be detrimental to tourism and the local economy.	Improved water quality would decrease the incidence of beach advisories and closings, thereby increasing the opportunity for saltwater-based recreation. Temporary adverse impacts would include transportation delays due to construction activities	Some increase in saltwater based activities due to improved nearshore water quality could be expected, however, at a slower pace as compared with Alternative 2.
6. Environmental Justice	Adverse impacts to low-income households who will have difficulties affording the cost of meeting 2010 mandates for wastewater treatment are expected.	Possible disproportionate impacts to low-income residents due to facility sitings in minority or low-income neighborhoods may occur. Without special consideration and financial assistance, low-income and fixed income households would have difficulty paying for wastewater and stormwater management improvements, hook up and service fees.	Possible disproportionate impacts to low-income residents due to facility sitings in minority or low-income neighborhoods. Without special consideration and financial assistance, low-income and fixed income households would have difficulty paying for wastewater and stormwater management improvements, hook up and service fees.

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List of Acronyms

AIDS	Acquired Immune Deficiency Syndrome
AIRFA	American Indian Religious Freedom Act
ARPA	Archaeological Resources Protection Act
ASTM	American Society of Testing and Materials
ATU	Aerobic Treatment Units
AWT	Advanced Wastewater Treatment levels
BAT	Best Available Technology
BFE	Base flood elevation
BMPs	Best management practices
BOCC	Board of County Commissioners
BOD	Biochemical oxygen demand
BP	Before present
CARL	Conservation and Recreation Lands
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resource System
CEQ	Council on Environmental Quality
CERP	Comprehensive Everglades Restoration Plan
CES	Key West City Electric Services
CFCRS	Continuous Feed Cyclic Reactor System
CFR	Code of Federal Regulations
CFV	Commercial Fishing Village
CIEGP	Cesspit Identification and Elimination Grant Program
CO	Carbon monoxide
CPU	Chemical precipitation unit
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dBA	Decibel
DCA	Department of Community Affairs
EA	Environmental Assessment
EDU	Equivalent Dwelling Unit
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPJV	Everglades Partners Joint Venture
ERP	Environmental Resource Permit
ESA	Endangered Species Act
F.A.C.	Florida Administrative Code
FAST	Fixed Activated Sludge Treatment
FDEP	Florida Department of Environmental Protection
FDH	Florida Department of Health
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency

FKAA	Florida Keys Aqueduct Authority
FKEC	Florida Keys Electric Cooperative
FKNMS	Florida Keys National Marine Sanctuary
F.L.	Florida Law
FPSC	Florida Public Service Commission
GIS	Geographical Information System
GMFMC	Gulf of Mexico Fishery Management Council
gpd	Gallons per day
HHS	Department of Health and Human Services
HUD	U.S. Department of Housing and Urban Development
Hz	Hertz
Ldn	Day-Night Sound Level
LOS	Levels of Service
MCC	Monroe County Code
MCSWMP	Monroe County Sanitary Wastewater Master Plan
MFI	Median family income
Mgal	Million gallons
mgd	Million gallons per day
$\mu g/m^3$	Micrograms per cubic meter
MHI	Median household income
MOU	Memorandum of understanding
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act of 1969
NGVD	National Geodetic Vertical Datum
NHPA	National Historical Preservation Act
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NO_3	Nitrate
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
O_3	Ozone
OFW	Outstanding Florida Waters
OSHA	Occupational Safety and Health Administration
OSTDS	On-site sewage treatment and disposal system
OWNRS	On-site wastewater nutrient reduction systems
OWTS	On-site wastewater treatment systems
PATA	Key West Port and Transit Authority
Pb	Lead
PEA	Programmatic Environmental Assessment
PM 10	Particulate matter less than 10 microns
ppm	Parts per million

RCRA	Resource Conservation and Recovery Act
ROGO	Rate of Growth Ordinance
SAFMC	South Atlantic Fishery Management Council
SDGS	Small diameter gravity sewers
SDI	Subsurface Drip Irrigation system
SEA	Supplemental Environmental Assessment
SER	Supplemental Environmental Review
SFWMD	South Florida Water Management District
SMMP	Stormwater Management Master Plan
SO_2	Sulfur dioxide
STEP	Septic tank effluent pump
SWMP TAC	Sanitary Wastewater Master Plan Technical Advisory Committee
TN	Total nitrogen
TON	Total organic nitrogen
TP	Total phosphorus
TSS	Total Suspended Solids
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UV	Ultraviolet
WQPP	Water Quality Protection Program
WWTF	Wastewater Treatment Facilities

1.0 Purpose of and Need for Action

The U.S. Congress has directed the U.S. Army Corps of Engineers (Corps) to assist local municipalities in Monroe County, Florida, in the planning and construction of wastewater and stormwater improvements designed to accomplish the goals listed below.

- Reduce nutrient loading to the nearshore waters of the Florida Keys National Marine Sanctuary (Sanctuary)
- Improve water quality throughout the waters of the Sanctuary
- Meet relevant federal and state regulatory standards

This section of the Programmatic Environmental Impact Statement (PEIS) explains the purpose and need for the federal action and the decision to be made by the federal government. Authorizing legislation for the Florida Keys Water Quality Improvement Program (FKWQIP) and the study area are also described. Relevant issues and related environmental documentation addressed during the scoping process are also discussed. A chronology of applicable regulatory developments is presented to inform the reader of the statutory mandates confronting the residents of Monroe County, Florida, with regard to required wastewater treatment upgrades. Finally, the organization of the PEIS is outlined.

The FKWQIP was created in response to regulatory requirements and in the interest of protecting public health and water quality.

1.1 Authorization

Under authority of Public Law 106-554 dated December 21, 2001 (Appendix A), the Corps is authorized to provide technical and financial assistance to carry out projects for the planning, design, and construction of treatment works to improve water quality of the Sanctuary. Design and construction assistance may be provided only for projects that are owned by public entities. Although authorized, funding for the program has not yet been appropriated. Funding will likely come on a yearly basis from Congress. Typically, large programs of this nature are not in accordance with Administration Program priorities of the Corps (i.e. navigation, flood control, or environmental restoration), however, non-traditional projects are routinely undertaken by the Corps as "work for others."

The FKWQIP is a cooperative effort between the Corps (lead federal agency) and the South Florida Water Management District (SFWMD) (lead non-federal sponsor). During implementation of Section 109 planning activities, the Corps will consult with:

- the Water Quality Steering Committee established under Section 8(d)(2)(A) of the Florida Keys National Marine Sanctuary and Protection Act
- the South Florida Ecosystem Restoration Task Force established by Section 528(f) of the Water Resources Development Act of 1996
- the Commission on the Everglades established by Executive Order of the Governor of the state of Florida

The Florida Keys Water Quality Improvement Act (Act) allocated $420,000 for the Corps to begin coordination activities with SFWMD and authorized Congress to appropriate up to $100 million for the FKWQIP (representing 65 percent of program costs) for the planning and construction of wastewater and stormwater improvements.

The SFWMD will be responsible for 35 percent of the total project cost and will receive credit for the reasonable costs of design work completed for all projects prior to entering into an agreement with the Government (passed on the date of passage of the Act). The Act does not authorize any construction activity by the Secretary of the Army. The non-federal sponsor is also responsible for providing all lands, easements, rights-of-way, and relocations required for the project and for obtaining any necessary permits, as well as 100 percent of the operation, maintenance, repair, rehabilitation, and replacement costs associated with a completed construction project, which are not part of the cost share. Although SFWMD is the non-federal sponsor, they will be obtaining the funding for these projects from the various municipalities of Monroe County.

1.2 Study Area

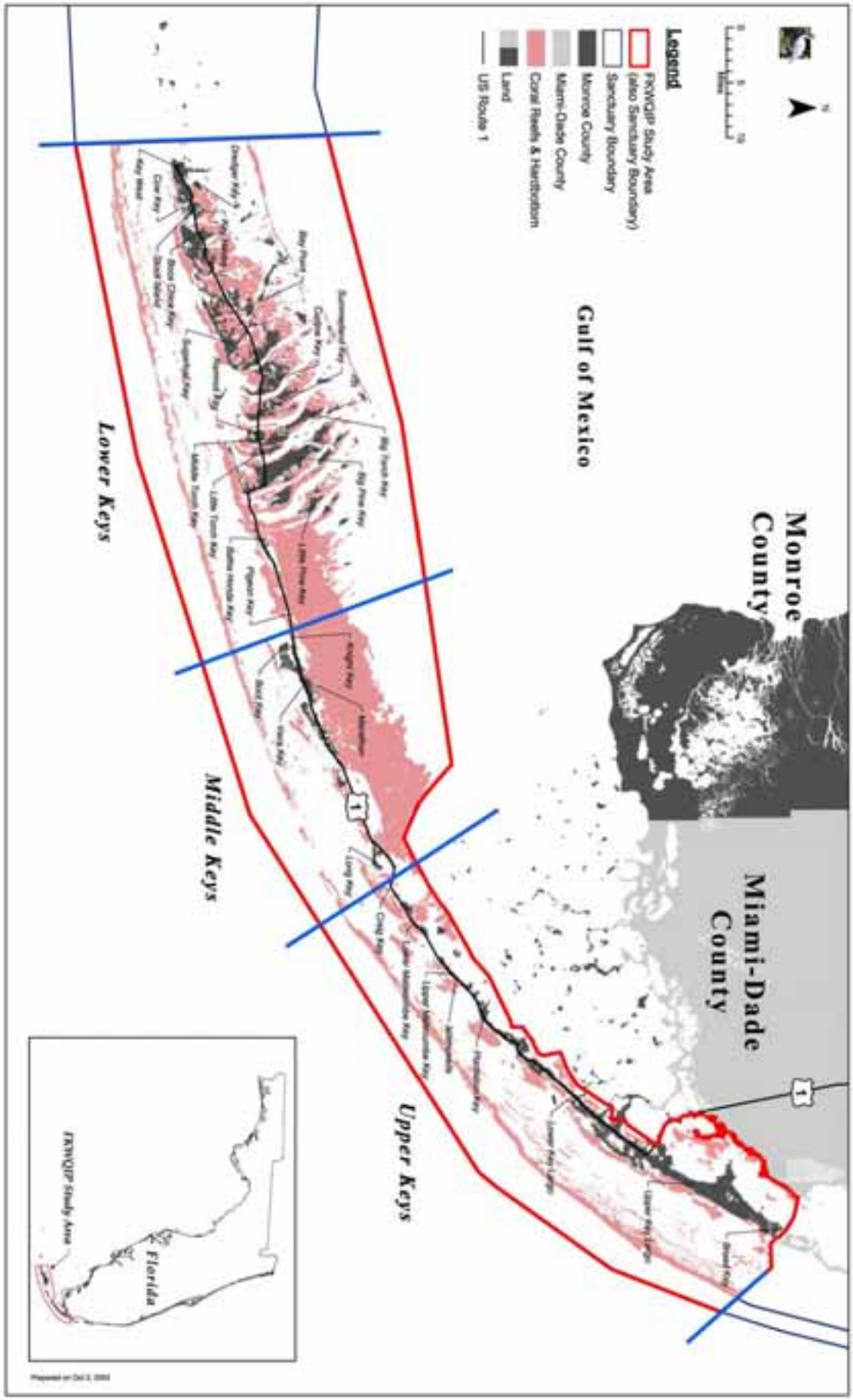
The study area for this PEIS is located along the portion of the Florida Keys (Keys) connected by U.S. Highway 1, a 110-mile stretch of roadway extending from Key Largo to Key West, and the remaining developed portion of the Keys. For clarity, the Keys have been divided into the upper, middle, and lower Keys, and are presented in Figure 1-1. The Sanctuary is part of a complex ecosystem that includes the Everglades, Florida Bay, and includes 2,800 square nautical miles of nearshore waters that begin just south of Miami, Florida and extend to the Dry Tortugas. The Keys are a chain of more than 800 islands extending approximately 220 miles southwest from the southern tip of the Florida peninsula and through the Sanctuary.

1.3 Purpose and Need

Similar to other Florida ecosystems, human activities over the past 100 years have affected the water quality in the Sanctuary. Bacteria and nutrients from human wastes, and chemicals such as pesticides and mercury, are reaching this delicate ecosystem, and thereby degrading water quality and posing a public health risk. Currently, most residents and commercial establishments in the Keys are not connected to advanced wastewater treatment systems, but rather septic tanks and outdated onsite package plants. These systems, if not properly operated, allow bacteria and nutrients to leech into nearshore waters. In areas where testing is performed on near shore waters, beaches are often posted for health advisories after moderate rainfall because fecal coliform bacteria have leeched into surface waters.

In recognition of the importance of improving water quality in the Sanctuary, the purpose of the FKWQIP is to assist Monroe County in implementing projects to reduce nutrient and bacteria loading, improve water quality in the Sanctuary, and meet relevant federal and state regulatory standards.

Within the Sanctuary are unique and nationally significant marine environments, including seagrass meadows, mangrove islands, and the only living coral barrier reef in North America.



1-1

Location of FKWQIP Study Area

These marine environments support rich biological communities possessing extensive conservation, recreational, commercial, and aesthetic values, all of which give this area special national significance. The Sanctuary offers many opportunities for recreation, commercial fishing, and tourism based businesses that comprise a large portion of Florida's economy. For example, over two million visitors per year visit the Sanctuary to view the nation's largest living coral reef. Anglers from around the world also visit the Sanctuary for its challenging game fish, especially billfish, found in deeper marine waters, and bonefish, which inhabit shallow waters.

Water quality is critical to maintaining the marine ecosystem of the Sanctuary and influences the coral reef and the multitude of living organisms dependent on the reef. Numerous scientific studies have documented the contribution of failing septic tanks and cesspools to the deterioration of canal and nearshore water quality in the Keys. In addition, research has suggested that increased nutrient loadings from wastewater into canals and nearshore waters are one of the major contributors to the decline of water quality within the Sanctuary.

In response to regulatory requirements and in the interest of protecting public health and water quality, the FKWQIP was created. At the federal level, the Florida Keys National Marine Sanctuary and Protection Act of 1990 directed the USEPA and the state of Florida to develop a water quality protection plan for the Sanctuary. Locally, the *Monroe County 2010 Comprehensive Plan* (see Appendix D) mandates that nutrient loadings to the marine ecosystem be reduced by the year 2010 and that wastewater systems meet more stringent Florida Statutory Treatment Standards. In recognition of the importance of improving water quality in the Sanctuary, the purpose of the FKWQIP is to assist local municipalities in Monroe County in implementing the priority projects designed to reduce nutrient and bacteria loading, subsequently improve water quality in the Sanctuary, and meet relevant federal and state regulatory standards.

1.4 Decision to be Made

Due to the high capital cost of implementing the proposed water quality improvements, municipal governments in the Florida Keys have requested assistance from the federal government to develop and implement wastewater treatment and stormwater management actions that will reduce nutrient loadings and improve water quality in the Sanctuary. Based on the potential benefits of the FKWQIP and the adverse effects on the natural and manmade environment if water quality improvements are not made, the federal government must determine the most favorable action to implement the FKWQIP Authorization. When completed, Florida Keys residents and visitors can expect improved water quality in the Sanctuary and nearshore waters.

When completed, Florida Keys residents and visitors can expect improved water quality in the Sanctuary and nearshore waters.

1.5 Scoping Issues

Under the National Environmental Policy Act (NEPA) of 1969, federal agencies are required to determine the scope of issues to be addressed for a project and identify the significant issues related to the proposed action. This process is called "scoping."

A Scoping Letter was issued to various stakeholders and interested parties on February 9, 2003 and comments were received through April 9, 2003. A public meeting was held in Marathon, Florida on February 27, 2003 to solicit comments and determine issues to be addressed during the National Environmental Policy Act (NEPA) process. Significant issues identified during the scoping process and discussion with regulatory agencies, stakeholders, and residents of the Florida Keys, are listed below and have guided the preparation of this document. The symbols associated with each issue are assigned to facilitate discussion, particularly in Chapter 3.

Symbol	Scoping Issue
	Issue 1: Water Quality
	Issue 2: Facility Siting
	Issue 3: Protected Species
	Issue 4: Effluent Disposal
	Issue 5: Tourism
	Issue 6: Environmental Justice

Issue 1: Water Quality.
A number of recent scientific studies have documented the contribution of failing septic tanks and cesspools to the deterioration of the canals and nearshore marine water quality of the Florida Keys. The studies attribute increased algal blooms, seagrass die-off, and the loss of coral reef ecosystems to inadequate onsite wastewater treatment. Scientists concur that one of the principal sources of water quality degradation in the Sanctuary is the elevated level of nutrients in the surrounding canals and nearshore waters. The EPA has concluded that the magnitude and extent of estimated nutrient loadings from wastewater sources are regionally substantial (USEPA 1993).

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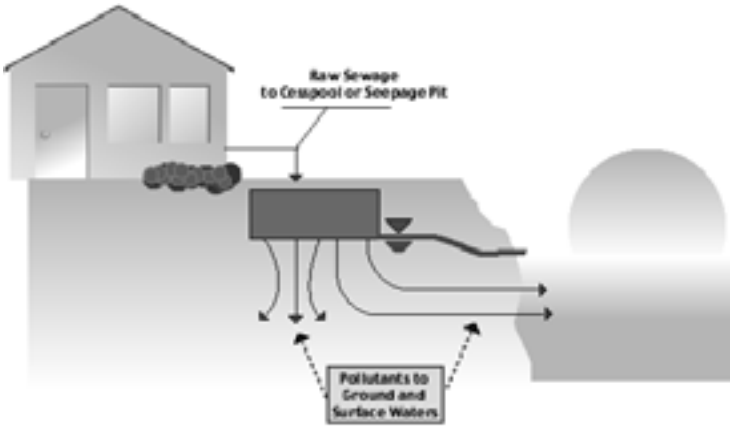
Cesspools. Early onsite wastewater treatment systems used in the Keys consisted of a cesspool or a seepage basin, consisting of a large excavation typically lined with brick or stone allowing raw wastewater to seep into the ground (Figure 1-2). Because the Keys have a limited soil layer, little if any treatment of the wastewater occurs through soil filtration. Due to limited nutrient removal, the cesspool and seepage basin discharge is essentially raw wastewater. There are an estimated 2,800 of these early cesspools still in operation throughout the Keys and they are a

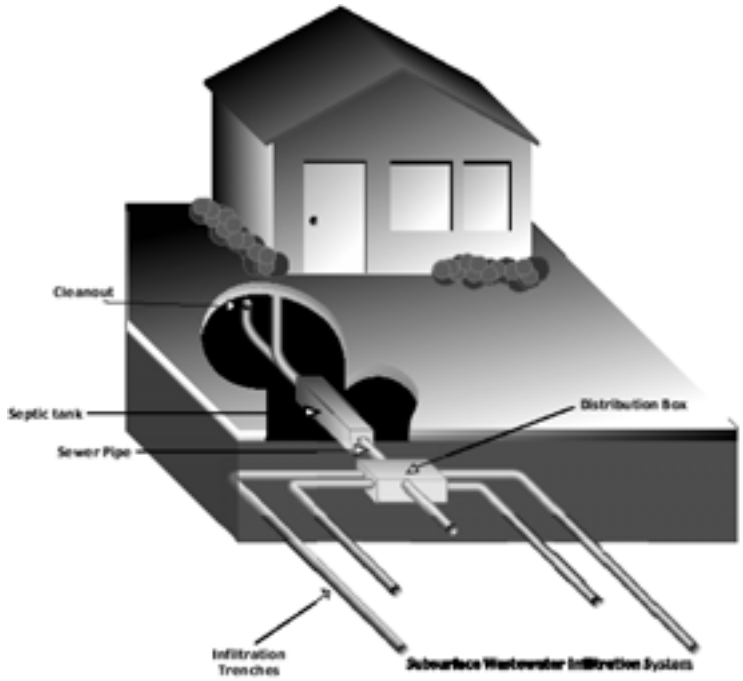
significant contributor to water quality degradation in the nearshore waters of the Keys. Monroe County Ordinance 03-1997 established a program to identify and eliminate cesspools, concentrating on suspected locations in older developed lots. Elimination of cesspools is a significant component of assigning priority to projects in the FKWQIP.

Figure 1-2
Typical Cesspool or Seepage Pit Wastewater Treatment System



Septic Tank Systems. This conventional onsite treatment system consists of a septic tank and a subsurface wastewater infiltration system, or drainfield, which relies on naturally occurring soils to provide wastewater treatment (Figure 1-3). The drainfield and underlying soils are the most critical components of septic tank systems for treatment of wastewater. However, because of the limited soil layer throughout the Keys, soil must actually be imported to construct these systems. The limited soil layer in the Keys reduces the effectiveness of septic tank systems, especially pertaining to nutrient removal. A direct connection between septic tank waste disposal and the nearshore marine water quality was measured during a tracer study in Key Largo. Tracers added to a domestic septic tank appeared in a canal 11 hours later and in nearshore marine waters within 23 hours (Paul *et al.* 1995).

Figure 1-3
Typical Septic Tank and Wastewater Infiltration System



Issue 2: Facility Siting.
Construction of wastewater collection and treatment facilities may require tracts of land two to five acres in area. Vacant parcels of land are scarce in the Keys, particularly in urban areas. Potential sites for these treatment facilities may contain sensitive or critical habitat for species. Additionally, construction of sewer collection systems has the potential to cross naturally or culturally sensitive lands. The farther a treatment facility is located from the area it serves, the greater the conveyance costs to construct and operate it. Increased cost creates additional pressure to locate these facilities in more populated areas of the Keys. Municipalities may invoke eminent domain to obtain needed lands, thereby displacing current residences and reducing tax revenue for smaller municipalities.

Issue 3: Protected Species. The Florida Keys are a relatively small landmass in a subtropical to tropical island setting and provide habitat for many rare and protected plants and animals. The limited amount of undeveloped natural habitat in the Keys makes these areas and associated species vulnerable to development. Because there are so few remaining developable lands, any FKWQIP actions that result in the loss of natural areas is likely to impact protected species. Protected species that occur or may occur in the study area and their associated habitats,

regulatory framework affecting these species, and areas important to maintaining the biodiversity in the Florida Keys are addressed in this PEIS.

Issue 4: Effluent Disposal. Treated effluent from most wastewater treatment in the Florida Keys is currently disposed of through the use of shallow injection wells. However, many of the existing injection wells are less than 90 feet deep, and many have shallow casings or are entirely uncased, which increases the probability of effluent leaks to nearshore surface waters. Florida Department of Environmental Protection (FDEP) rules require wells to be drilled to a depth of 90 feet and cased to a depth of 60 feet.

Issue 5: Tourism. Tourism quality of life in the Florida Keys depends upon a healthy marine ecosystem and are negatively impacted by water quality degradation. Over two million individuals per year visit the Florida Keys to enjoy its unique natural features. Water related activities, including snorkeling, diving, fishing, and other water related activities comprise 70 percent of tourism in the Keys, which generates over $1.3 billion per year and supports over 21,000 jobs. Poorly treated wastewater presents a public health risk to nearshore waters of the Keys, which in turn can result in beach advisories, decreases in tourism and fewer individuals participating in recreational activities within waters of the Sanctuary.

Issue 6: Environmental Justice. A low and fixed-income population makes up a substantial segment of Monroe County population and affects the ability of the County and other municipal governments to fund improvements to wastewater treatment and stormwater management facilities. About 10 percent of the population was below the poverty level in 1999 and over 15 percent of the population was over the age of 65 in 2000. Many of the standard measures of affordability are based on median family income, which does not adequately reflect the abilities of those least able to afford the capital costs associated with the installation of an advanced onsite wastewater treatment system or connecting to a new public sewer system.

Because of the pending Florida Statutory Treatment Standard mandates, some residents may be required to pay the cost of immediate replacement of onsite wastewater treatment systems as well as future sewer connections. Residents with cesspools or septic tanks may be required to replace existing systems with a more advanced onsite treatment system before a public sewer system is available to their neighborhood. Once a public sewer system is available, the resident will then be required to connect to the public system, imposing additional costs to the user. Thus a resident may be required to pay for both a new onsite treatment system and ultimately for connection to the sewer system. Differences in the cost of implementing centralized wastewater collection and treatment vary significantly between proposed service areas in the Keys. These differences contribute to potential problems in identifying equitable and affordable means of funding wastewater and stormwater improvements.

1.6 Related Environmental Documents

Documents related to the FKWQIP and water quality improvements in the project area that may influence the scope of this PEIS are presented below.

Federal Emergency Management Agency (FEMA) Programmatic Environmental Assessment for Wastewater Improvements in the Florida Keys. On December 23, 2002, FEMA finalized a Programmatic Environmental Assessment (PEA) for a project with the Village of Islamorada and three additional projects with the Florida Keys Aqueduct Authority (FKAA). Under these four projects, FEMA will issue approximately $11 million in grants for construction of wastewater systems. Matching funds will be provided through the Florida Division of Emergency Management and local government applicants. FEMA's PEA broadly addresses the purpose and need for wastewater improvements in the Keys and presents alternative wastewater management options along with their anticipated environmental consequences. Project and site specific Supplemental Environmental Assessments are currently being prepared. Information from the PEA has been incorporated into the Corps' PEIS, particularly the description of the existing environment. Appropriate citation has been made when information from the PEA has been used in this PEIS.

Florida Keys Carrying Capacity Study. This study was recently conducted to assess the ability of the Florida Keys ecosystem to support continued growth. The study examined past, present, and future impacts to the ecosystem and developed a database and analysis of consequences that may be used to determine the level of land development activities that can occur in the Keys without causing further irreversible and/or adverse impacts to the Florida Keys ecosystem. This was accomplished using an interactive, spatially explicit Carrying Capacity Analysis Model (CCAM) that simulates the conditions of land development activities and population growth through time to inventory the impacts on the natural resources and infrastructure in the Florida Keys (see Appendix D).

Comprehensive Everglades Restoration Plan (CERP) Related Projects. A number of efforts to restore the south Florida ecosystem are currently underway, including two CERP projects directly related to the FKWQIP. These projects are: (1) the Florida Bay and Florida Keys Feasibility Study and (2) the Florida Keys Tidal Restoration Project. Although the FKWQIP is not a component of CERP, it is extremely important to ecosystem restoration in the Florida Keys.

Project 1: Florida Bay and Florida Keys Feasibility Study will examine the Florida Bay and Florida Keys marine environments, and the actions and land uses upstream, to determine modifications necessary to successfully restore water quality and ecological conditions of the Bay. The study may also include analyses of alternatives for restoration of the marine environment in the Florida Keys if there are positive impacts on Florida Bay. The study goal is to evaluate Florida Bay and its connections to the Everglades, the Gulf of Mexico and the Florida Keys marine ecosystem to determine the modifications that are needed to successfully restore water quality and ecological conditions of the Bay, while maintaining or improving these conditions in the Keys' marine ecosystem.

Project 2. Florida Keys Tidal Restoration Effort. This project addresses the use of bridges or culverts to restore tidal connections between Florida Bay and the Atlantic Ocean in Monroe County. The four potential sites are located in the Middle Keys near Marathon and include: 1) Tarpon Creek, just south of Mile Marker 54 on Fat Deer Key (width 150 feet); 2) unnamed creek between Fat Deer Key and Long Point Key, south of Mile Marker 56 (width 450 feet); 3) tidal

connection adjacent to Little Crawl Key (width 300 feet); and 4) tidal connection between Florida Bay and Atlantic Ocean at Mile Marker 57 (width 2,400 feet). Only one of the four sites will be restored as part of this project.

The purpose of this project is to restore the tidal connection in a section of the Middle Keys that was eliminated in the early 1900s during the construction of the Flagler railroad. Restoring the circulation to areas of surface water that have been impeded and stagnant for decades will significantly improve water quality, benthic floral and faunal communities, and larval distribution of both recreational and commercial species (e.g. spiny lobster) in the nearshore waters in the vicinity of these restoration sites.

1.7 National Environmental Policy Act (NEPA) Requirements

Under the National Environmental Policy Act (NEPA) of 1969 and the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR Parts 1500 to 1508), the Corps must consider the environmental consequences of proposed federal actions (projects). Accordingly, the Corps has prepared this document to evaluate the environmental consequences of implementing a wide range of projects designed to improve water quality; and protect water resources in the Sanctuary. This PEIS describes a program to improve the wastewater and stormwater infrastructure in the Florida Keys. Because the affected environment and environmental consequences are addressed in general terms, supplemental NEPA documentation will be required for project level actions.

These improvements include wastewater collection, treatment, and disposal options and stormwater best management practices. This document is programmatic, and as such, the alternatives and environmental consequences of the overall FKWQIP implementation on the affected environment are described at a general level. Due to the conceptual nature of the FKWQIP, project-specific Environmental Impact Statements or Environmental Assessments that build upon this programmatic document would be required to address individual projects in sufficient detail for final decision-making and full compliance with NEPA. This process is called *tiering* and was established by the CEQ to provide "coverage of general matters in broader environmental impact statement with subsequent narrower statements or environmental analyses…. Agencies are encouraged to tier environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review" (40 CFR 1508.02 and 1520.20).

Supplemental NEPA documentation will be prepared for each FKWQIP project receiving federal funding. In most cases it is assumed the environmental consequences of project implemented will be relatively minor. For these projects an environmental assessment will be prepared. Individual projects for which it has been determined that potentially significant adverse impacts exist will go through the more rigorous EIS process as required by NEPA.

1.8 Summary of Prior Regulatory Action

A historical chronology of applicable regulations related to the construction of wastewater treatment improvements and stormwater best management practices in the Keys is described below to inform the reader of the more stringent Florida Statutory Treatment Standards that will confront residents and commercial entities of Monroe County within the coming years.

The *Monroe County Year 2010 Comprehensive Plan* (1997) mandated reductions in nutrient loadings to the marine ecosystem by the year 2010. In 1998, the Florida Governor issued Executive Order (EO) 98-309, directing local and state agencies to coordinate with Monroe County in the implementation of the *Year 2010 Comprehensive Plan* to eliminate cesspits, failing septic systems, and other substandard onsite sewage systems.

Additionally, in 1998 the Florida Legislature amended the enabling legislation of the FKAA (F.L. 76-441) to reinforce their involvement in wastewater projects within Monroe County. The FKAA is the main potable water supplier for the Keys. A Memorandum of Understanding (MOU) between Monroe County and the FKAA was signed to "request that the FKAA exercise its authority to purchase, finance, construct, and otherwise acquire and to improve, extend, enlarge, and reconstruct a wastewater collection, transmission, treatment, and disposal system or systems in the Florida Keys."

In 1999 the Florida Legislature set statutory effluent standards for wastewater treatment systems and compliance schedules in Monroe County. Effluent standards for onsite systems are Best Available Treatment (BAT) for flows less than or equal to 100,000 gallons per day (gpd) and Advanced Water Treatment (AWT) for design flows greater than 100,000 gpd. The statutory compliance schedule for the regulatory actions is outlined below.

- All unknown or unpermitted onsite systems in non-designated high polluting areas of the Florida Keys, known as "Cold Spots", and new installations shall be replaced or upgraded with an Onsite Wastewater Nutrient Reduction System (OWNRS) by July 12, 2003.
- All existing onsite systems shall cease discharging or shall be upgraded by July 1, 2010.
- All existing onsite wastewater treatment plants must be upgraded to either BAT or AWT effluent standards by July 1, 2010.

A chronological summary of these and other events relevant to wastewater management in the Keys is presented in Table 1-1.

In addition to local treatment standards, Sections 303 (d) of the Clean Water Act (CWA) requires all states to develop a list of priority surface waters that do not meet applicable water quality standards (impaired waters) after implementation of technology-based effluent limitations. States are required to establish Total Maximum Daily Loads (TMDLs) that designate the maximum amount of a pollutant a water body can assimilate without exceeding water quality standards.

Chapter 99-223, Laws of Florida, sets forth the process by which the 303 (d) list is refined through more detailed water quality assessments. It also establishes the means for adopting TMDLs, allocating pollutant loadings among contributing sources, and implementing pollution reduction strategies. Implementation of TMDLs can include any combination of regulatory, non-regulatory , or incentive-based actions necessary to reduce pollutant loading. Non-regulatory, or incentive based actions may include development and implementation of Best Management Practices (BMPs), pollution prevention activities, and habitat preservation or restoration. Regulatory actions may include issuance or revision of wastewater, stormwater, or

environmental resource permits necessary for consistency with the TMDL. Permit conditions may be quantitative effluent limitations or, for technology-based programs, a combination of structural and non-structural BMPs necessary for achieving the desired pollutant load reduction.

Florida is comprised of 52 major hydrologic basins, which have been categorized geographically into TMDL groups, and will be assessed for pollutant levels. The five phases of the study for each group are as follows:

- Phase I – Preliminary Basin Assessment
- Phase II – Strategic Monitoring
- Phase III – Data Analysis and TMDL Development
- Phase IV – Management Action Plan
- Phase V – Implementation

The Keys are in the fifth group of water bodies to undergo TMDL implementation and are scheduled to undergo Phase I from fiscal year 2005 to fiscal year 2009.

Table 1-1
Recent Chronology of Regulatory Milestones of Wastewater Management in the Florida Keys

1993	• Initial adoption of Monroe County Year 2010 Comprehensive Plan.
1997	• Monroe County Comprehensive Plan Amended to comply with Florida Statutes. • Administration Commission adopts amendments to Monroe County Year 2010 Comprehensive Plan and established Five-year Work Program (Rule 28-20.100). • Monroe County established original Identification and Elimination of Cesspools Ordinance, 03-1997; this ordinance was unsuccessful and was later rescinded.
1998	• Governor's Executive Order 98-309 (State and Local Agency Participation in Carrying Out Monroe County Year 2010 Plan). • Florida Legislature amends the enabling legislation of the FKAA (F.L. 76-441) to reinforce the FKAA's involvement in wastewater for Monroe County • Monroe County enters into a Memorandum of Understanding with the FKAA requesting that the FKAA exercises its authority to finance, construct, and operate wastewater systems in the Keys
1999	• Governor Bush and his cabinet amend the 1997 Five-Year Work Program (Rule 28-20.100) to accelerate pace of program, identify "*hot spots (designated polluting problem areas)*," and initiate cesspool identification outside of "*hot spot*" areas. • Monroe County passes ordinance 031-1999 (Revised Identification and Elimination of Cesspools) to comply with the Governor's revised Five-Year Work Program. • F.L. 99-395 passed (New requirements for all sewage treatment, reuse and disposal facilities, and all on-site systems Monroe County; prohibits new or expanded discharges into surface waters, and require existing surface water discharges be eliminated before July 1, 2006).
2001	• The Florida Keys Water Quality Act approved by the U.S. Congress, authorizing the Corps to provide technical and financial assistance to carry out projects for the planning, design and construction of wastewater treatment and stormwater management to improve water quality of the Florida Keys National Marine Sanctuary.

Source: Modified from Monroe County, 2000

1.9 Document Organization

The basic elements of a PEIS, as well as all applicable subelements, are presented in this document. Subsequent individual sections of the PEIS are listed and briefly described below.

- **Chapter 2. Description of Alternatives** including the Proposed Action. Presents a detailed description of alternatives for the FKWQIP, thereby providing the basis for decision making.
- **Chapter 3. Affected Environment.** Existing conditions in the project area are presented that provide a description of environmental conditions and the context in which to evaluate the alternatives.
- **Chapter 4. Environmental Consequences**. This chapter provides an analysis of the potential environmental consequences anticipated as a result of the proposed alternatives considered as part of this PEIS. Examination of existing environmental conditions provides the context for understanding the environment being affected, especially in terms of wastewater and stormwater treatment and the Sanctuary, as they presently exist and as they would exist under implementation of each of the alternatives.
- **Chapter 5. Public Involvement.** Water quality in the Sanctuary and the need to reduce nutrient loading in the nearshore waters of the Florida Keys are of interest to regulatory agencies and citizens alike. Consequently, public participation has been an important component throughout the preparation of this PEIS to ensure compliance with the intent of NEPA and other applicable statutes, including public and agency input and accurate documentation of the NEPA process.
- **Chapter 6. Conclusion.** In this chapter, conclusions regarding potential environmental impacts of the three alternative actions proposed for FKWQIP to the physical, biological, and human environment in the Florida Keys are presented. The analysis is premised on the need to implement water quality improvement projects that will reduce nutrient loading and result in commensurate increases in water quality to the Sanctuary.
- **Chapter 7. Bibliography.** The bibliography documents the literature cited throughout the PEIS as well as documents used during the preparation of the PEIS that were not specifically cited.
- **Chapter 8. List of Preparers.** The authors primarily responsible for the preparation of this PEIS are listed in this chapter.
- **Chapter 9. List of Recipients.** The agencies, organizations, and persons to whom copies of this PEIS are being sent are listed in this chapter.
- **Chapter 10. Glossary of Terms.**
- **Chapter 11. Index.**

2.0 Description of Alternatives

Project alternatives are described and evaluated in this section, providing the basis for decision making and thereby becoming the core of this PEIS. While this chapter relies on supporting information presented in Chapter 3.0 Affected Environment and Chapter 4.0 Environmental Consequences, it is in this chapter that the environmental consequences are clearly and concisely differentiated for each of the alternatives. The three alternatives evaluated as part of this PEIS are listed below and discussed in the following sections.

- ***Alternative 1: No Action.*** Do not provide federal funding for projects designed to address state mandates to improve water quality in the Sanctuary. Local mandates to address inadequate treatment of wastewater, primarily through the use of cesspools and septic tanks, and without the benefit of centralized wastewater collection and treatment, will continue.
- ***Alternative 2: Proposed Action.*** Provide federal funding to develop an integrated area-wide system of wastewater treatment and stormwater management improvements that are designed to address state mandates to improve water quality in the Sanctuary.
- ***Alternative 3: Pursue other Sources of Funding for Project Implementation.*** Identify and use other sources of funding to implement projects designed to address state mandates to improve water quality in the Sanctuary as no federal monies would be provided.

In this chapter project alternatives are described and evaluated providing the basis for decision making and thereby becoming the core of PEIS.

While other funding sources are currently being pursued to assist in implementing stormwater and wastewater improvements in Monroe County, the proposed federal funding for the FKWQIP will expedite the implementation of projects. It is important to note, however, that implementation of the FKWQIP is not anticipated to resolve all the water quality issues in the Sanctuary. First, the FKWQIP with its $100 million cap in authorized funding will provide less than 20 percent of the funding necessary to implement the entire list of projects. Second, while the FKWQIP is limited to wastewater treatment and stormwater management projects, other sources contribute to the change in water quality in the Florida Keys (e.g. natural upwellings of offshore waters with nutrient inputs).

2.1 Delineation of Alternatives

The enabling legislation for the Florida Keys Water Quality Improvements Act directs the Corps to coordinate with local and state agencies as part of the planning process identifying and developing water quality improvement projects designed to decrease nutrient loading and improve the water quality of the Sanctuary. At the programmatic level, the alternatives analysis examines the potential environmental effects of implementing or not implementing proposed water quality improvement projects throughout the Keys in an effort to identify those alternatives with the greatest potential for improving water quality throughout the Sanctuary.

Planning at the county level has also addressed water quality improvements in the Keys, primarily in response to the mandated Florida Statutory Treatment Standards of 2010. In addition, local municipalities of Monroe County have prepared wastewater treatment and stormwater management master plans during the past eight years. Consequently, the water quality improvement projects in each master plan have undergone a rigorous analysis of alternatives, including facility siting and treatment technology applications.

The water quality improvement projects in each master plan have undergone a rigorous analysis of alternatives, including facility siting and treatment technology applications.

As a result of the extensive planning efforts already implemented at the county and municipal levels, including the identification of potential alternatives and plan recommendations, additional plan formulation regarding individual water quality improvement projects for the FKWQIP was deemed unnecessary for the purposes of this PEIS. A Program Delivery Team (PDT) is responsible and accountable for ensuring that effective, coordinated actions are combined for successful implementation of the FKWQIP. Membership of the PDT consists of one elected representative from each municipal governmental agency in Monroe County as well as state and federal agency representatives (Appendix B). The PDT is also responsible for preparation of a Program Management Plan (PMP), which will establish the framework for projects planned under federal authority. The PMP will provide the rationale for assigning priority to specific wastewater treatment and stormwater management projects included within the various master plans prepared by Monroe County or municipalities within Monroe County.

2.1.1 Master Plans and Other Documents Reviewed

This section of the PEIS demonstrates the planning processes used by Monroe County and other municipalities in Monroe County in developing site-specific water quality improvement alternatives. The Corps has used these documents as the foundation for the planning component of the FKWQIP, and the extensive amount of work undertaken by these municipalities has alleviated the need for additional program planning by the Corps as part of the FKWQIP.

A Plan Formulation Memorandum (Memorandum) has been prepared (Appendix C) that summarizes the decision-making process used in each master plan and recommendations made. From these various plans, a Master List of Projects was developed (reference to Appendix D omitted). The following plans were reviewed by the Corps during the development of alternatives presented in this chapter of the PEIS and preparation of the Master List of Projects.

Wastewater

- *Draft Wastewater Facilities Plan with Phased Implementation for the Marathon Area of the Florida Keys* (*Marathon Wastewater Facilities Plan*)
- *Design/Build/Operate Wastewater Management System for the City of Marathon*
- *Monroe County Sanitary Wastewater Master Plan*
- *City of Marathon Reuse Component of Central Wastewater Request for Proposal*
- *City of Key Colony Beach Sewer System Evaluation*
- *Federal Emergency Management Agency (FEMA) Final PEA for Wastewater Management Improvements in the Florida Keys*

Stormwater

- *Stormwater Runoff Study prepared for the City of Key West*
- *City of Key West Water Quality Improvement Program*
- *Islamorada, Village of Islands, Stormwater Management Master Plan*
- *City of Key West Long Range Stormwater Utility Plan*
- *Monroe County Stormwater Management Master Plan*

2.1.2 Summary of Recommendations from Master Plans

Recommendations generated from the various master plans have been summarized in the Monroe County Sanitary Wastewater Master Plan and the Monroe County Stormwater Management Master Plan and are briefly described below.

- Upgrade or replace existing onsite wastewater treatment systems located in lower density areas of the Florida Keys with Onsite Wastewater Nutrient Reduction Systems (OWNRS)
- Install 12 community wastewater collection and treatment systems throughout the Keys
- Install 5 regional wastewater collection and treatment systems
- Continue to operate and upgrade treatment processes for 17 existing facilities to meet best available technology (BAT) or advanced wastewater treatment (AWT) standards, as required, by July 2010
- Rank stormwater issues based on flood severity and potential water quality benefits and apply the best management practice (BMP) to alleviate the situation

The sanitary wastewater master plan further recommended five of the 12 community wastewater collection and treatment systems feature interim wastewater treatment facilities that, over time, would become part of the larger regional systems. Details of the recommendations from the Monroe County Master Plan for each of the three regions of the Florida Keys are presented below.

Lower Keys. In the lower Keys, four new community wastewater systems and two new regional wastewater systems are recommended for construction. The two proposed regional systems are relatively small, in terms of both volume and area, and can be constructed at the actual regional WWTF site. In addition to the new systems or extension of existing systems that are discussed, the master plan recommended that seven existing facilities in the lower Keys continue to operate and upgrade their treatment processes to meet the BAT/AWT standard by July 2010.

Middle Keys. In the middle Keys, two new community wastewater systems and one new regional system are recommended. Other than Duck Key, Conch Key, and Long Key/Layton, all study areas of the middle Keys will continue to operate and upgrade their treatment process to meet the BAT/AWT standard by July 2010. These systems include:

- Hawk's Cay (Hawk's Cay portion of AWT upgrade)
- West end Long Key (three facilities)
- East end Long Key (two facilities)

Upper Keys. In the upper Keys, one new community wastewater system was recommended in Lower Matecumbe, and two new regional systems are recommended. The systems include a 1.5 million gallon per day (mgd) system to serve Islamorada Regional Wastewater Management District and a 2.25 mgd system to serve the Tavernier/Key Largo Regional Wastewater Management District.

2.1.3 Master List of FKWQIP Projects

The first task of the PDT was development of the Master List of Projects. This list is a consolidation of projects from planning and other documents presented, as described in the Memorandum contained in Appendix C, and was updated by each municipality during the fall and winter of 2002. Currently, the FKWQIP project master list has a total of 256 projects in the study area. Stormwater projects total 184 and wastewater projects total 72. A summary of the number and estimated costs of the projects for each government entity, based on quoted costs in the PDT and applicable escalation factors, is provided in Table 2-1. This table represents over $615,909,194 in total FKWQIP projects.

Estimated costs of proposed FKWQIP projects represent a total cost over $615 million without Federal funding.

Table 2-1
Number and Estimated Costs of Priority Projects for each Government Entity

Government Entity	Wastewater Projects		Stormwater Projects		Total	
	Number	Estimated Cost[1]	Number	Estimated Cost[1]	Number	Estimated Cost[1]
Monroe County	34	$ 165,663,213	22	$ 6,332,641	56	$ 165,280,816
Village of Islamorada	7	$ 107,455,090	63	$ 52,069,268	70	$ 132,443,981
City of Key West	8	$ 20,671,000	99	$ 17,404,567	107	$ 38,075,567
City of Key Colony Beach	1	$ 335,000	0	$ -	1	$ 335,000
Key Largo Wastewater Board	14	$ 139,693,435	0	$ -	14	$ 130,001,711
City of Layton	1	$ 4,650,000	0	$ -	1	$ 4,650,000
City of Marathon	7	$ 101,634,979	0	$ -	7	$ 142,233,606
Totals	**72**	**$540,102,717**	**184**	**$ 75,806,476**	**256**	**$615,909,194**

[1] These costs are based solely on information provided in each of the respective plans or studies and have been updated based on information provided by the various PDT members or based on the Engineering News Record Construction Cost Index

2.2 Description of Alternatives

Three alternatives have been proposed for FKWQIP implementation and are described in the following sections.

2.2.1 Alternative 1 (No Action): No Implementation of FKWQIP

Under the *No Action* alternative, the Corps would not provide funds to municipalities of Monroe County for needed improvements or upgrades to wastewater collection and treatment systems or for proposed stormwater management improvements. Communities within the Florida Keys would continue using onsite systems, such as cesspools and septic tanks, to manage wastes.

Under the No Action Alternative, the Corps would not provide funds to municipalities of Monroe County for needed improvements or upgrades to wastewater collection and treatment systems or for proposed stormwater management improvements.

Reliance on individual and privately owned cluster or package treatment facilities would continue under the *No Action* alternative. Individual property owners and businesses would be responsible for meeting the defined level of service standards prescribed by county ordinance or state regulation. Public entities would not own or operate any of the proposed wastewater treatment facilities. Under the *No Action* alternative, Monroe County residents would not receive the benefits of financial and program management assistance that would otherwise be provided by the federal government.

2.2.2 Alternative 2 (Proposed Action): Provide Federal Funding Assistance to Implement FKWQIP

Under Alternative 2, priority projects would be implemented as an integrated, area-wide water quality improvement program as federal monies are made available. Alternative 2 would accomplish the goals listed below.

- Objectives of the Florida Keys Water Quality Improvements Act would be met.
- Individual water quality improvement projects that address regional water quality issues, based on need, design constraints, available technology, and funding would occur.
- Nutrient loadings reductions and commensurate improvement in water quality throughout the Sanctuary would be achieved.
- Compliance with federal and state regulatory water quality treatment standards would be achieved in a timely manner.

Under Alternative 2, priority projects would be implemented as an integrated, area-wide water quality improvement program as federal monies are made available and state and federal water quality improvement objectives would be addressed.

Alternative 2 includes implementation of priority projects from the master project list described previously in addition to other actions described here. First, the master list of water quality improvement projects developed by local municipalities would undergo further evaluation by the PDT. Greater detail regarding the roles and responsibilities of project applicants with respect to design, construction, maintenance, and operation activities would be outlined in Project Cooperation Agreements between the Corps and the non-federal sponsor.

Second, several water quality improvement projects would be implemented. The master project list addresses five principal components, as outlined in the Monroe County Sanitary Wastewater Master Plan and listed below.

- Upgrade or replace outdated onsite systems with advanced wastewater treatment package units in areas identified as non-polluting that are generally located in less populated areas of the Keys.
- Implement central community wastewater collection and treatment system service areas in the more densely developed and highest ranked water quality *hot spot* areas (Section 2.2.2.2 below) where analyses indicate central sewer systems are more cost effective and environmentally sound.
- Consolidate community treatment systems into larger facilities when numbers of systems and customers in the upper and middle Keys increase beyond a level of economic feasibility.
- Phase implementation of smaller regional systems in the lower Keys and construct the treatment facilities at the proposed regional sites, so that interim community treatment systems are not necessary.
- Convert five of the 12 interim community wastewater treatment facilities into larger regional systems over time.

2.2.2.1 Water Quality Improvement Actions

Actions that would occur under Alternative 2 include new construction of community and regional WWTFs following an evaluation of the location, design, and construction methods planned. Central sewers would eliminate a high number of declining and inadequate onsite wastewater treatment methods, such as septic tanks and cesspools. Community WWTFs in the lower Keys would likely remain independent, while consolidation of community plants in the upper and middle Keys would occur steadily over time as populations increased. All proposed regional WWTFs would be designed to accommodate higher quantities of wastewater volume as required. Capacity expansions to existing WWTFs as well as treatment level upgrades would also be required under this alternative (Monroe County 2000).

Actions that would occur under Alternative 2 include new construction of community and regional WWTFs following an evaluation of the location, design, and construction methods planned.

As part of implementing priority projects from the master project list, individual projects were evaluated regarding their suitability as a treatment method in the Keys. The projects were

evaluated as four broad categories: solid waste disposal, wastewater collection, wastewater effluent disposal methods and stormwater management systems.

Solid Waste Disposal. Under Alternative 2, existing disposal practices used for solid waste products such as sludge and septic waste would continue in the Keys. Wastewater sludge and septic waste generated in the Keys are currently transferred to facilities at Cudjoe Key, Long Key, or Key Largo and then the sludge is transported to a regional wastewater treatment facility in Miami-Dade County for treatment. Partially stabilized secondary solids are dewatered at the Key West WWTF and transported privately to a location near Okeechobee, Florida, where they are applied to agricultural lands on the same day to meet FDEP vector attraction reduction requirements.

Treatment facilities with capacities less than 100,000 gallons per day (gpd) would provide temporary storage for decanted sludge in an aerated tank and the liquid sludge would be transported to the Monroe County Solid Waste Transfer Station. Facilities with capacities of 100,000 gpd or more would undergo filtration and dewatering, followed by Class B lime stabilization and transported for offsite agricultural land application.

Wastewater Collection. Wastewater collection alternatives evaluated for suitability throughout the Florida Keys are listed below.

- Conventional gravity sewers
- Simplified gravity sewers
- Smaller diameter gravity sewers
- Septic effluent pump systems (centrifugal and progressive cavity grinder pumps)
- Vacuum sewers

Conventional gravity systems offer the advantage of widely accepted technology, low energy requirements, and generally low operation and maintenance costs. However, as the number of manholes and lift stations increase, operation and maintenance costs and odor control problems increase. There are also potential problems with infiltration and inflow from stormwater runoff and high groundwater entering pipes and manholes.

The systems determined to be most suitable for the Florida Keys are the septic effluent grinder pump system and the vacuum sewers. The primary advantage of these systems is that they do not rely on gravity and can follow land topography. Generally speaking, vacuum collection is the lowest cost alternative for serving the entire study area, particularly when the number of equivalent dwelling units (EDUs) being collected is more than 350. The advantages of vacuum sewers are listed below.

- No electrical power is required at each home or vacuum valve.
- Wastewater collection service is maintained during short-term or long-term utility power outages. A standby generator that will automatically generate power if there is a loss of utility power will be provided at each vacuum station.

- Air drawn into the vacuum system with the sewage will help keep the sewage oxidized, thus reducing odors.

Wastewater Effluent Disposal Methods. Legislation mandating the elimination of new and existing effluent discharges to surface waters in Monroe County by July 1, 2006 was passed in 1999. This legislation allows effluent reuse systems, but requires the use of underground injection for effluent disposal, as described below.

Shallow Injection Wells. If the design capacity of the facility is less than 1 mgd, the well must be at least 90 feet deep and cased to a minimum depth of 60 feet.

Deep Injection Wells. If the design capacity of the facility is greater than or equal to one mgd, the well must be cased to a minimum depth of 2,100 feet.

Water Reuse. The Monroe County Master Plan recommended limited use or reliance on effluent reuse and cited the drawbacks outlined here.

Land application requires full storage or backup disposal systems whenever treatment requirements are not achieved, or when the land application site cannot take reclaimed effluent. This includes extended periods of wet weather.

Relatively large tracts of land are required to accommodate the effluent being disposed. Such tracts may be distant from the plant site, causing high transmission conveyance costs.

Stormwater Management Systems. Based on the stormwater master plans prepared for Monroe County, there are two general types of stormwater concerns in the Florida Keys: water quality and nuisance flooding. To address these concerns the various stormwater master plans have ranked proposed projects based on criteria such as flood severity, potential water quality benefits to be gained by project implementation, and projected growth to determine the future population that would benefit from the project. Once projects have been ranked, the best management practices would be selected for each problem area.

2.2.2.2 Priorities and Allocations of Federal Funds

The FKWQIP PDT was responsible for developing a ranking system by which to assign priority to individual projects and produce a master project list. An approach for allocation of funds among the various municipalities was developed based on individual need relative to other municipalities. Although actual funding will depend on appropriations made by Congress, up to $100 million have been authorized for the FKWQIP by enacted legislation. The master project list will be reevaluated on an annual basis and priority will be reassigned, based on existing priority rank, available funding, and readiness to proceed.

Although actual funding will depend on appropriations made by Congress, up to $100 million have been authorized for the FKWQIP by enacted legislation.

The enabling legislation for the FKWQIP states that "In selecting projects under subsection (a), the Secretary shall consider whether a project will have substantial water quality benefits relative to other projects under consideration." A priority system has been developed to accomplish this objective and one of the criteria is to ensure that federally funded projects are located within one of the water quality *hot spots* delineated by the EPA, as described below.

The EPA Oceans and Coastal Protection Divisions (July 1992) produced a report entitled *Water Quality Protection Program for the Florida Keys National Marine Sanctuary: Phase 1 Report*, which listed 84 water quality *hot spots*. These are areas that have been identified as sites of known or suspected water quality degradation, based on workshops and discussion groups. The list was later increased to include 88 *hot spots* (March 1996) based on wastewater issues. The document *Water Quality 'Hot Spots' in the Florida Keys: Evaluations for Stormwater Contributions* (Monroe County July 1999) defined the most probable stormwater-influenced problem areas.

A priority system has been developed to rank FKWQIP projects and one of the criteria is to ensure that federally funded projects are located within one of the water quality hot spots delineated by the EPA.

The following criteria were used in assigning priority to projects for inclusion in the FKWQIP master list and to address the enabling legislation described earlier.

Wastewater Project Priority Criteria. Elimination of previously unidentified cesspools and other sources of pollutants into the Sanctuary, and annual cost per pound of nitrogen or phosphorus removed, were considered as priority criteria. Parameters other than cesspool elimination were considered of secondary importance in improving water quality in canals and nearshore waters. Consequently, annual costs of eliminating a previously unidentified cesspools was used as the principal criteria for determining the need for a community wastewater collection and treatment system and for establishing and ranking water quality *hot spot* areas.

Stormwater Project Priority Criteria. Stormwater priorities were assigned to each project using a criterion similar to that used for wastewater. As a result, the highest priority concern was water quality protection and improvement.

Allocation of Available Funding Criteria. The development of an approach for the allocation of program monies among the various municipalities of Monroe County was performed by the Monroe County Intergovernmental Task Force (IGTF), which includes representatives from each of the municipal governments in the Keys. Their intent is to provide a consistent approach to improving water quality, encourage implementation of wastewater treatment and stormwater management projects, and ensure progress toward improving water quality in the Florida Keys.

The IGTF developed a *Distribution Formula* for allocating the $100 million to be appropriated by Congress for FKWQIP implementation. The distribution formula documents the agreed allocation of the funds and includes the provisions listed below.

Provision 1: All priority projects should be considered for any appropriated funding until the committed funding levels are reached, as long as all priority projects are considered "ready to proceed" in the fiscal year in which the appropriation is made.

Provision 2: Readiness to proceed will be based on the "Readiness to Proceed" document developed by the IGTF (Appendix E).

Upon receiving appropriations, the PDT will review the "readiness to proceed" status of each priority project. If the funding is too small to be divided according to provisions described above such that "substantial progress can be made," the PDT will propose an implementation strategy for a project for which "substantial progress" can be made.

Readiness to Proceed Criteria. The Readiness to Proceed Criteria (June 22, 2001) were prepared to "define when a recipient is eligible to receive a percentage of their share of any federal or state appropriation for wastewater and stormwater improvements authorized under the Florida Keys Water Quality Improvements Act of 2001."

Readiness to proceed occurs when all planning (including the selection of sites and wastewater/stormwater systems to be implemented, reclaimed water evaluation, and financing) are complete. This means that sites are established as available for the intended purposes, public participation is documented, and construction (design/build/operate or design/build) or a construction contract is either executed or authorized for execution by the project sponsor's governing body.

Further definitions of these criteria were undertaken for application to the FKWQIP and include requirements for project site identification and availability, engineering, planning documentation, financial planning, connection and pretreatment ordinances, user charge fees, and public participation. Acceptance of any federal grant funds shall not be contingent upon the receipt of additional federal/state funds in subsequent appropriations. A revised Readiness to Proceed Criteria document was drafted by a sub-committee of the PDT and distributed for comment on December 6, 2002. Substantial changes were made for project financing, contracting, and receipt of bids, and the deadline for demonstrating readiness to proceed was eliminated. Based on these revised criteria, a point system was developed for use by the PDT to determine the rank of each project in terms of *readiness to proceed* (Appendix E).

Initial Projects. Based on the priority and funding allocation described above, the PDT developed a listing of initial projects to receive federal funding (Table 2-2). This list is preliminary and will be updated as funds are made available and circumstances change with regard to the *readiness to proceed* of other projects.

2.2.3 Alternative 3: Pursue Alternative Funding Sources for Implementing Water Quality Improvements in the Florida Keys

Alternative 3 would require that alternative funding sources be pursued to implement the projects contained within each of the master plans (Appendix C). This alternative is not within the jurisdiction of the federal government and no monies would be obtained from federal sources.

Consequently, projects would be implemented by local municipalities based on available funding and would not be part of an area-wide water quality improvement plan. The assumption made for this alternative is that water quality improvement projects would likely be limited to smaller facilities completed as funding becomes available. Emphasis on smaller and/or fewer projects is anticipated to result in potential delays of two to three years.

Under Alternative 3, alternative funding sources would be pursued to implement the projects continued within the master list of projects.

In addition, larger capacity (100,000 gpd or greater) wastewater treatment systems are required by state law to meet more stringent effluent water quality criteria requirements than smaller facilities. Therefore, under Alternative 3, net mass nutrient loadings to the Sanctuary would be higher as smaller treatment facilities would likely be constructed as opposed to larger regional facilities.

Briefly, the overall effects of implementing Alternative 3 are presented below.

- Goals of the Florida Keys Water Quality Improvements Act may not be achieved.
- Water quality improvement projects may be implemented in a fragmented manner rather than integrated with other projects as part of an area-wide effort.
- Nutrient loadings may increase due to the construction of smaller treatment facilities with less stringent treatment requirements.
- Current nutrient loadings and declines in water quality in nearshore and other waters of the Keys would continue until alternative funding sources are made available for water quality improvement projects.
- Attainment of federal and state regulatory water quality standards in the Sanctuary may be delayed until additional funding is available for water quality improvement projects.

Table 2-2
Florida Keys Water Quality Improvement Program Priority Project List

Entity	Project Priority	Project Name	Project Type SW/WW	Hot Spot Area?	Readiness (Out of 20)	Projected Cost of Top Priority Projects	Potential Allowance from Federal Funding	Local Match to Federal Funds	Total in FKWQIP	Other Local Match Required
Key West	1	Stormwater Projects 1-89	SW		20	$ 15,964,567	$ 10,320,000	$ 5,556,923	$ 15,876,923	$ 87,644
Subtotal Key West						**$ 15,964,567**	**$ 10,320,000**	**$ 5,556,923**	**$ 15,876,923**	**$ 87,644**
Layton	1	Long Key Estates, City of Layton, area adjacent to US1	WW	Y	11	$ 4,650,000	$ 800,000	$ 430,769	$ 1,230,769	$ 3,419,231
Subtotal Layton						**$ 4,650,000**	**$ 800,000**	**$ 430,769**	**$ 1,230,769**	**$ 3,419,231**
Key Colony Beach	1	City of Key Colony Beach Sanitary Sewer Rehabilitation	WW		20	$ 335,000	$ 200,000	$ 107,692	$ 307,692	$ 27,308
Subtotal Key Colony Beach						**$ 335,000**	**$ 200,000**	**$ 107,692**	**$ 307,692**	**$ 27,308**
Marathon	1	Phase 1 - Little Venice	WW	Y	20	$ 11,500,000	$ -	$ -	$ -	$ 11,500,000
	2	Phase 2 – AWT Plant I and Fat Deer Key Basin	WW	Y	20	$ 24,200,000	$ 9,860,000	$ 5,309,231	$ 15,169,231	$ 9,030,769
	3	Phase 3 – Vaca Key Basin	WW	Y	20	$ 11,400,000	$ 4,500,000	$ 2,423,077	$ 6,923,077	$ 4,476,923
	4	Phase 4 – AWT Plant II and Stirrup Key	WW	Y	20	$ 21,400,000	$ 8,500,000	$ 4,576,923	$ 13,076,923	$ 8,323,077
	5	Phase 5 – Remainder of Little Venice Area	WW	Y	20	$ 5,700,000	$ 2,300,000	$ 1,238,462	$ 3,538,462	$ 2,161,538
	6	Phase 6 – Boot Key and Vaca Key Harbor	WW	Y	20	$ 8,500,000	$ 3,300,000	$ 1,776,923	$ 5,076,923	$ 3,423,077
	7	Phase 7 – Crawl Key and Grassy Key	WW	Y	20	$ 2,900,000	$ 1,100,000	$ 592,308	$ 1,692,308	$ 1,207,692
Subtotal Marathon						**$ 74,100,000**	**$ 29,560,000**	**$ 15,916,923**	**$ 45,476,923**	**$ 28,623,077**
Islamorada	1	Plantation Key Colony Phase I	WW	Y	20	$ 10,125,000	$ -	$ -	$ -	$ 10,125,000
	2	Plantation Key Colony Phase IA	WW	Y	20	$ 525,817	$ 341,781	$ 184,036	$ 525,817	$ 0
	3	Plantation Key Colony Phase II	WW	Y	20	$ 10,791,982	$ 7,014,788	$ 3,777,194	$ 10,791,982	$ 0
	4	Plantation Key Remainder	WW	Y	10	$ 41,599,546	$ 22,203,431	$ 11,955,694	$ 34,159,125	$ 7,440,421
Subtotal Islamorada						**$ 63,042,345**	**$ 29,560,000**	**$ 15,916,923**	**$ 45,476,923**	**$ 17,565,422**
Key Largo	1	PAED 19/20 - Tavernier KL Regional	WW	Y	20	$ 11,759,286	$ -	$ -	$ -	$ 11,759,286
	2	PAED 18 - KL Trailer Village, Ect	WW	Y	20	$ 8,400,000	$ -	$ -	$ -	$ 8,400,000
	3	PAED 18 - Cross Key Waterway Estates, Etc.	WW	Y	4	$ 10,369,553	$ 6,740,209	$ 3,629,344	$ 10,369,553	$ -
	4	PAED 16 / Area A	WW	Y	4	$ 1,881,052	$ 1,222,684	$ 658,368	$ 1,881,052	$ -
	5	PAED 15 - Harris Ocean Park	WW	Y	4	$ 9,686,853	$ 6,296,454	$ 3,390,399	$ 9,686,853	$ -

Entity	Project Priority	Project Name	Project Type SW/WW	Hot Spot Area?	Readiness (Out of 20)	Projected Cost of Top Priority Projects	Potential Allowance from Federal Funding	Local Match to Federal Funds	Total in FKWQIP	Other Local Match Required
	6	PAED 19/20 - Remainder of PAED 19/20	WW	Y	4	$ 28,880,339	$ 15,300,652	$ 8,238,813	$ 23,539,465	$ 5,340,874
Subtotal Key Largo						**$ 70,977,083**	**$ 29,560,000**	**$ 15,916,923**	**$ 45,476,923**	**$ 25,500,160**
Totals						**$ 229,068,995**	**$ 100,000,000**	**$ 53,846,154**	**$ 153,846,154**	**$ 75,222,841**

2.3 Comparison of Alternatives

The alternatives examined as part of this PEIS were premised on the need to implement water quality improvement projects that will reduce nutrient loading and result in commensurate improvement in water quality in the Sanctuary. Environmental consequences of physical, biological, and human issues are presented in comparative form in Table 2-3 and are described in more detail in *Section 4.0 Environmental Consequences.*

2.4 Preferred Alternative

The preferred alternative is Alternative 2, the *Proposed Action*. Under this alternative, federal funding would be provided to improve the water quality of the Sanctuary by reducing nearshore nutrient loading throughout the Keys. This would be accomplished by implementing a coordinated program of wastewater and stormwater improvement projects with public municipalities of the Florida Keys.

Under the Proposed Action, federal funding would be provided to improve the water quality of the Sanctuary by reducing nearshore nutrient loading throughout the Keys.

2.5 Summary of Mitigation Requirements for FKWQIP

Unavoidable impacts may occur as a result of the proposed action and will require consideration of mitigation measures. Because of the programmatic nature of this document, it is difficult to specify the exact nature of mitigation that might be implemented for an individual project. Mitigation measures for individual projects will be addressed in supplemental NEPA documentation and in consultation with appropriate state and federal agencies. Proposed mitigation measures at the programmatic level are discussed below.

Biological Resources. Mitigation measures for the project would most likely be associated with any loss of sensitive resources, such as habitat for protected species, which may occur as a result of land requirements for facility construction. The first step in mitigation process would be to take every action possible to reduce the size of the land required for projects that may include sensitive ecological habitat. Minimization of adverse impacts to sensitive natural resources would occur in consultation with appropriate federal and state agencies for each individual project.

Cultural Resources. During environmental assessments for individual projects Phase I surveys will be conducted to minimize potential impact to cultural resources. However, some mitigation could be required in the unlikely event that archaeological or historical resources are discovered during construction activities (e.g. construction of sewer systems along a linear corridor or new pump station). In this case, appropriate steps will be taken in accordance with applicable federal and state laws and in cooperation with the State Historic Preservation Office.

Mitigation measures for individual projects will be addressed in supplemental NEPA documentation and in consultation with appropriate state and federal agencies.

Environmental Justice. Executive Order 12898 directs federal agencies to provide for participation by minorities and low income populations in the federal decision making process, and further directs agencies to fully disclose any adverse effects of plans and proposals on minority and low-income populations. Over 25 percent of the population of the Keys is made up of individuals regarded as either low income or over 65 years of age, some of whom live on a fixed income. Because many of the standard measures of affordability are based on median income, the abilities of those least able to afford the capital costs associated with the installation of an onsite wastewater treatment unit or connecting to a new public sewer system and paying monthly service charges may not be adequately considered in developing connection fees or service charges. Three potential approaches that local municipalities may select to address this issue are presented below as outlined in the FEMA PEA (FEMA 2003):

(1) Subsidize Connection Fees. Subsidize the cost of connection for low-income or fixed-income residents. The principal issue associated with providing subsidies for this group of residents is the source of funding, which could be provided by the sewer utility, lead federal agency, the state sponsor, or local government property tax revenues. In each case the potential for funding would have to be evaluated.

(2) Subsidize Cost of Sewer Service. Subsidize the recurring cost of sewer service. Again, the principal issue would be the source of funding. A major difference between funding requirements for subsidizing connection charges and recurring charges is the continuing nature of the recurring charges.

(3) Rate Structure Based on Water Volume Use. Service fees based on the volume of water actually used. Such a rate structure would include a very low base charge for the first 3,000 gallons of water use per month, with a sharply increasing charge for greater volumes of water use.

Table 2-3
Comparison of Environmental Consequences for FKWQIP Alternatives

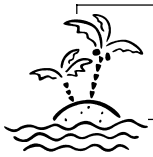
Alternative		Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Alternative Funding
Issue		No implementation of stormwater and wastewater improvements in the Keys. Pollutant inputs to the Sanctuary would continue.	Integrated, centrally managed, implementation of area-wide storm and wastewater improvement projects in the Florida Keys. Pollutant inputs to the Sanctuary would be reduced and water quality improved.	Pursue other funding to implement water quality improvements. Projects would be smaller and fragmented in terms of time (2-3 years) and area. Improvements may occur more slowly.
Physical Environment				
Soils		Continued adverse impacts of contamination of soils due to inputs from untreated waste- and stormwater.	Reduced storm and wastewater surface discharges and commensurate reduction in pollutants entering soils.	Delayed and smaller reductions in pollutant inputs into soils may be anticipated.
Aquifers	Biscayne	Continued contamination due to seepage of untreated waste and stormwater.	Reduced seepage of contaminants into aquifer due to decreased quantities of untreated waste- and stormwater.	Similar to Alternative 2 except benefits could be delayed and/or reduced due to fragmented implementation process.
	Floridan	No adverse impacts due to confined nature of this aquifer.	Increases in deep well injections may occur, although no impacts anticipated due to confined nature of aquifer.	
Water Resources		Continued adverse impacts of altered flow regimes due to untreated waste and stormwater discharge volumes into nearshore waters and approx. 700 canals.	Improved flow regimes due to decrease in runoff and discharge volumes entering nearshore waters and canals.	Similar to Alternative 2 except that altered flows may continue until implementation is complete.
Water Quality	Nearshore Waters and Canals	Continued degradation of water quality in nearshore waters and approximately 700 canals due to nutrient inputs from untreated waste and stormwater.	No adverse impacts anticipated. Benefits to nearshore waters and canals include decreased waste and stormwater discharges and improved water quality.	Continued degradation of water quality until funding is obtained to implement priority projects.
	Centralized Sewer	Elimination of cesspools and associated nutrient and contaminants. The goal of eliminating cesspools will progress at a slow pace.	Construction of centralized sewers as part of the FKWQIP will expedite the removal of cesspools and associated pollutants in pollutant *hot spots* throughout the Keys.	Construction of sewers will be less effective due to fragmented approach to implementation. Delays in construction are also anticipated.
	Effluent Disposal	Effluent disposal practices will essentially remain the same.	Larger WWTFs would result in more deep well injection of treated water, reducing effluent discharged to the Sanctuary.	Fewer and smaller WWTFs would not be centrally managed and may rely more on shallow injection wells.
Air Quality		Continued odors associated with existing or new individual or cluster treatment facilities, cesspits and septic tanks.	Temporary, minor adverse impacts are anticipated due to construction activities. WWTFs construction would impact primarily industry areas. An air permit would be required for a sludge incinerator as part of a WWTF or an auxiliary generator operating over 25 percent of the time.	Air quality impacts would be reduced due to construction of fewer WWTFs. However, more of the existing cesspits and septic tanks would remain and reductions in odors would be less when compared with Alternative 2.

Alternative	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Alternative Funding
Biological Environment			
Habitats, Fish and Wildlife Resources	Continued nutrient and sediment inputs may alter soils/habitat and species distributions. Contaminants would adversely impact vegetation and wildlife, through food chain transfer, toxins, and bioaccumulation. Phosphorus additions may benefit mangrove.	Net environmental benefits anticipated. Quality habitat may be adversely impacted due to land required for facilities development. However, decreased algal blooms, improved water clarity and light penetration would benefit seagrasses and corals. Individual projects would be evaluated to ensure regulatory protections and compliance.	Conditions described for Alternative 1 would continue until water quality improvements are implemented. Delays and smaller scale projects anticipated under this alternative may result in similar, but less expansive benefits, when compared with those for Alternative 2.
Protected Species	Protected species could be adversely impacted due to continued habitat degradation directly related to unregulated and regulated cesspools and septic tanks, and subsequent nutrient and other pollutant inputs into the nearshore coastal waters.	Minimal adverse impacts are anticipated, primarily due to land required for treatment facilities. ESA Section 7 consultation with USFWS/ NMFS and FFWCC for state protected species would occur as required for each project. USFWS/ NMFS support AWT and have listed areas to be avoided to provide protection.	As a result of delays, water quality degradation and potential subsequent adverse affects as described under Alternative 1 (No Action) would continue until water quality improvement projects are implemented
Essential Fish Habitat	Continuing pollutant discharges could adversely impact federally designated EFH due to direct or indirect discharges of inadequately treated wastewater and stormwater into canals and nearshore waters.	Anticipated reductions in nutrient loadings and discharge volumes would improve nearshore water quality and habitats, directly benefiting EFH. NMFS supports development of AWT.	As a result of the delays under this alternative, potential adverse impacts to EFH are anticipated as described under the No Action alternative, until water quality improvement projects are implemented.
Coastal Barrier Resources	Continued pollutant inputs and water quality degradation would adversely impact benthics, corals, and seagrasses	No adverse impacts anticipated. Benefits include improved water quality and improvements in associated benthic, coral, and seagrass habitats	Anticipated delays would allow for continued nearshore water quality degradation with potential adverse effects as described under the No Action alternative.
Human Environment			
Cultural Resources	No treatment facilities, stormwater ponds or transmission pipelines would be constructed, so unidentified cultural resources would not be impacted.	Construction of the proposed facilities may impact undocumented, buried archaeological and historical resources and detract from visual interest of historic resources by intruding on the viewshed. Coordination with SHPO, and compliance with Section 106 of the NHPA will be required.	Construction of the proposed facilities may impact undocumented, buried archaeological and historical resources and detract from visual interest of historic resources by intruding on the viewshed. Coordination with SHPO, and compliance with Section 106 of the NHPA will be required.
Demographics	Constrained growth in land development and population.	Growth in land development and population is anticipated to occur at a modest pace. Moderate growth expected for waste- and storm-water improvements for current residents as well.	Constrained growth in land development and population.
Tourism	Beach health advisories due to poor water quality would continue, adversely affecting immediate recreational and tourist opportunities, although tourism is not expected to be negatively impacted.	Improved water quality would decrease the incidence of beach advisories and closings, thereby increasing the opportunity for saltwater-based recreation. The only adverse impact would be temporary transportation delays due to construction activities.	Some growth in tourism anticipated due to improved nearshore water quality could be expected, however, at a slower pace as compared with Alternative 2.

Alternative	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Alternative Funding
Existing Wastewater Management Costs	Existing wastewater management costs will remain the same.	Increased cost of utility services would result due to considerable connection charges and monthly fees. Impacts would be greatest for low-income households. Potential mitigation measures would include low-cost financing for connection charges and subsidies for recurring wastewater service fees.	Cost of wastewater management would increase at a slower pace as compared with Alternative 2.
Public Health	Potential decrease in public health conditions due to a decline in water quality from higher levels of bacteria.	Reduced incidence of water borne disease, and health advisories and beach closings related to waste- and storm- water discharges.	Similar to Alternative 2, except beach health advisories and closings would continue until water treatment is implemented.
Infrastructure	Stormwater can be accommodated with onsite improvements, so existing lands and future land development would not be adversely impacted.	Regional treatment facilities would provide infrastructure necessary for future land use development. Minor temporary impacts to traffic could occur due to heavy trucks accessing the construction site.	Delayed infrastructure improvements.
Land Use and Planning	No affect on existing land uses would be anticipated. However, future land use would be delayed/ limited to developments with approved on-site wastewater facilities.	No adverse impact on existing land use except the construction of treatment facilities in vacant or other areas. Future land use may be affected due to available facilities and concurrency with comprehensive plans.	The impacts of Alternative 3 on land use would be similar to those of Alternative 2, occurring slower and possibly at a lower level.
Facility Siting	No land areas required implementing displacement of residents or invasion of sensitive habitat will not occur.	Facility land requirements may displace existing residents and encroach on sensitive lands and protected species.	Similar to Alternative 2 except will occur over time in smaller parcels of land.
Environmental Justice	Low-income households struggle with the cost of meeting 2010 mandates for wastewater treatment.	Possible disproportionate impact to low-income residents due to facility sitings in minority or low-income neighborhoods. Increased cost of treatment services is not expected to be disproportionate. Low-income households would have difficulty paying for wastewater and stormwater management improvements.	Possible disproportionate impact to low-income residents due to facility sitings in minority or low-income neighborhoods. Increased cost of treatment services is not expected to be disproportionate. Low-income households would have difficulty paying for wastewater and stormwater management improvements.
Regulatory	Florida Statutory Treatment Standards of 2010 would not be met.	Florida Statutory Treatment Standards mandated for 2010 compliance would likely be met.	Difficult for Monroe County to meet the treatment standards mandated by Florida Statue.

3.0 Affected Environment

The affected environment represents the baseline environmental conditions of the area for which the Florida Keys Water Quality Improvements Program (FKWQIP) is proposed. As described previously, the study area includes the Florida Keys and surrounding waters, including the Florida Keys National Marine Sanctuary (Sanctuary). This chapter describes the environmental components (resources) of the study area that may be affected by program alternatives under consideration and the context in which potential impacts will later be evaluated in *Chapter 4, Environmental Consequences*.



This chapter describes the environmental resources of the study area and provides a current baseline against which comparisons of alternatives discussed in Chapter 4, Environmental Consequences, can be compared.

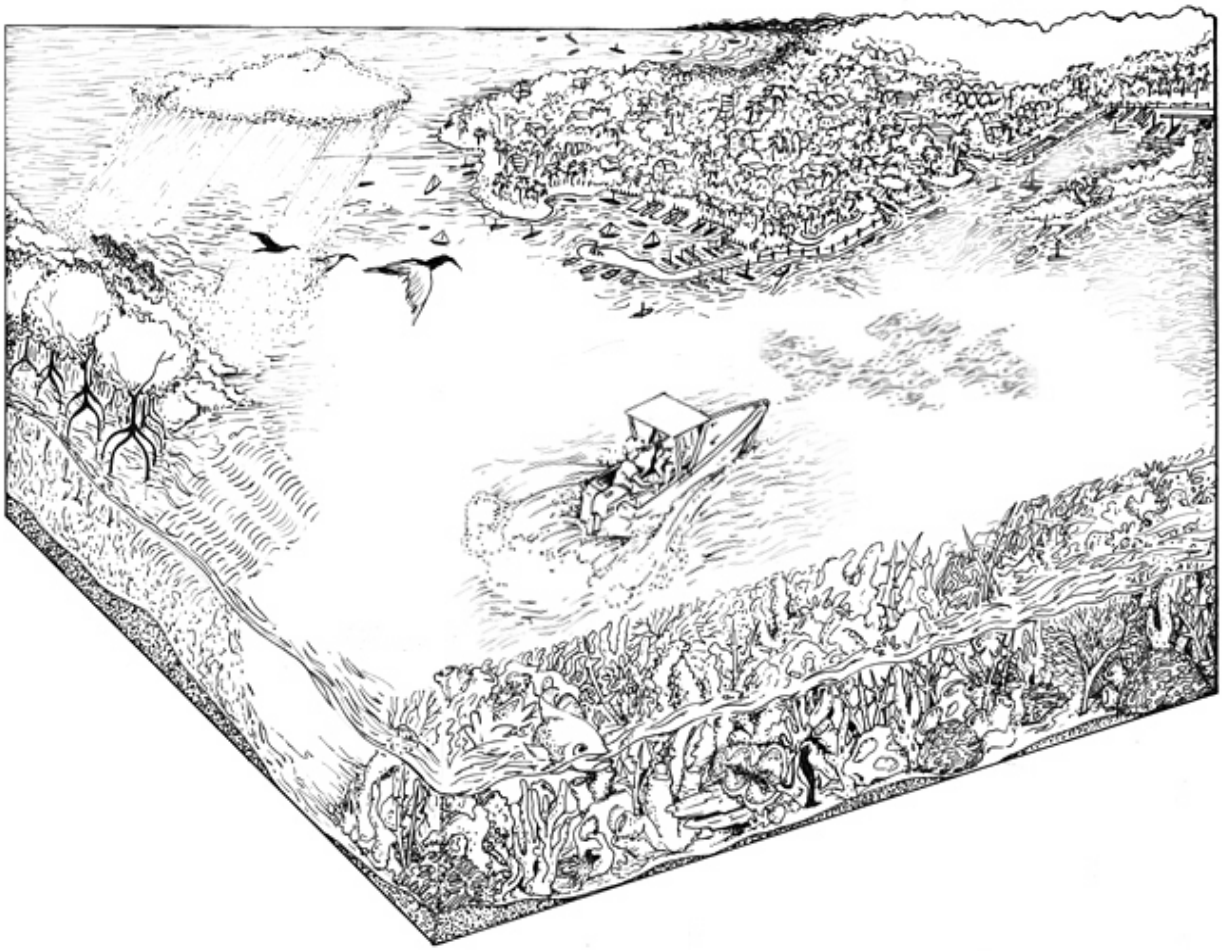
✓	✓	✓	✓	✓	✓

This chapter is organized into physical, biological, and human environmental resources, respectively (Figure 3-1), following Corps guidance for the preparation of an EIS. It is further organized to emphasize resources that may be affected by implementation of the alternatives, commensurate with the severity of the potential impact. For example, while global or regional conditions such as climate will not be affected by the alternatives under consideration, impacts to resource components such as water quality and protected species are anticipated during the implementation of specific projects. Because this is a *programmatic* EIS, environmental resources have been addressed in sufficient detail to *tier-off* into supplemental environmental documentation.

A matrix of the significant relationships among relevant issues identified during the NEPA scoping process (from Chapter 1) and environmental resources discussed in this chapter are presented in Table 3-1. Issues that emerged during initial scoping meetings and communications with regulatory agencies and stakeholders are listed in order of relative importance. The reader should note that some issues (e.g. Issue 4: Effluent Disposal) apply to relatively few environmental resources, while others (e.g. Issue 2: Facility Siting) apply to most, if not all, of the environmental resources listed.

Because of the broad, programmatic nature of this EIS, text boxes are inserted in each section of this chapter to emphasize major points of interest. Palm trees are used to designate text boxes which briefly describe the major focus of each section. In addition, symbols representing the six scoping issues addressed in this chapter appear as “tabs” attached to each text box identifying relevant concerns. Other text boxes emphasize factual information.

Figure 3-1
Inter-relationships of Human and Natural Environments in the FKWQIP Study Area



"The FKWQIP is intended to alleviate stormwater and wastewater impacts in the Sanctuary, which includes the nation's largest living coral reef."

Table 3-1
Relationship between Scoping Issues and Environmental Resources

Section	Affected Environment	Scoping Issues					
		1. Water Quality	2. Facility Siting	3. Protected Species	4. Effluent Disposal	5. Tourism	6. Environmental Justice
3.1	Climate						
3.2	Topography, Geology and Soils	✓	✓		✓	✓	
3.3	Water Resources	✓	✓	✓	✓	✓	
3.4	Water Quality	✓	✓	✓	✓	✓	
3.5	Ecological Habitats	✓	✓	✓		✓	
3.6	Protected Species	✓	✓	✓		✓	
3.7	Essential Fish Habitat	✓	✓	✓		✓	
3.8	Air Quality and Noise		✓				
3.9	Cultural Resources		✓				
3.10	Demographics and Socioeconomics	✓	✓			✓	✓
3.11	Recreation	✓	✓	✓		✓	
3.12	Open Space and Aesthetic Resources	✓	✓	✓		✓	
3.13	Environmental Justice		✓			✓	✓
3.14	Land Use and Planning	✓	✓	✓	✓	✓	✓
3.15	Infrastructure		✓				
3.16	Hazardous Materials and Waste		✓				

3.1 Climate

Geographically, the Keys are subtropical and are located above the Tropic of Cancer; however, the influences of the Gulf currents make it more similar to tropical settings. As a result, species diversity is high, and a combination of temperate species such as live oak (*Quercus virginiana*), as well as tropical species, including gumbo limbo, royal palms (*Roystonea elata*), tree orchids, and airplants occur in the Keys that are West Indian in origin, rather than North American. These species were carried from the West Indies by winds, waves, and migrating birds. About 70 percent of the 700 native plant species in the Keys are of tropical origin (Ferren 2003).

While global and regional climate conditions strongly influence the physical environment that supports biological and human activities, climate conditions will not be impacted by project alternatives.

While global and regional climate conditions strongly influence the physical environment that supports biological and human activities, climate conditions will not be impacted by any of the project alternatives. This section is presented to provide the setting for subsequent sections.

Climatic cycles affect ecosystems because of changes in temperature, precipitation, and drought events (Luce *et al*. 1995). In addition, climatic events such as global warming and sea level rise, and more localized events such as hurricanes, have historically had enormous impacts on coral reefs and human populations. Implications to Florida environments are noted by the World Wildlife Fund (2003), who assert that "global warming and subsequent precipitation changes will have major consequences for vegetation in Florida, and changes in sea surface temperatures pose a major threat to coral reefs and other marine systems."

The Keys receive more direct sunlight than any other area in Florida and the weather in the Keys is related to the tropical maritime air associated with the Bermuda/Azores high-pressure system. Wind direction and speed, temperature, and precipitation are affected by the interaction of this high-pressure system with other pressure systems. During the summer, east-southeast winds prevail, while during the winter east-northeast winds dominate, with northwest winds occurring infrequently during the passage of cold fronts (UMRSMAS 2001-2003).

As a result of these conditions, the Keys are characterized by a sub-tropical maritime climate with moderate temperatures, where the four seasons characteristic of more northern climates are reduced to two long seasons. The summer wet season (June to October) is marked by numerous thunderstorms, while winter (November to May) features dry conditions and infrequent, fast-moving cold fronts (30-40 each year). Convective storms and low-pressure systems in the form of tropical storms and hurricanes are also important climate components in the Keys (Chen and Gerber 1990). Common weather characteristics in the Keys are summarized in Table 3-2.

Table 3-2
Common Weather Related Parameters and Values for the Florida Keys

Weather variable	Value	Likely Occurrence
Average annual max/min temperature	82°/73°F	N/A
Highest normal daily maximum temperature	90°F	July-August
Lowest normal daily minimum temperature	66°F	February
Average annual humidity	75%	N/A
Average annual rainfall	40 inches	May - October
Probability of hurricane	13-16%	June - November

Data from Florida Keys and Key West - Weather and Climate (date unavailable), Chen and Gerber (1990).

Temperature and Humidity. Temperatures in the Keys are moderated primarily by the Gulf Stream, the prevailing current representing the confluence of a number of southern currents that mix the tropical South Atlantic waters with those of the Caribbean Sea and the Gulf of Mexico. The Loop Current of the Gulf of Mexico flows north from the Caribbean Sea and into the Gulf of Mexico. The Florida Current flows from the Gulf of Mexico into the Florida Straits and then joins the Antilles Current just off the tip of Florida, making up the second major current flowing into the Gulf Stream. In addition, smaller clockwise currents (gyres) near the Keys are created by temperature variations in the major currents and re-circulate cooler water.

The Keys include relatively little landmass, and the air temperature over land is strongly influenced by the surrounding water temperature. As a result, temperature variation in the Keys is less than any other area in Florida. The average annual maximum temperature at Key West is 82°F and the average annual minimum is 73°F. The highest normal daily maximum temperature is 90°F and typically occurs in July and August. The lowest normal daily minimum is 66°F, usually in February.

As a result of the strong influence of surrounding water temperatures, humidity in the Keys is relatively constant throughout the year. Relative humidity varies only slightly during the day, with the highest humidity occurring in the morning and the lowest humidity occurring in the late afternoon, with a mean annual relative humidity of 75 percent (Chen and Gerber 1990).

Precipitation. The Keys receive the least amount of precipitation in Florida when compared with other portions of the state. This lack of precipitation can be attributed to minimal land/sea breezes and the limited number of large-scale synoptic systems in the area (NOAA 1996). Convection is weak and normally occurs over open water because of the small land area.

Rainfall averages 40 inches per year in the Keys and occurs mostly during the summer when daily rain showers are common. Precipitation peaks in June and late September when unstable edges of the Bermuda/Azores High are positioned over the area (NOAA 1996). Tropical storms generally occur from June through November and contribute most of the precipitation. The highest monthly mean rainfall measured, occurring in September, amounted to 6.5 inches. The lowest monthly mean rainfall measured, occurring in March, was 1.3 inches (NOAA 1996).

Hurricanes. Hurricanes and tropical storms affect south Florida more than any other area in the United States (NOAA 1996). Storms normally occur between June and November, with most occurrences falling in September and October. A tropical storm is classified as a hurricane when winds reach 75 miles per hour (mph). The probability of a hurricane occurring in the Keys is 13 to 16 percent annually, once every seven to eight years. Before Hurricane Andrew in 1992 (Class 5 Saffir-Simpson Scale storm with winds equal to and above 155 mph), the last hurricane to make landfall in the Keys was Hurricane Betsy in 1965. The last major hurricane to pass over the Keys was Hurricane Georges in 1998.

3.2 Topography, Geology and Soils

Geologically, the islands of the Florida Keys are former coral reefs that developed at higher sea levels millions of years ago and were subsequently exposed and eroded by wind and water during sea level decline. The topography, geology, and soils in the Keys provide the substrate over and through which water flows in these islands. These components are therefore important to understanding potential impacts that may result from implementing any of the alternatives presented in this PEIS.

The topography, geology, and soils in the Keys provide the substrate over and through which water flows in these islands and are therefore important to understanding impacts that may result from any of the alternatives presented in this PEIS.

✓	✓		✓	✓	

3.2.1 Topography and Geology

The Keys make up a low-lying archipelago extending from Key Largo to Key West for approximately 110 miles and covering 66,000 acres. The islands are located at the southernmost tip of the Florida Platform, a geologic sequence that is 15,000 feet thick and composed of carbonate and evaporate sediments with minor amounts of fine-grained siltstones and shale. Coral reefs roughly define the southern boundary of the Florida Platform. Just east of the Platform, the depth increases to 2,640 feet or more into the Straits of Florida and to nearly 10,000 feet deep farther west in the Gulf (Randazzo and Halley 1997).

The upper and lower Keys make up two geologically distinct portions of the Keys in Monroe County. The upper Keys geologic portion, extending from Upper Matecumbe Key to Key Largo, is of Pleistocene coral reef origin and is known as the Key Largo Limestone. The lower Keys geologic portion, extending from Lower Matecumbe Key to Key West, is comprised of rock of oolitic (limestone made up of small spherical grains) origin, referred to as the Miami Limestone Oolite (Randazzo and Halley 1997).

Geologically, Key Largo Limestone is oriented parallel to the continental shelf and consists of exposed coral reef limestone with some residual soils in localized areas. Ninety-six percent of the landmass in the Keys is less than 6.7 feet above sea level. Topographic relief in the Upper Largo Limestone is greatest on Key Largo and Windley Key, where elevations reach 16 to 18 feet above mean sea level. Topographic relief in some areas includes ragged surfaces with the appearance of microkarst (White 1970).

Ninety-six percent of the landmass in the Keys is less than 6.7 feet above sea level.

The outer areas along the Key Largo Limestone have smoother surfaces in comparison with the interior portions, primarily a result of marine erosion. Near the edges of the relict reef, the surfaces slope gently to the present shoreline where the calcium carbonate is eroding away, creating irregular honeycombed surfaces with solution holes, several inches to a foot in size (Randazzo and Halley 1997).

In contrast with the upper Keys, the lower Keys (oolitic Keys) are topographically smoother and have less relief. These islands are thought to have formed as a sub-tidal marine ooid-shoal, during a sea level high during the Pleistocene Epoch. The oolitic rock of the lower Keys contains an abundance of marine fossils while quartz makes up a relatively small portion of the

rock. The Miami Oolite in the lower Keys is oriented perpendicular to the continental shelf and has the configuration of a tidal bar with low, flooded, areas between the bars (Evans 1987).

3.2.2 Soils

Soils in the Keys are sparsely distributed and are generally confined to hammocks at the higher elevations and mangrove stands in the lower lying areas of the islands. Soil thickness is generally less than ten inches, although some soil map units have a depth of up to 82 inches (Table 3-3). Most thin soil pockets found in upland areas throughout the Keys are the insoluble residue from the fallout of African dust from the modern Sahara desert. This soil is generally rich in iron oxide and is rust colored (Muhs *et al.* 1990, Prospero *et al.* 1981).

Soil thickness in the Keys is generally less than ten inches and provides limited filtration of nutrients from septic tank discharges.

A soil map of the study area was generated using the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) digital database, digitized from the 1995 Monroe County Soil Survey (Hurt *et al.* 1995). Five soil map units comprise 69 percent of the study area: Udorthents-Urban Land Complex (fifteen percent), Key Largo muck-tidal (thirteen percent), and Rock Outcrop-Cudjoe Complex-Tidal (ten percent); Pennekamp gravelly muck, 0-2 percent slopes, extremely stony (nine percent); and Islamorada muck tidal (eight percent). Eleven soil map units comprise the remaining 29 percent of the study area. Acres of each soil map unit in the study are listed in Table 3-3 after USDA/SCS (Hurt *et al.*1995).

Table 3-3
Soil Map Units in the Study Area

Soil Map Units	Acres	Percentage
Unclassified	12,421	16%
Udorthents-Urban Land Complex	11,798	15%
Key Largo Muck; Tidal	10,164	13%
Rock Outcrop-Cudjoe Complex; Tidal	7,958	10%
Pennekamp Gravelly Muck; 0-2 Percent Slopes; Extremely Stony	7,274	9%
Islamorada Muck; Tidal	6,495	8%
Cudjoe Marl; Tidal	5,106	7%
Matecumbe Muck; Occasionally Flooded	3,855	5%
Urban Land	2,556	3%
Keyvaca Very Gravelly Loam; Extremely Stony	2,454	3%
Saddlebunch Marl; Occasionally Flooded	1,846	2%
Rock Outcrop-Cudjoe Complex; Frequently Flooded	1,478	2%
Lignumvitae Marl; Tidal	1,411	2%
Rock Outcrop-Tavernier Complex; Tidal	856	1.1%
Keywest Marl; Tidal	536	0.7%
Bahiahonda Fine Sand; 0 to 3 Percent Slopes	349	0.5%
Beaches	35	0.05%
Totals	**76,593**	**100%**

Data from Hurt *et al.* (1995).

3.3 Water Resources

Ground water, surface waters, and nearshore and marine waters in the Keys are the environmental resources targeted by the FKWQIP for wastewater treatment and stormwater management improvements. The interconnections among these waters is important when considering impacts of stormwater and wastewater inputs that may flow overland, through canals, and through limestone, into nearshore waters.

Ground water and surface waters are the environmental resources targeted by the FKWQIP for wastewater treatment and stormwater management improvements.

✓	✓	✓	✓	✓	

3.3.1 Ground Water

While large quantities of saline water underlie the Keys in the Floridan Aquifer, freshwater resources are limited to relatively thin freshwater lenses of the larger islands of the lower Keys, e.g. Key West and Big Pine Key. As described in *Section 3.2.1*, Geology and Topography, the Key Largo Limestone, extending from Upper Matecumbe Key to Key Largo, is composed of the skeletal remains of the ancient Pleistocene reef. The islands are generally long and narrow and the ground water is at best brackish and of little potential utility except as input for desalination systems.

While large quantities of saline water are located beneath the Keys in the Floridan Aquifer, freshwater resources are limited to relatively thin freshwater lenses on the larger islands of the lower Keys.

It is the combination of landmass and geology that favors the occurrence of small freshwater to slightly brackish water lenses beneath some of the larger islands composed of the Miami Oolite. Stormwater captured by the landmass of the larger islands percolates to the Miami and Key Largo Limestone formations and accumulates as a lens of freshwater above the denser underlying saline water. Such lenses have been used in the past for domestic water supply and for irrigation and other water uses. No new domestic water supply wells have been permitted in the Keys since 1986 (FEMA 2002). Characteristic depths and volumes of the Key West and Big Pine Key freshwater lenses are listed in Table 3-4 below.

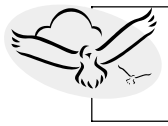
Table 3-4
Characteristics of Freshwater Lenses in Key West and Big Pine Key

Freshwater Lens	Key West	Big Pine Key
Volume	30 (wet season) million gallons 20 (dry season) million gallons	Data unavailable
Lens depth at center	5 feet	16 feet
Lens chloride content	Less than 250 mg/L	Less than 500 mg/L
Transition layer depth at center	40 feet	Data unavailable
Transition layer chloride content	19,000 mg/L	Data unavailable

Source: Haley *et al.* 1997

Although some ground water is used for irrigation (on Big Pine Key), and some potable water is provided by cisterns and reverse-osmosis facilities, more than 95 percent of water for domestic use is now provided by the FKAA via pipeline from a wellfield on the mainland. Currently about 15 mgd are pumped to the Florida Keys. The FKAA, created in 1937 by Special Legislation of the state of Florida, is the sole provider of potable water for all residents of the Florida Keys. The FKAA presently serves 42,237 customers within Monroe County. Potable water is transported to the Keys through a 130 mile transmission pipeline with an additional 649 miles of distribution pipelines.

The hydrogeologic formations of southern Florida have been grouped into two principal aquifer systems: the Floridan Aquifer and the Biscayne Aquifer. The Biscayne Aquifer is separated from the deeper Floridan Aquifer System by 1,000 feet of low permeable, clayey deposits (upper confining unit) that isolate the freshwater from the lower saline water.



Although some ground water is used for irrigation and some potable water is provided by cisterns and reverse-osmosis facilities, more than 95 percent of water for domestic use is piped from the mainland.

The Biscayne Aquifer. Pleistocene carbonate rocks beneath the Keys make up the Biscayne Aquifer and are a prolific source of fresh water beneath 4,000 square miles of south Florida and the Biscayne Aquifer is highly permeable. Within the Keys, this aquifer formation is subdivided into the Key Largo Limestone, which runs from Key Largo south to upper Matecumbe Key, and the Miami Oolite, which lies south and west of lower Matecumbe Key (Miller 1997).

The Biscayne Aquifer is the primary source of fresh water throughout south Florida. In the Keys, however, the Biscayne Aquifer is brackish to saline and is therefore used little for potable supply. On the larger islands, such as Key West and Big Pine Key, a thin freshwater lens exists, floating on top of the denser saline water (Miller 1997).

The Key Largo Limestone of the upper Keys is of coral reef origin and consists of coral remains, interbedded calcareous sands and thin beds of quartz sand. At Big Pine Key, the limestone is 200 feet thick. At the south end of Big Pine Key, the Miami Oolite grades laterally into the Key Largo Limestone. The Key Largo Limestone formation is subdivided into five units (Q1-Q5) which vary in thickness depending on location, but always have a total thickness of more than 60 feet (Perkins 1977). The hydraulic conductivity has been estimated to be 44.6 feet per day for the Key Largo Limestone (Perkins 1977). In the southern portion of the Keys, the Miami Oolite overlays older units of the Key Largo Limestone (Randazzo and Halley 1997).

The lower Keys Miami Oolite consists of well-sorted oolitic grains with variable amounts of coral, echinoid, mollusk, calcareous algae, and other skeletal materials and some quartz sand (FEMA 2002). In contrast with the Key Largo Limestone, the Miami Oolite is 9 to 15 feet thick and was deposited on marine banks and bars during the Pleistocene Epoch. The hydraulic conductivity for the Miami Oolitic Limestone is approximately 394 feet per day (Halley *et al.* 1997).

Floridan Aquifer System. The Floridan Aquifer is comprised of water bearing carbonates of Paleocene to early Miocene Era and underlies all of Florida, Georgia, and parts of South Carolina, Alabama, and Mississippi. In Florida, the aquifer thickens to 3,400 feet in south Florida. The Floridan Aquifer is a source of potable water to populations in other areas of Florida, however, in the Keys, the aquifer contains saline water used only for industry (Miller 1997).

In the Keys, the Floridan Aquifer ranges in thickness from 2,600 feet at the north end of Key Largo to 3,400 feet near Key West. The aquifer system consists of a thick sequence of carbonate rocks, comprised of limestones and dolomites, that are mostly of Pliocene Age and have a hydraulic connection in varying degrees. The Floridan Aquifer is highly confined in south Florida and the Keys, and the upper confining unit is generally greater than 100 feet thick and unbreached. The hydraulic head is about 40 feet above mean sea level at the eastern end of the Keys and less than 40 feet west of Key Largo. These conditions are fairly unchanged from pre-development conditions. To inject wastewater into the Floridan Aquifer System, pumping must be used to overcome this artesian pressure. The Boulder Zone, a highly permeable cavernous zone in the lower Floridan Aquifer, extends throughout the Keys and its top ranges from –2,800 feet at the north end of Key Largo to –3,300 feet near Key West (Miller 1997).

Ground water circulation in the Floridan Aquifer of south Florida occurs as follows: (1) cool seawater flows inland from the Straits of Florida through the Boulder Zone and other permeable strata of the Floridan Aquifer; the inflowing seawater is warmed by geothermal heat as it moves inland, becoming less dense as the temperature increases; (2) the lighter, warmer seawater migrates upward through confining units above the lower Floridan Aquifer into the lower part of the upper Floridan Aquifer where it mixes with fresher water from surface sources; and (3) the blend, somewhat less saline than seawater, then flows seaward to discharge points along the continental slope. Because the temperature and salinity of the water in the Boulder Zone are similar to those of seawater, the zone may be connected to the Atlantic Ocean in the Straits of Florida (Kohout 1965).

3.3.2 Surface Waters and Stormwater Runoff

Inland surface waters in the Keys include canals and ponds that receive overland stormwater runoff, ground water, and direct rainfall. Canals flow directly into nearshore waters. The limited number of freshwater wetlands occur on only the largest of the lower Keys, Big Pine and Key West for example, where freshwater lenses still exist.

Historically, the Keys were characterized by diverse West Indian tropical hardwood forests, pine rocklands, freshwater wetlands (e.g. Big Pine Key), and mangroves that surrounded the islands. These communities were replaced by waterfront development on “fast land,” which was constructed on material dredged for canals. More than 200 canals and access channels were dredged from the 1950s through the 1970s. Currently there are approximately 700 inland canals and access channels in the Keys islands, often 10 to 20 feet in depth.

Inland ponds are relatively infrequent across the Keys and make up approximately four percent of the land area in the study area. Freshwater systems are limited in the Keys to smaller pocket

wetlands occuring on some of the larger islands and may hold some stormwater runoff. The highly porous limestone rock that forms the Keys is not conducive to stormwater retention, even on the larger islands. Consequently, stormwater generally percolates into the ground quickly and nutrients, pathogens, and other stormwater contaminants can enter the Keys nearshore marine environment. The study area contains approximately 560 lakes/ponds, with an average size of six acres. These ponds include both freshwater and saltwater ponds that receive rainwater and stormwater runoff, but are not connected to nearshore waters.

Inland surface waters in the Keys include canals and ponds that receive overland stormwater runoff, ground water, and direct rainfall.

Stormwater ponds, retention ponds, and wet extended detention ponds in the study area are constructed basins that may be permanent or seasonal. Ponds treat incoming stormwater runoff by settling and algal uptake. The primary removal mechanism in a stormwater retention pond is settling. Nutrient uptake also occurs through biological activity in these ponds. Wet ponds are among the most cost-effective and widely used stormwater treatment practices in the Keys.

The average annual rainfall in the Keys amounts to over 40 inches per year (NOAA 2003a, NOAA 2003c, Florida Keys and Key West Weather and Climate date unavailable). Each rainfall event produces approximately an inch of rain, of which 75 percent results in runoff (Livingston 1990). Stormwater runoff from rainfall events often contains pollutants in quantities that could adversely affect water quality. For this reason, most stormwater discharges are considered point sources and best management practices (BMPs) are employed to control stormwater discharges.

Stormwater runoff from roadways, bridges, driveways and yards, rooftops, and shopping center parking lots contribute stormwater loading to surface and nearshore waters. Runoff from stormwater is considered a major source of pollutants to surface waters at a national level. Runoff typically contains substances such as organic debris, silt, nitrogen, phosphorus, metals, and hydrocarbons. Stormwater swales that collect stormwater and divert it from roads and highways also occur throughout the Keys and direct runoff into canals and nearshore waters.

3.3.3 Nearshore and Offshore Waters

Importantly, the water quality of nearshore and marine waters and associated habitats in the Keys is the focus of the FKWQIP. While this section addresses the location and extent of nearshore and marine waters, the transport of nutrients in nearshore and marine waters of the Keys is described in detail in the subsequent section on water quality (Section 3.4.4).

Nearshore and marine waters provide a unique habitat for a variety of plants and animals in the Keys, including sea grasses, fish, and shellfish. Nearshore waters alone provide habitat for 80 percent of the fish species in the U.S. and most commercially valuable fish species depend on nearshore waters at some point during their development. In addition, the largest living coral reef system in the U.S. parallels the Atlantic side of the Keys.

In addition to valuable fish and wildlife habitat, nearshore and marine waters provide numerous recreational opportunities, such as boating, diving, swimming, surfing, snorkeling, and fishing. In fact, the Keys are the number one diving destination in the world.

Nearshore waters in the Keys extend seaward from the shore into the Gulf of Mexico and the Atlantic Ocean. Currents in these waters are a function of wave action. In contrast, the marine system farther seaward is characterized by offshore currents and tides. There is also a high degree of interaction between ground, canal, nearshore, and marine waters in the Keys. However, the net flow of ground and surface water in the Keys is from the bay-side to the ocean-side, and then south and west. Locally, water flows from Florida Bay on the Gulf side of the Keys into Hawk Channel. Periodically, the Florida Current can influence lower portions of Hawk Channel, depending on offshore circulation patterns and tides (Monroe County 2001a, FEMA 2002). Consequently, the currents on the bay-side of the Keys have little influence on the ocean-side waters.

3.4 Water Quality

The biodiversity, natural beauty, and recreational opportunities of the Keys are important to Florida's tourism industry and are a significant part of the nation's collective natural resources. Because of the importance of water quality to these resources, including coral reefs and other communities in the Sanctuary and the Keys, both state and federal programs targeting water quality improvements are being implemented.

Improvement of water quality in the Sanctuary by reducing nutrient loading to nearshore waters and eliminating health advisors is the central focus of the FKWQIP.

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The purpose of the FKWQIP is to improve water quality in the Sanctuary, consistent with the mission of state and federal entities. Therefore, the focus of this section is on:

- Wastewater discharge and stormwater runoff as significant sources of nutrient loading to nearshore waters in the Keys
- Discharges from septic tanks and cesspools as contributing factors to health advisories in canals and nearshore waters in the Keys
- Water quality degradation in waters of the Sanctuary as an important factor in impairing maintenance of healthy ecosystems, including coral reefs

For example, water quality concerns resulted in the designation of the Keys as an Outstanding Florida Water (OFW) in 1985, and as such, no water quality degradation is permitted in these waters. The Keys have also been identified by the state of Florida as an Area of Critical State Concern since 1975. In addition, the Keys are one of 13 established National Marine Sanctuaries (1989). Eutrophication of these waters is the primary water quality concern presently being addressed by NOAA, EPA, and the state of Florida in the design and implementation of the

Florida Keys National Marine Sanctuary Water Quality Plan (Szmant 1995). Most recently, the Corps has undertaken the Florida Keys Carrying Capacity Study to address marked reduction and fragmentation of the native marine and terrestrial habitat and a general decline in habitat quality and biodiversity by identifying thresholds of sustainability for all of these resources (see Appendix D).

A major source of nutrient loading of nearshore waters in the Sanctuary is the sewage generated from 200 sewage treatment facilities, 22,000 septic tanks, 5,000 cesspools and 139 marinas harboring over 15,000 boats. These nutrients are carried through the Keys by more than 700 canals and channels.

3.4.1 Regulatory Framework

The Federal Clean Water Act (Federal Water Pollution Control Act Amendments of 1972, as amended in 1977) provides the statutory basis for state water quality standards programs. States are responsible for reviewing, establishing, and revising water quality standards. Florida standards and water quality criteria have been established by the FDEP for each class of surface waterbody under Chapter 62-302 of the Florida Administrative Code (F.A.C.). The surface waters in and around the Keys are classified as Class III waters under Rule 62-302.400. Under this classification, water quality criteria have been established to protect and support recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife.

The intent of the OFW designation by the Florida Legislature is to prevent the degradation of water quality in a waterbody. In general, FDEP cannot issue permits for direct pollutant discharges to OFW which would lower ambient (existing) water quality or indirect discharges which would significantly degrade the OFW.

FDEP can issue permits that allow degradation of water quality to the minimum standards allowed for that waterbody classification, in this case Class III, provided that such degradation is necessary or desirable under federal standards and under circumstances which are “clearly in the public interest” (Rule 62-302 F.A.C.). Generally, new project activities receiving FDEP permits must be demonstrated to be clearly in the public interest. As a result of the OFW designation in the Keys, most direct surface water discharges of pollutants have been eliminated, or are in the process of being phased out. There are some exceptions to compliance with OFW. Most notably, permitted activities existing on the date of OFW designation are “grandfathered” in and may continue without any new OFW requirements.

Florida standards for ground water classifications have been established under Chapter 62-520 F.A.C. and drinking water standards are designated in Chapter 62-550 F.A.C. The FDEP water quality criteria for relevant parameters for drinking water and Class III waters are shown in Table 3-5. Class III waters include recreation, propagation, and maintenance of a healthy, well-balanced fish and wildlife population.

The Monroe County Year 2010 Comprehensive Plan, adopted in 1993 and amended in 1997, addressed immediate and growth related issues faced by the County, including sanitary wastewater disposal and stormwater management (see Appendix D). In 1998, the Florida Governor issued an executive order (EO 98-309) that charged local and state agencies with

adherence to the goals of the Year 2010 Comprehensive Plan. The goals relevant to this project are listed below.

- Provide adequate, economically sound collection, treatment, and disposal of sewage which meets the needs of present and future residents while ensuring the protection of public health, and the maintenance and protection of ground, nearshore, and offshore water quality.
- Correct existing facility deficiencies by requiring the elimination of cesspools and the improvement of failing septic tanks and package treatment facilities as necessary to meet state and county standards.
- Establish more stringent nutrient limiting standards based on the best available data and analysis of the maximum loads that can be tolerated by the nutrient sensitive waters and ecosystems.
- Provide a stormwater management system which protects real and personal properties, and which promotes and protects ground and nearshore water quality.

The Monroe County Sanitary Water Master Plan (Monroe County 2000) was developed in response to, and to comply with, the Year 2010 Comprehensive Plan. The MCSWMP reiterated the mandate of the Florida Legislature to the reduction of nutrients in effluent from both on-site systems and wastewater treatment facilities and the requirement that by July 1, 2010, all existing on-site wastewater facilities must either cease discharging or upgrade to meet the new nutrient reduction standards. The applicable treatment standards for biological oxygen demand (BOD), total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP) are listed below.

- For on-site systems and community collection and treatment systems with design flows of less than or equal to 100,000 gpd, best available technology (BAT) standards of 10/10/10/1 mg/L apply.
- For design flows greater than 100,000 gpd, advanced wastewater treatment (AWT) standards of 5/5/3/1 mg/L apply.

Table 3-5
FDEP Surface and Groundwater Quality Criteria for Selected Parameters

Water Quality Parameter	Units	Drinking Water Standards Ch 62-550 F.A.C.	Class III: Predominantly Marine Waters Ch 62-302 F.A.C.
Ammonia[1]	mg/L	No state criteria	No marine criteria
Atrazine	µg/L	3.0	No marine criteria
Bacteria, fecal coliform	col./100 ml	Presence/Absence	<200 monthly avg. <400 in 10% of samples <800 daily
Bacteria, total coliform	col./100 ml	Presence/Absence	<1000 monthly avg. <1000 in 20% of samples <2400 any one time
Bromacil	µg/L	90	No marine criteria
Conductivity	µS/cm	No state criteria	No marine criteria

DDT	µg/L	0.1	0.00059 annual avg.; 0.001 max
Dissolved Oxygen	mg/L	5	5
EBD	µg/L	0.02	No marine criteria
Water Quality Parameter	**Units**	**Drinking Water Standards Ch 62-550 F.A.C.**	**Class III: Predominantly Marine Waters Ch 62-302 F.A.C.**
Endosulfan	µg/L	0.35	.0087
Endrin	µg/L	2	0.0023
Iron	mg/L	0.3	0.3
Lead	µg/L	15	8.5
Nitrate	mg/L	10 or that which exceeds nutrient criteria	No marine criteria
Nitrite	mg/L	1.0	No marine criteria
Nutrients		No state criteria	In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna
Oil and Grease	mg/L	No state criteria	No undissolved oil, or visible oil defined as iridescence, shall be present so as to cause taste or odor, or otherwise interfere with the beneficial use of waters.
PAHs (Total)[2]	µg/L	No state criteria	0.031annual avg
PCBs	µg/L	0.5	0.000045 annual avg.; 0.003 max
pH	s.u.	6.5 - 8.5	6.5 - 8.5
Simazine	µg/L	4.0	No marine criteria
Total Phosphorus	mg/L	No state criteria	0.1
Turbidity	NTU	1.0	29 units above background

1 - Ammonia is not regulated but converts to nitrite in the presence of oxygen and *Nitrosomones*.
2 - PAHs in drinking water are regulated as individual components and not as total.
Source: Chapter 62-520 F.A.C.

3.4.2 Ground Water

Declining groundwater quality due to increased nutrient loading from septic systems and the illegal use of cesspools is a major concern in the Keys. There is no municipal sewer system serving the Keys with the exception of the City of Key West. The Key West Southernmost Wastewater Treatment Plant was brought on line in 1989 and originally discharged treated and disinfected wastewater through a 30 inch pipeline to the ocean via an outfall. The ocean outfall was replaced with a deep injection well system which has been in operation since early September 2001. This system has an average daily flow of 4.0 mgd and maximum capacity of 7.2 mgd (FEMA 2002).

Declining groundwater quality due to increased nutrient loading from septic systems and (illegal) cesspools is of major concern in the Keys.

Approximately 23,000 private on-site systems and approximately 246 small wastewater treatment facilities commonly relied upon by multifamily dwellings and commercial facilities are

currently operating throughout the Keys. The on-site systems are comprised of approximately 15,200 permitted septic systems, 640 advanced treatment units, and 7,200 additional systems of unknown type and/or function. About 2,800 of the 7,200 unidentified systems are suspected to be illegal cesspools. On-site systems contribute an estimated 4.88 mgd of wastewater and small treatment systems contribute 2.40 mgd of wastewater. Each of these on-site systems and small treatment facilities provide minimal nutrient removal, and generally discharge effluent with nutrient levels of about 20 milligrams per liter (mg/L) of TN and 5 mg/L of TP into the porous and transmissive Floridan Aquifer (Monroe County 2001b).

Because of stringent regulatory standards for surface water discharges, the treatment facilities generally discharge treated effluent through permitted "shallow" Class V injection wells, of which 750 have been permitted in the Keys (Kruczynski 1999). These shallow Class V wells are required to be 90 feet deep with a grouted cement casing to 60 feet; thus, they discharge relatively fresh but nutrient rich waters into the upper Water-Bearing Zone (a zone of the Floridan Aquifer consisting of dense, highly weathered limestone of low permeability and ranging in thickness from 40 to 80 feet).

Continued wastewater disposal into the upper Water-Bearing Zone has led to groundwater quality changes around the developed areas of the Keys. Aside from becoming less saline because of the freshwater influence of wastewater inputs, groundwater quality is becoming degraded because wastewater is typically oxygen-depleted, enriched in the nutrients like nitrogen and phosphorus, and contains fecal coliform bacteria. Because ground water is minimally used in the Keys, ground water degradation has been of little direct concern to human health. However, because of its open nature, as previously discussed, the effects of degraded ground water can be seen in nearshore and offshore marine waters and their ecosystems.

3.4.3 Surface Waters and Stormwater Runoff

Stormwater discharge is regulated at the federal level through the Clean Water Act and the National Pollution Discharge Elimination System (NPDES) permit programs. The SFWMD regulates surface waters on the state level. Historically, property owners and developers were responsible for drainage projects and boat canals were treated as the primary receiving waters. Building sites drained directly into canals by sheet flow, ditches, or percolation. On several islands in the Keys, ditches along U.S. Highway 1 serve as the primary drainage system, transporting stormwater along the highway into the ocean, although much of U.S. Highway 1 has no drainage system (Monroe County 1997b).

Recent estimates of nutrient loadings in the Keys attribute about 20 percent of the TN load and about 45 percent of the TP load to stormwater (USEPA 1993, Kruczynski 1999, FEMA 2002).

The amount or load of pollutants in stormwater runoff is largely a function of rainfall quantity, imperviousness of the soils, and land use. In residential areas, nutrients are typically a major part of the load whereas pollutants from roadways include mostly hydrocarbon products and metals (Kruczynski 1999). Residential runoff can also carry anthropogenically-induced pollutants such as sediments, fertilizers, detergents (car washing etc.), automotive fluids, metals, and pesticides.

Rainfall from storm events can raise the water table and increase transport of particulate matter from septic tanks and cesspools in ground water and as surface runoff, thereby increasing nutrient loads and pathogens that reach ground and surface waters.
Estimates of total loadings of nitrogen and phosphorus due to wastewater and stormwater runoff into nearshore waters were summarized in the Phase II Report of the Water Quality Protection Plan (WQPP) (USEPA 1993). Recent estimates of nutrient loadings in the Keys attribute about 20 percent of the TN load and about 45 percent of the TP load to stormwater (USEPA 1993, Kruczynski 1999, FEMA 2002).

An inventory of stormwater management structures was conducted as part of the Monroe County Stormwater Management Master Plan. Of the 254 stormwater management structures located, 167 (66 percent) had a water quality treatment system (infiltration trench or detention/retention pond). Inlets were found on 110 structures; 64 treatment systems had associated wells; and 4 treatment systems had oil/water separators. The results of surveys conducted as part of the master plan found that swales were the predominant best management practice used for treating stormwater runoff (Monroe County 2001a).

3.4.4 Nearshore and Offshore Waters

Ground water in the upper Water-Bearing Zone of the Keys is directly connected to inland and nearshore waters in the Keys. Consequently, degraded ground water can flow into nearshore waters of the Sanctuary within hours or days. A variety of factors have been implicated as potential sources of the degraded water quality occurring in the Sanctuary.

- Leaking septic systems, cesspools (fecal contamination).
- Untreated stormwater runoff.
- Leakage from injection wells.
- Nutrient-enriched runoff from the agricultural areas of south Florida.

The connection between fecal contamination and nutrient enrichment of nearshore waters and septic tanks has been reviewed in many studies. One study concluded that the widespread use of septic tanks increases the nutrient contamination of ground water that discharges into shallow nearshore waters, resulting in nutrient enrichment of coastal waters (Lapointe and Clark 1992). Paul *et al*. (1997) used an active shallow Class V disposal well in the middle Keys and a simulated injection well in Key Largo to study the transport and fate of wastewater. In both areas, viral tracers appeared in nearshore marine waters after short periods (10 hours for Key Largo and 53 hours for the middle Keys). Other studies conducted to examine the transport of sewage from cesspools and septic tanks into canals in Key Largo found that experimental tracers appeared in a canal within 11 hours of discharge from a septic tank (Paul *et al.* 1995).

Septic system waste discharges are a significant source of nutrients and pathogens to canal waters.

Rainfall is an important factor affecting the movement of substances through ground water, especially in the Keys. During a rainfall event, nutrients and pathogens are transported in ground water to local canals and adjacent nearshore waters due to the porous characteristic of the

underlying aquifer. The hydraulic conductivity, or the rate at which water moves through the aquifers, is a key factor in determining how quickly ground water reaches the marine environments (Halley *et al.* 1997). The hydraulic conductivity of the Miami Oolite is estimated to be 394 feet per day and the Key Largo Limestone about 4,593 feet per day. The deep, box-cut configuration of canals has the general effect of increasing the transport and discharge of ground water to nearshore waters. In addition, the movement of nutrient enriched ground water from inland areas to adjacent nearshore waters increases at low tides (Kruczynski 1999, Lapointe and Matzie 1996). The cumulative effect of these actions is an increase in ground water transport into nearshore environments. In most cases, the ground water reaches adjacent nearshore waters before dissolved nutrients from sanitary wastewater or runoff have been adequately treated.

Nutrient Loadings to Nearshore and Offshore. Water quality monitoring data collected in and around the Keys by Florida International University since 1995 as part of the WQPP, revealed significant increases in TP and nitrate (NO_3) in the Keys and Tortugas over a five year sampling period. Increases did not occur in areas influenced by Florida Bay water transport and these results may suggest that increasing nutrients outside the influence of Florida Bay are due to local influences of nearshore waters. In contrast, total organic nitrogen (TON) decreased over the five year sampling period and may be a result of regional circulation patterns of the Loop and Florida Currents (Jones and Boyer 2001).

The USEPA (1996) estimates that nutrient loadings from the Keys to nearshore marine waters total 2,377 lbs/day of TN and 544 lbs/day of TP. About 80 percent of this TN and 56 percent of the TP were attributed to wastewater disposal, while the remainder was attributed to stormwater runoff. An analysis of inputs from municipal wastewater, live-aboard boats, and stormwater indicated nutrient rich ground water accounts for about 63 percent of TN and about 44 percent of TP loading from the Keys to the nearshore marine waters (USEPA 1996).

In general, studies have found effects of nutrient pollution from inland sources are greater for nearshore than offshore due to greater dilution from currents and tidal movement in nearshore waters. Szmant and Forrester (1996) measured distribution patterns of nutrients to determine whether the nutrients may be reaching the outer coral reefs in the Keys. In the middle Keys, water column nitrogen and chlorophyll were elevated near marinas and canals, but returned to low nutrient conditions within three miles of shore (Kruczynski 1999, Szmant and Forrester 1996). Phosphorus concentrations were higher at offshore stations and were attributed to upwelling of deep water along the shelf edge at the time of sampling (Kruczynski 1999, Szmant and Forrester 1996).

Declining water quality throughout south Florida, from Lake Okeechobee through the Everglades into Florida Bay and ultimately to offshore waters of the Keys, is well documented (Brand 2002, Lapointe *et al.* 2002). Path analysis of nutrient concentrations, however, reveals an extremely low nutrient system through Everglades National Park and into Florida Bay (Stober *et al.* 2001), indicating a general lack of connection between the Everglades system and the waters surrounding the Keys. Sewage pollution from local sources and possibly agricultural runoff is emphasized as the cause of water quality degradation and ecosystem decline in the Keys (Lapointe *et al.* 1990).

Although it is difficult to distinguish between natural events and anthropogenic impacts, the most important environmental factors affecting coral reefs are nutrification and overfishing, followed by turbidity, temperature changes, pesticides, metals and hydrocarbons (Szmant 1995). It should be noted that several other studies, including Cook (1997) and Rudnick *et al.* (1999), identify Florida Bay and the Gulf of Mexico as significant contributors of nutrients to the marine waters of the Keys. Other researchers have demonstrated large fluctuations in background nutrient concentrations due to strong tidal upwelling. While scientific research regarding the sources of nutrient inputs into the marine ecosystem in the Keys continues, there is widespread consensus that conditions of the coral reef environment have changed dramatically in recent years and that anthropogenic activities are a major cause (Porter and Porter 2002). Additional research is necessary to identify the relative contributions of the various sources of nutrient input into the ecosystem and associated water quality degradation in the nearshore and offshore waters of the Sanctuary.

Water Quality *Hot Spot* Areas. As previously discussed in *Chapter 1*, the USEPA prepared the *Water Quality Protection Program for the Florida Keys National Marine Sanctuary: Phase 1 Report*, which listed 84 water quality *hot spots*. These areas have been identified as sites of known or suspected water quality degradation, based upon workshops and discussion groups (Figure 3-2). The list was later increased to a list of 88 *hot spots* in 1996, primarily as a result of water quality issues and wastewater influences. *Hot spot* locations correspond with higher-density urban areas, representing neighborhoods and subdivisions with the poorest sewage treatment and strongest need for central sewage facilities. During preparation of the Monroe County Sanitary Wastewater Master Plan, a priority ranking system was developed to determine the order in which these areas should be provided with wastewater collection and treatment facilities, using BAT. Three recommendations were made for all higher priority, poorly designed canal systems: 1) install BAT sewage treatment; 2) collect and treat stormwater runoff; and 3) improve canal circulation (Kruczynski 1999, USEPA 1993a).

Health Advisories. In addition to nutrient loading and anaerobic conditions, degraded water quality in canals and isolated waterbodies also pose a human health concern. Multiple studies have been conducted to determine the presence of pathogens and their origins. One such study in 1997 involved the testing of 19 sites throughout the Keys, including 17 residential canals and two nearshore sites selected from a USEPA *hot spot* list based on suspected poor water quality. The testing detected the presence of viruses, but did not determine whether they were infectious in nature. In the survey, 15 of the 19 sites tested positive for enteroviruses and 12 sites tested positive for the hepatitis A virus. Clinical symptoms of enteroviruses are generally mild, but occasional infections may cause serious disease such as paralytic poliomyelitis, meningitis, or myocarditis.

Another study, funded by the USEPA (Fuss 2000), showed that at least one Keys canal contained live infectious viruses linked to human waste. Among the viruses identified in the water sampling were those that cause polio and viral meningitis, along with a variety of others that cause lesser viral illnesses. Researchers sampled water at six sites from Key Largo to Key West, and one canal in lower Matecumbe Key that was defined as a *hot spot*. Test results indicated the presence of live enteroviruses, including polio, Coxsackie A and B and echoviruses in Captains Cove, a canal basin in the Port Antigua neighborhood of lower Matecumbe Key. Coxsackie A

and B can cause diseases such as herpangina and myocarditis. Echoviruses can cause a variety of illnesses, ranging from fever to viral meningitis. Coxsackie B has also been repeatedly implicated as a causal agent for chronic fatigue syndrome.

These studies indicate that current wastewater treatment practices are contributing to health hazards in the canals in the Keys. All of the detected viruses are transmissible through human feces and are believed to have been transported into Keys canals in raw sewage from leaking cesspools and septic tanks (Fuss 2000).

Declining water quality in nearshore waters has resulted in health advisories and beach closings in the Keys.

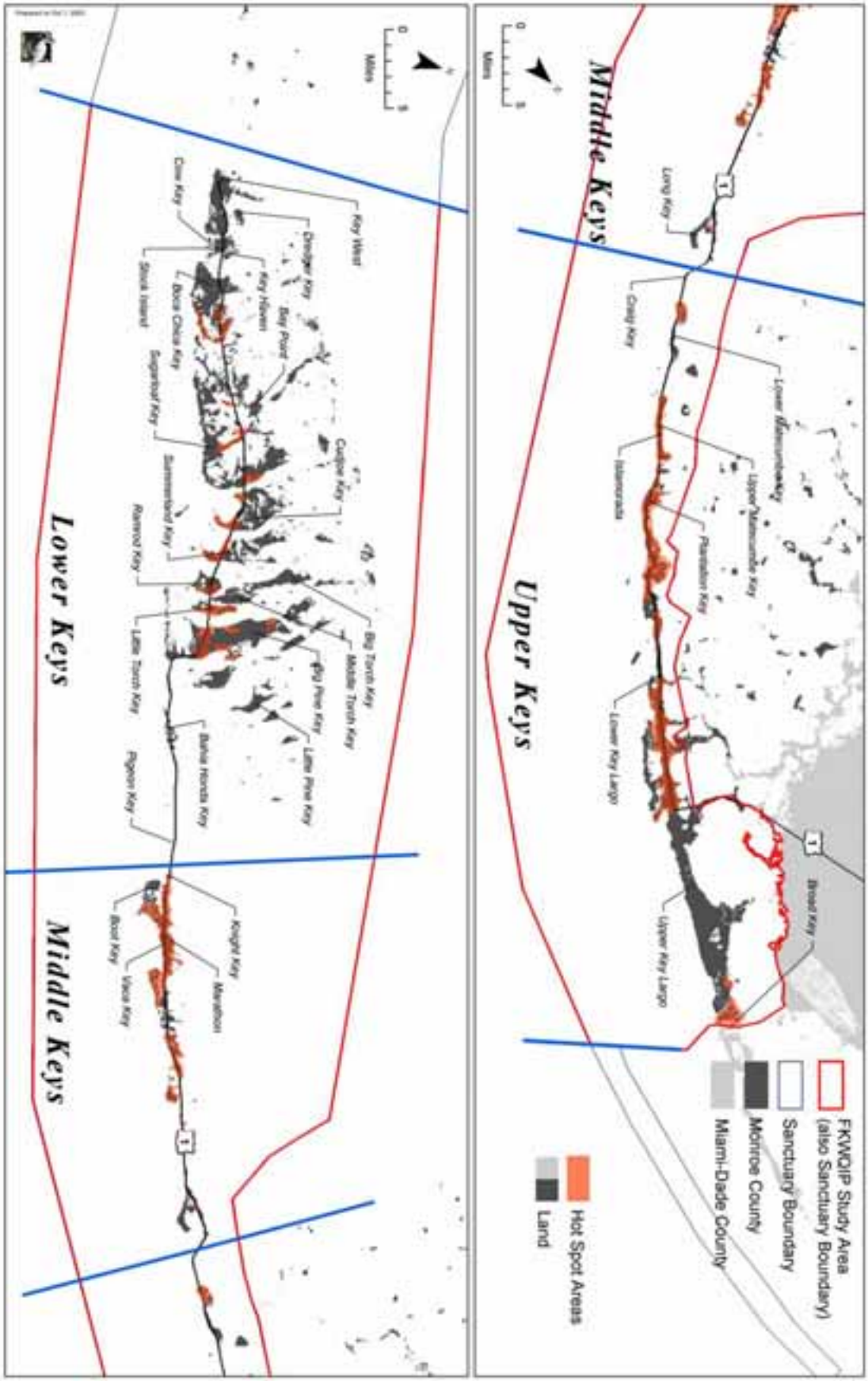
Clean public beaches and nearshore water quality are leading health concerns in Monroe County. The number of beach closings and health advisories due to elevated contamination levels has risen during recent years. Of 15 Monroe County beaches monitored in 2001, five were found to have elevated bacterial levels and received water quality advisories (Table 3-6). In 2002, 15 Keys beaches were tested and two, John Pennekamp Coral Reef State Park in Key Largo and Higgs Beach in Key West, were found to have high concentrations of enterococcus indicating contamination from mammalian waste through wastewater or stormwater.

While there were no beach closings reported in 2001, the total number of advisories was up substantially from earlier years. A total of 30 days of beach advisories and closings were reported in 2000 as compared to 60 in 2001 (FEMA 2002). The total number of beach advisories and closings for 2002 was 138 days for all health advisories. These advisories were issued throughout the year, with little apparent association with time of year.

Table 3-6
Monroe County Beach Advisories and Closings in 2001

Beach	Advisory or closing	Number of advisories or closings	Number of days, respectively	Reason	Indicator
Bahia Honda Oceanside	advisory	2	24 & 11	Elevated bacteria levels	Enterococci
Coco Plum Beach	advisory	2	11 & 11	Elevated bacteria levels	Enterococci
Curry Hammock State Park - Marathon	advisory	1	1	Elevated bacteria levels	Enterococci
Higgs Beach – Key West	advisory	4	14, 11, 24, & 27	Elevated bacteria levels	Enterococci & fecal coliform (1)
Veteran's Beach Marathon	advisory	1	4	Elevated bacteria levels	Enterococci

Source: Florida Department of Health 2003.



3-2

Water Quality Hot Spots in the FKWQIP Study Area

3.5 Ecological Habitats

Unique and nationally significant resources, including the only living coral reefs in North America, emphasize the importance of the Keys and Sanctuary as part of a complex ecosystem that includes numerous public conservation areas and habitat for protected species. Ecological habitats in the Florida Keys include uplands, estuarine and freshwater wetlands, and marine habitats. Habitats such as tropical hardwood hammocks have been specifically identified by the state as important to maintaining species diversity. While many of these habitats occur in existing conservation areas, others are on located vacant lands that were part of platted subdivisions but were never developed.

In this chapter, the ecological habitats in the Keys are described so that potential adverse impacts to these habitats as a result of the FKWQIP can be evaluated. General wildlife and vegetation characteristics are included in this chapter as an integral part of each ecological habitat description rather than in a separate chapter addressing wildlife. However, habitat issues relevant to protected species are presented in *Section 3.6, Protected Species*.

Unique and nationally significant resources, including the only living coral reefs in North America, emphasize the importance of the Keys and Sanctuary as part of a complex ecosystem that includes numerous public conservation areas and habitat for protected species.

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Land cover in the Keys consists of terrestrial, wetland, aquatic, and marine habitats, as well as urban lands. Urban lands comprise approximately 26 percent of the 81,046 acres of land cover in the Keys, and consists of residential, commercial, institutional, and light industrial areas, as well as golf courses, landscaped areas, roads, and active use parks. Since the urban land cover does not provide significant or essential ecological habitat for wildlife or native plants, it is not discussed in this section.

Terrestrial habitats in the Keys include tropical hardwood hammocks, pinelands, coastal dunes, and disturbed areas. The disturbed areas include those areas recently cleared but not yet developed, and areas with a dominance of nuisance non-native vegetation. Disturbed areas are included in this section because they are considered transitional and have the potential to provide ecological habitat in the future or may serve as host sites for FKWQIP wastewater treatment facilities.

Together, these habitats are inhabited by numerous fish and wildlife species, many of which are federally and/or state protected. The marine environment alone supports over 6,000 species of plants, fishes and invertebrates and is dominated by the third largest coral reef system in the world. The value of these habitats to fish and wildlife can be altered by anthropogenic influences, including increased urban development, water quality degradation, altered groundwater flows, and expansion of non-native and invasive species.

Florida Fish and Wildlife Conservation Commision (FFWCC) land cover mapping data indicate a total of 15 land cover classes in the study area. Land cover classes (Table 3-7) include approximately 81,046 acres (FFWCC 2002a). In addition to these land cover classes, marine habitats such as coral reefs make up an additional 1,405,943 acres in the study area. While not included as a FFWCC land cover class, marine habitats and coral reefs are presented in this section because of their importance to the ecosystem in the Keys and sanctuary.

Of the 15 upland and wetland land cover classes, the major land cover components are mangrove swamp (46 percent), urban (26 percent), tropical hardwood hammock (11 percent), coastal salt marsh (seven percent), scrub mangrove (seven percent), pinelands (three percent), and low impact urban (three percent). An additional seven land cover classes together comprise less than one percent of the upland and wetland land cover within the study area. The land cover classes and communities listed below are addressed individually in the following sections.

- Upland habitats
- Disturbed lands and non-native and invasive plants
- Estuarine and freshwater wetlands
- Marine habitats
- Coral reefs

Table 3-7
Land Cover Classes in the Study Area

Class	Class Code	Total Acres	Upland/Wetland/ Coastal Dune Land Cover
High impact urban	221	18,318	23%
Tropical hardwood hammock	9	9,144	11%
Pinelands	3	2,294	3%
Low impact urban	222	2,131	3%
Total Uplands		**31,887**	**40%**
Mangrove swamp	16	36,841	45%
Coastal salt marsh	10	5,924	7%
Scrub mangrove	161	5,645	7%
Tidal flat*	50	486	<1% *
Freshwater marsh and wet prairie	11	103	<1%
Shrub swamp	15	56	<0.1%
Hardwood swamp	13	16	<0.1%
Coastal dune (beach/sand)	36	5	<0.1%
Total Wetlands/Coastal Dune		**49,076**	**60%**
Disturbed/bare soil/clearcut	40	9	<0.1%
Australian pine	211	50	<0.1%
Exotic plant communities	21	24	<0.1%
Total Invasive and Non-Natives		**83**	**<0.1%**
Totals		**81,046**	**100%**

*The tidal flat land cover is a marine habitat and is discussed in *Section 3.5.4, Marine Habitats*. Data from FFWCC's Land Cover Map (1985-1989).

3.5.1 Upland Habitats

Of the 15 land cover classes identified within the study area, two (tropical hardwood hammocks and pinelands) are classified by the FFWCC as upland habitats (Gilbert and Stys date unavailable). High impact urban, low impact urban, and bare soil/clearcut land cover classes are classified by FFWCC as urban/extractive areas.

Upland habitats in the study area include native tropical hardwoods and pinelands, as well as urban areas.

Tropical Hardwood Hammocks. Tropical hardwood hammocks comprise approximately 11 percent of the land cover in the study area (Table 3-7). Tropical hardwood hammocks are found on upland areas of the Keys which consist of outcroppings of the Key Largo and Miami limestones (Snyder *et al.* 1990). These communities are characterized by more than 150 tree and shrub species on the northern edge of a range that extends southward into the Caribbean (Snyder *et al.* 1990). The vegetation in these communities is comprised of a closed canopy of evergreen and semi-evergreen, broad-leaved trees which are mostly of West Indian origin, as well as tropical shrubs, orchids, bromeliads and ferns (Snyder *et al.* 1990, USFWS 1999).

Tropical hardwood hammock communities are not salt-tolerant and there is usually an abrupt transition between tropical hardwood hammocks and salt-tolerant mangrove forests in the upper Keys (Snyder *et al.* 1990). The transition is usually less abrupt between tropical hardwood hammocks and mangrove fringes or freshwater wetlands in the lower Keys (Snyder *et al.* 1990). Large areas of this community type have been developed in the Keys (USFWS 1999).

Common species found in this community include gumbo limbo (*Bursera simaruba*), white stopper (*Eugenia axillaries*), pigeon plum (*Coccoloba diversifolia*), poisonwood (*Metopium toxiferum*), mahogany (*Swietenia mahagoni*), black ironwood (*Drugiodendron ferreum*), wild tamarind (*Lysiloma latisiliqua*), willow bustic (*Bumelia salicifolia*), Jamaica dogwood (*Piscidia piscipula*), mastic (*Sideroxylon foetidissimum*), strangler fig (*Ficus aurea*), Spanish stopper (*Eugenia foetida*), torchwood (*Amyris elemifera*), and wild coffee (*Psychotria nervosa*) (Weiner 1979, Snyder *et al.* 1990, USFWS 1999). Tropical hardwood hammocks of the Keys may include several species that are very rare in the U.S. including lignum vitae (*Guaiacum sanctum*), mahogany, thatch palms (*Thrinax* spp.), and manchineel (*Hippomane mancinella*) (Gilbert and Stys date unavailable).

Based on the FFWCC land cover data, tropical hardwood hammocks occur throughout the study area. In the upper Keys, these communities occur on Pumpkin Key, from Upper Key Largo to Lower Matecumbe Key, and on Lignum Vitae Key. In the middle Keys, tropical hardwood hammocks are found on Long Key, a small portion of the Conch Keys, Duck Key, and from Grassy Key to Vaca Key and Boot Key. In the lower Keys, tropical hardwood hammocks occur on a small portion of Little Duck Key, from Missouri Key to Bahia Honda Key, on the Spanish Harbor Keys, from Little Pine Key to Sugarloaf Key, and from Big Coppitt Key to Boca Chica Key. The most significant areas of tropical hardwood hammock land cover appear to be located on Upper Key Largo, lower Key Largo, Tavernier, Plantation Key, Lignum Vitae Key, Little Pine Key, No Name Key, the Torch Keys, and Sugarloaf Key.

Wildlife native to south Florida and potentially found in the tropical hardwood hammock habitat include gray squirrel (*Sciurus carolinensis)*, marsh rabbit (*Sylvilagus palustris)*, raccoon (*Procyon lotor*), hispid cotton rat (*Sigmodon hispidus floridanus)*, white-tailed deer (*Odocoileus virginianus*), opossum (*Didelphis virginiana)*, red-bellied woodpecker (*Melanerpes carolinus*), Carolina wren (*Thyrothorus ludovicianus)*, pine warbler (*Dendroica pinus*), cardinal (*Cardinalis cardinalis*), mangrove cuckoo (*Coccyzus minor*), black-whiskered vireo *(Vireo altiloquus*), white-crowned pigeon (*Columba leucocephala*), southern toad (*Bufo terrestris*), green tree frog (*Hyla cinerea)*, green anole (*Anolis carolinensis*), black racer (*Coluber constrictor priapus)*, rough green snake (*Opheodrys aestivus aestivus*) and other species. Introduced species found in this habitat include Cuban tree frog (O*steopilus septentrionalis)*, greenhouse frog (*Eleuthrodactylus planirostris)*, brown anole (*Anolis sagrei)*, and several species of gecko.

Pinelands. FFWCC land cover data indicate that pinelands (pine rocklands) comprise approximately three percent of the land cover in the study area. Like tropical hardwood hammocks, pine rocklands of the Keys are found on upland areas formed by outcroppings of Miami limestone (Davis 1943, Snyder *et al.* 1990). The pine rockland communities of the Keys are limited to the lower Keys and are generally surrounded by wet prairies (Snyder *et al.* 1990). Pinelands are maintained by fire (Alexander and Dickson 1972). Based on the FFWCC land cover map, pine rockland communities are located on Little Pine Key, Big Pine Key, No Name Key, Cudjoe Key and Sugarloaf Key.

Species that dominate the canopy in these communities include south Florida slash pine (*Pinus elliottii* var. *densa*), silverpalm (*Coccothrinax argentata*), Florida Keys blackbead (*Pithecellobium keyense*), and Key thatch palm (*Thrinax morrisii*) (Schomer and Drew 1982). Species that are frequently found in the understory include stopper (*Myrtus verrucosa*), saw palmetto (*Serenoa repens*), indigo berry (*Randia aculeata*), pisonia (*Pisonia rotundata*), poisonwood, locustberry (*Byrsonima lucida*), and senne (*Cassia keyensis*) (Schomer and Drew 1982).

In addition to the listed species found in the pineland communities, common species such as armadillo (*Dasypus novemcinctus)*, eastern cottontail rabbit (*Sylvilagus floridanus*), hispid cotton rat, white-tailed deer, raccoon, opossum, gray squirrel, marsh rabbit, red-bellied woodpecker, Carolina wren, pine warbler, cardinal, mangrove cuckoo, black-whiskered vireo, white-crowned pigeon, southern toad, green tree frog, green anole, black racer, rough green snake, and others are frequently found in this habitat. Introduced species similar to those found in the tropical hardwood hammocks are also found.

High impact urban and low impact urban areas were mapped under a single category (urban) on the FFWCC land cover map and comprise a total of 26 percent of the landcover in the Keys. Based on the FFWCC land cover map, the urban land cover class is located throughout the Keys. The more significant urban areas in the upper Keys include Ocean Reef, Key Largo, Tavernier, Plantation Key, Islamorada/Upper Matecumbe Key, and Lower Matecumbe Key. Significant urban areas in the middle Keys include Duck Key, Marathon/Vaca Key, and Knight Key. Significant urban areas in the lower Keys include Ohio Key, Big Pine Key, Summerland Key, Cudjoe Key, Big Coppitt Key, Rockland Key, Boca Chica Key, Stock Island, and Key West.

Based on the FFWCC land cover data, the high impact urban land cover class comprises approximately 23 percent of the land cover in the study area. This land cover class represents unvegetated sites within urban areas such as roads, buildings, and parking lots (Gilbert and Stys date unavailable). Wildlife use of these sites would be generally low.

Bare Soil/Clearcut. Based on the FFWCC land cover data, the bare soil/clearcut land cover class comprises less than 0.1 percent of the land cover in the study area. This land cover class represents "areas of bare soil representing recent timber cutting operation, natural areas of exposed bare soil (e.g. sandy areas within xeric communities), or bare soil exposed due to vegetation removal for unknown reasons" (Gilbert and Stys date unavailable). Extremely small areas of bare soil/clearcut land cover occur on Little Torch Key and on the Newfound Harbor Keys south of the Torch Keys.

3.5.2 Disturbed Lands and Non-Native and Invasive Species

Based on the FFWCC land cover data, the disturbed lands land cover class comprises less than 0.3 percent of the land cover in the project area. This land cover class represents "areas of bare soil representing recent timber cutting operation, or bare soil exposed due to vegetation removal for unknown reasons" (Gilbert and Stys date unavailable), as well as areas with a dominance of nuisance non-native vegetation. These disturbed areas are combined because bare areas in the Keys are typically not bare for a significant period of time before they are either developed and become urban land, or become infested with nuisance vegetation.

Non-native species in the Keys include Brazilian pepper and Australian pine, both of which can outcompete native species and alter habitat for wildlife.

Nuisance plant communities occur in uplands, coastal dunes and on the fringes of wetlands and are dominated by trees and herbaceous species that were planted or have escaped and invaded native plant communities (Gilbert and Stys date unavailable). Nuisance species that are the major problems in the Keys include Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina* sp.), and latherleaf (*Colubrina asiatica*). Latherleaf, originally from the continent of Asia, was introduced into south Florida and the Caribbean. It has spread through the region because of its ability to tolerate saline environments. This species disperses throughout the Caribbean basin via ocean currents which distribute the floating seed capsules. The name of this invasive plant was derived from the fact that when the leaves are rubbed in water, lather is produced. This plant has spread rapidly through the Keys, displacing native communities and vegetation in the coastal system. Rapid growth and salt tolerant characteristics have allowed this species to outcompete native flora (UF-IFAS 2003).

Australian pine inhabits approximately 50 acres within the project area and was introduced in the late 1800s from Australia to provide windbreaks, lumber, and shade. This species can be found in other areas of Florida and can grow to heights of 60 to70 feet. This species disrupts native habitats by altering soil conditions and forming dense litter under the trees that inhibits understory growth of other species. Australian pines are commonly found on dunes where they contribute to erosion and can affect sea turtle nesting habitat (UF-IFAS 2003).

Brazilian pepper (also known as Florida holly), was introduced from Brazil, as its name implies, into Florida in the late 1800s. This ornamental tree/shrub rapidly grows to approximately 35 feet, producing large clusters of red berries that are eaten and dispersed by raccoons and birds. Brazilian pepper can successfully outcompete native plant species for light, soil nutrients, and moisture due to its allelopathic nature and aggressive growth (UF-IFAS 2003).

Based on the FFWCC land cover data, the disturbed lands and invasive species are located on Upper Key Largo in the upper Keys; Grassy Key and Key Colony Beach in the middle Keys; and Key West and Fleming Key in the lower Keys, and extremely small areas of disturbed land cover appear to be located on Little Torch Key and on the Newfound Harbor Keys south of the Torch Keys. Small patches of this nuisance vegetation, however, are scattered throughout the Keys.

Disturbed Lands and Nuisance Exotic Vegetation. Disturbed land provides some habitat for wildlife, but mainly for generalist native species that are adapted to urban environments. These species include opossum, raccoon, various rats and mice, cardinal, blue jay (*Cyanocitta cristata*), mockingbird (*Mimus polyglottos*), Carolina wren, eastern cottontail rabbit, and other common species. Introduced species commonly found in these areas include feral cats (*Felis catus)*, house sparrow (*Passer domesticus*), rock dove (*Columba livia*), European starling (*Sturnus vulgaris*), common grackle (*Quiscalus quiscula*), marine toad (*Bufo marianus)*, monk parakeet (*Myiopsitta monachus*), gecko, Cuban tree frog, and others.

3.5.3 Estuarine and Freshwater Wetland Habitats

Wetlands include areas where water is present either at or near the surface of the soil for all or part of the year, resulting in characteristic soils, water regimes and plant species. Estuarine and freshwater wetlands are susceptible to water quality degradation when they receive stormwater runoff and associated nutrients, sediments, and toxins. As a result, native vegetation can be replaced by more invasive species that may more efficiently assimilate nutrients and grow more quickly.

Estuarine and freshwater wetlands are susceptible to water quality degradation because they receive stormwater runoff containing a variety of pollutants.

Water saturation largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promote the development of characteristic wetland (hydric) soils.

Wetland vegetation reduces the flow of water, resulting in the deposition of mineral and organic particles and constituents attached to them, such as phosphorus or trace metals. Plants introduce oxygen to the generally oxygen-deficient soil environment through their roots, creating an oxidized root zone where bacterial transformations of nitrogenous and other compounds can occur (Good and Patrick 1987). Plants also provide a surface for microbial colonization. Wetland plants remove small quantities of nutrients, trace metals, and other compounds from the soil water and incorporate them into plant tissue, which may later be recycled in the wetland

through decomposition, stored as peat, or transported from the wetland as particulate matter (Tilton and Kadlec 1979, Hammer 1992).

Natural functions of wetlands can be altered or impaired by human activity. Although slow incremental changes in the natural landscape can lead to small changes in wetlands, the accumulation of these small changes can permanently alter wetland function (Brinson 1988). Some of the major hydrologic and water quality functions of wetlands include: (1) flood storage and stormflow modification; (2) ground water recharge and discharge; (3) alterations of precipitation and evaporation; (4) maintenance of water quality; (5) maintenance of estuarine water balance; and (6) erosion reduction.

Nutrient enrichment of wetland systems can, if persistent over time, lead to dramatic and widespread changes in plant species composition. Opportunistic nutrient-tolerant plant species may encroach upon and colonize environments that are experiencing nutrient enrichment (Urban *et al.* 1993). These opportunistic species can outcompete and displace the plants that are common in nutrient-poor wetlands (Davis 1991, Craft *et al.* 1995, Jensen *et al.* 1995).

Nutrient enrichment of wetland systems can, if persistent over time, lead to dramatic and widespread changes in plant species composition.

Inland and coastal wetlands make up nearly 45,000 acres, or about 50 percent of the study area. USFWS National Wetlands Inventory (NWI) maps were used to identify wetlands and deepwater habitats in the study area (listed below).

- Marine (open ocean and associated coastline)
- Estuarine (bays, estuaries, canals)
- Riverine (rivers, creeks, and streams)
- Lacustrine (lakes and deep ponds)
- Palustrine (shallow ponds, marshes, swamps, sloughs)

The NWI provides information on the characteristics, extent, and status of U.S. wetlands and deepwater habitats. Based on the NWI map, three of the five major wetland systems occur in the study area: estuarine, palustrine and marine. Estuarine wetlands make up the vast majority (over 99 percent) of the wetlands in the study area, while marine and palustrine wetlands make up less than one percent, combined (Table 3-8).

Table 3-8
National Wetlands Inventory (NWI) Wetland Classifications in the Study Area

NWI Wetland Classifications	Acres	Percent of NWI Wetlands	Percent of Study Area
Estuarine	44,776	99.58%	55.24
Marine	167	0.37%	< 1%
Palustrine	22	0.05%	< 1%
Totals	**44,965**	**100%**	**55.48**

Data from FGDL (2000).

The estuarine system is described by Cowardin *et al.* (1979) as deepwater tidal habitats and adjacent wetlands with low energy and variable salinity. Mangrove swamps, coastal marshes, and canals in the Keys fall into this classification. Estuarine areas capture sediment and stormwater runoff and filter nutrients and other contaminants from the water before flowing into the ocean, buffer erosional forces, and provide important habitat for juvenile fish and invertebrate species.

Estuarine wetlands make up the vast majority (over 99 percent) of the wetlands in the study area, while marine and palustrine wetlands make up less than one percent, combined.

The palustrine system is described as nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all wetlands in tidal areas with salinities of 0.5 practical salinity units (psu). The following palustrine wetland types were identified in the study area: unconsolidated bottom; open water/unknown bottom; and forested (Cowardin *et al.* 1979). Palustrine systems in the Keys include swamps, freshwater marshes and prairies, and inland ponds.

Marine systems include open ocean overlying the continental shelf, shoreward to the coastline. Marine habitats are exposed to the currents and waves of the open ocean and water regimes are determined by the ebb and flow of the tide. Marine wetland types identified in the study area were subtidal aquatic beds, subtidal unconsolidated bottom, intertidal unconsolidated shore, and intertidal aquatic bed (Cowardin *et al.* 1979).

Coastal Dune Habitat. Based on the FFWCC land cover data, the beach/sand land cover class comprises less than 0.1 percent of the land cover in the study area. The beach/sand land cover class represents coastal areas constantly impacted by wind, waves and tides, including sand dunes and bare sands (Gilbert and Stys date unavailable). Natural beaches in the Keys are comprised mostly of calcium carbonate sand (Johnson and Barbour 1990). Natural sand beaches are small and infrequent in the Keys, although mixed sand and gravel beaches have been deposited by human activities (Getter *et al.* 1981). Coastal dune communities are found on the foredunes of the beach and are mainly comprised of grassy and herbaceous vegetation or thickets comprised of shrubs and small trees (Davis 1942, 1943, USFWS 1999). Coastal strand communities occur just landward of the coastal dune communities and are comprised of grasses or shrubs (USFWS 1999).

Coastal dune communities of the Keys are associated with salt-tolerant vegetation such as sea oat (*Uniola paniculata*), beach morning glory (*Ipomoea pes-caprae*), Key grass (*Monanthochloe littoralis*), beach cordgrass (*Spartina patens*), bay cedar (*Suriana maritima*), sea lavender (*Argusia gnaphalodes*), coastal ragweed (*Ambrosia hispida*), spider lily (*Hymenocallis latifolia*), and sea pickle (*Sesuvium portulacastrum*) (Schomer and Drew 1982, Kruer 1992, Davis 1942). The beach/sand land cover class appears to be located at the northernmost portion of the study area, specifically the eastern portion of Broad Key and an area just south of Broad Key.

Willet (*Catoptrophorus semipalmatus*) and laughing gull (*Larus atricilla*) are common birds known to nest on the beaches of the Keys. Other common species occurring include raccoon, feral cats, and various rodents. The harsh conditions of the habitat preclude many species.

Mangroves. Based on the FFWCC land cover data, mangrove communities comprise approximately 52 percent of the land cover in the Keys study area. The mangrove forest types identified by the FFWCC land cover data include mangrove swamps (45 percent) and scrub mangroves (seven percent). Mangrove forests are valuable communities that serve a variety of natural functions including acting as storm buffers, decreasing erosion and stabilizing land, enhancing water quality, recycling nutrients, providing habitat for a large variety of animals, and acting as nursery grounds for many species, including many commercially valuable fish species (Snedecker and Lugo 1973, USFWS 1999, NOAA 2001b).

The three species of mangrove found in the Keys are the red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*) (Tomlinson 1986). Mangroves tend to be found within tidal elevations or zones along a shoreline. Red mangroves tend to dominate the upper subtidal to lower intertidal zones, black mangroves the upper intertidal zone to higher elevations, and white mangroves the higher elevations that experience occasional flooding (Davis 1940).

Fringe and overwash mangrove forests are the two most frequent types of mangrove swamp in the Keys (Davis 1940). Fringe mangrove forests are thin forests found along protected shorelines (Lugo and Snedaker 1974). These forests, which have the typical mangrove zonation described above, tend to receive lower amounts of runoff of terrestrial nutrients and trees are usually 33 feet or less in height (Odum and McIvor 1990). Overwash forests are found on smaller islands and land projections (Lugo and Snedaker 1974). These forests, which are generally comprised of red mangroves, are inundated daily by tides (USFWS 1999, Lugo and Snedaker 1974). The red mangroves of the overwash forest are typically 23 feet or less in height (USFWS 1999).

Scrub or dwarf forests are comprised of mangroves typically 4.9 feet or less in height and also found in the Keys (USFWS 1999). The stunted growth of these mangroves may be due to a combination of extreme tidal flushing, limited nutrients, and harsh rocky substrates (Lugo and Snedaker 1974, USFWS 1999).

Mangroves provide valuable habitat for many common faunal species including over 200 species of fish, over 12 species of mammals (raccoon, mink, river otter, etc.), over 20 species of reptiles and amphibians, and more than 170 species of birds.

Coastal Salt Marsh. FFWCC land cover data also indicate that coastal salt marsh comprises approximately seven percent of the land cover in the study area. Coastal salt marshes occur in protected areas within the intertidal zone (Schomer and Drew 1982, USFWS 1999, Montague and Wiegert 1990). These communities are important transition zones between tidally influenced habitats and upland habitats (USFWS 1999). Coastal salt marshes are periodically flooded by tides and are inhabited by emergent salt tolerant species (USFWS 1999).

Salt marshes of the Keys are isolated from mainland flows of freshwater and tend to have a different structure and species composition than salt marshes in other areas of the state (USFWS 1999) that receive freshwater runoff or are influenced directly by river flows. Intertidal marshes, grassy salt marshes, and buttonwood transitional marshes are the typical coastal salt marshes found in the Keys (Goodyear 1987, McNeese 1998). Intertidal marshes are found at the lowest elevations and inhabited by species more tolerant of saline soils (halophytic species) such as

glasswort (*Salicornia perennis*), saltwort (*Batis maritima*), and Key grass (*Monanthochloe littoralis*) (USFWS 1999). Mangroves, particularly the black mangrove, may also inhabit the intertidal marsh communities (USFWS 1999).

Grassy salt marshes occur at higher elevations than intertidal marshes and are typically inundated only during spring tides and storm events (Ross *et al.* 1992). The dominant vegetation of the grassy salt marsh includes Gulf cordgrass (*Spartina spartinae*), sea oxeye (*Borrichia arborescens*) and salt marsh fimbristylis (*Fimbristylis castanea*) (Forys and Humphrey 1992). Buttonwood transitional marshes, which are found at higher elevations than other salt marsh habitats, are inundated only during storm events (USFWS 1999). Salt grass (*Distichlis spicata*), coastal dropseed (*Sporobolus virginicus*), and sea oxeye are typical of the buttonwood transitional marsh communities (USFWS 1999).

Based on the FFWCC land cover map data, coastal salt marsh communities occur throughout the Keys, although the majority appear to be located in the lower Keys. In the upper Keys, Upper Key Largo, and El Radabob Key east of Largo Sound contain areas of significant coastal salt marsh land cover. In the middle Keys, significant areas occur on Long Key, Channel Key (north of Duck Key) and Long Point Key. In the lower Keys, significant areas occur on Ohio Key, Bahia Honda Key, the Johnson Keys, Little Pine Key, No Name Key, Big Pine Key, the Torch Keys, Ramorod Key, Summerland Key, Knockemdown Key, Cudjoe Key, Sugarloaf Key, the Saddlebunch Keys, and Boca Chica Key.

Common faunal species found in the coastal marsh habitat include white-tail deer, river otter, raccoon, mink, marsh rabbit, cotton rats and mice, a wide variety of herons and egrets (*Ardeidae*), water fowl, gulls, and an abundance of fish and reptiles.

Freshwater Marsh and Wet Prairie. Based on the FFWCC land cover map data, freshwater marsh and wet prairie communities appear to be located on Big Pine Key. Freshwater marsh and wet prairies together comprise less than one percent of the land cover in the study area. These communities are inhabited by emergent herbaceous vegetation and are characterized by shallow surface water that is at or above ground elevation for all or part of the year (Kushlan 1990). Freshwater marshes have higher elevations and shorter periods of inundation than wet prairies (USFWS 1999). These two communities tend to be composites of both communities that vary over time (Weller 1994).

In the Keys, isolated freshwater marshes and wet prairies are generally seasonally inundated depressions (McNeese 1998). The dominant vegetation species found in these communities are saw grass (*Cladium jamaicensis*), buttonwood (*Conocarpus erectus*), red mangrove, white mangrove, wax myrtle (*Myrica cerifera*), saffron plum (*Sideroxylon celastrinum*), *Fimbrystylis* spp., and Gulf coast spikerush (*Eleocharis cellulosa*).

The shallow sawgrass marshes of the Keys provide habitat for such common species as little grass frog, narrow mouthed toad, leopard frog, pygmy rattlesnake, Florida water rat, red-winged blackbird, herons and egrets, white ibis, common moorhen, common yellowthroat, cardinal, and numerous other birds.

Shrub Swamp. Based on the FFWCC land cover data, shrub swamp comprises less than 0.1 percent of the land cover in the study area. Shrub swamps are defined as "wetland communities

dominated by dense, low-growing, woody shrubs or small trees usually characteristic of wetland areas experiencing environmental change, and are early to mid-successional in species complement and structure" (Gilbert and Stys date unavailable).

Based on the FFWCC land cover map data, the shrub swamp land cover class appears to be located on upper Key Largo. Shrub swamp communities may not exist in the Keys. The FFWCC land cover data associated with the shrub swamp habitat type in the Keys is likely incorrectly interpreted from Landsat images. These communities may be a type of transitional habitat between herbaceous and woody wetlands. A field verification of the areas would be necessary to determine the community type (personal communication P. Frank USFWS 2003, personal communication T. Gilbert FFWCC 2003).

Hardwood Swamp. Hardwood swamp comprises less than 0.1 percent of the land cover in the study area), primarily in Key Largo. Hardwood swamps of the Keys are wooded wetland communities adapted to wetland conditions and organic soils (Gilbert and Stys date unavailable).

Vegetation that may occur in hardwood swamps of the Keys include pond apple (*Annona glabra*), Carolina willow (*Salix caroliniana*), buttonbush (*Cephalanthus occidentalis*), and strangler fig. Federally protected animal species that may occur within this habitat include the eastern indigo snake (*Drymarchon corais*), wood stork (*Mycteria Americana*), bald eagle (*Haliaeetus leucocephalus*), and American alligator (*Alligator mississipiensis*.

The hardwood swamp communities within the Keys would also provide habitat for such common species as those found in the tropical hardwood community.

Canals and Inland Ponds. Canals in the Keys are included as an estuarine systems due to their tidal and salinity characteristics, as well as their connection to marine waters. Approximately 700 canals have been constructed in the Keys to provide boat access to marinas and residential developments (FEMA 2002). In most cases the canal shorelines in the Keys have been reinforced by seawalls and therefore have no associated vegetation. In cases where seawalls are absent or degraded, mangroves have become established.

Floating vascular plants and/or algae often comprise a majority of the vegetation biomass. Bottom sediments consist of mud, sand, cobble, gravel, and organic debris (IDNR date unavailable). The federally listed endangered West Indian manatee is documented to occur in the study area and the animal may use these canals to feed on the vegetation.

Inland ponds that occur in the study area comprise approximately four percent of the land cover mapped for the study area. These ponds are freshwater and saltwater ponds that receive rainwater and stormwater runoff, but are not connected to nearshore waters. The study area contains approximately 560 lakes/ponds, ranging in size from 0.02 acres to 642 acres, with an average size of six acres.

3.5.4 Marine and Benthic Habitats

Marine habitats are characterized by high productivity and biodiversity and are essential to many commercially and recreationally important fisheries (Livingston 1990), as well as recreational activities such as SCUBA diving, snorkeling, and boating, all of which are important to the local

and regional economy. Marine habitats, particularly seagrasses and coral reefs, are susceptible to water quality degradation and the effects of water quality degradation in these habitats is described in *Section 3.4, Water Quality*.

Acreages and percentages of each marine benthic habitat type were calculated based on the FMRI Benthic Habitats of the Keys data (FMRI 1998), which were generated through interpretation of aerial photographs. Overlap among coastal habitats, such as tidal flats and other nearshore communities, account for differences in acres of cover between the "land" habitat designated by FMRI and "land cover." Percentages of each habitat relative to the study area are listed in Table 3-9. Marine and benthic habitats in the study area are mapped in Figure 3-3.

The marine environment alone supports over 6,000 species of plants, fishes and invertebrates and is dominated by the third larget coral reef system in the world and the only living coral reef in the U.S.

For the purpose of this project, nearshore waters cover 981,000 acres on the Gulf and Atlantic coasts. On the Atlantic side, the marine and estuarine waters from shore to the inside boundary of the barrier reef (approximately three to six miles), including seagrass, patch reef and hardbottom communities, and excluding the barrier reef make up nearshore waters. On the Florida Bay and Gulf side, those waters within the Sanctuary boundary, which includes seagrass, hardbottom and sandy bottom habitats. Nearshore areas, because of their proximity to shore, are susceptible to impacts from wastewater discharges and stormwater runoff.

Table 3-9
Marine Benthic Habitats in the Study Area

Habitat Group	Area (square miles)	Area (acres)	Percent
Seagrasses	1,114	712,918	51%
Coral reef habitats	373	239,138	17%
Water	492	314,793	22%
Bare/unknown substrate	218	140,017	10%
Total	**2,197**	**1,406,866**	**100%**

Data from FMRI (1998).

FMRI data indicate that tidal flat/sand flat, sand/mud bottom, hardbottom, seagrass and coral reef habitats combine to make up 78 percent of the study area, exclusive of the land cover described earlier under *Section 3.5, Ecological Habitats*. The water classification refers to areas that are beyond the depth threshold of the aerial photography (approximately 30 feet) or are uninterpretable due to glare or turbid waters. The FMRI maps may overestimate the "land" area. This is because exposed tidal flats and/or very shallow areas may have been mistakenly included in this category. A description of those habitats comprising approximately 73 percent of the study area follows.

Marine habitats, particularly seagrasses and coral reefs, are susceptible to water quality degradation. See *Section 3.4, Water Quality*, for a discussion of the effect of water quality degradation in these habitats.

Tidal Flat/Sand Flat. Tidal flats and sand flats would be incorporated into the FMRI "unknown bottom" classification. Unknown bottom comprises approximately eight percent of the study area. The FFWCC land cover data identified approximately 490 acres of tidal flat land cover in the study area.

Exposed tidal flats of the Keys tend to be located in open bays (e.g. Vaca Key Bight), on the leeward side of offshore islands (e.g. Boot Key), or in close proximity to tidal inlets (e.g. Teatable Channel in Upper Matecumbe Key) (Schomer and Drew 1982). These flats experience moderate to high wave activity and tidal currents and are comprised of carbonate sands along with muds (Schomer and Drew 1982). Sheltered flats, which occur within island lagoons of the Keys, are characterized by little to no wave action or tidal currents and are comprised of carbonate mud (Schomer and Drew 1982).

Vegetation associated with exposed tidal flats may include mangroves (red and black) and shoal grass (*Halodule wrightii*) (Schomer and Drew 1982). Vegetation associated with sheltered flats of the Keys would include mangroves (red and black), grasses (saltwort and Key grass), seagrasses (shoal grass and turtle grass (*Thalassia testudinum*)), and algae (green and blue-green algae) (Schomer and Drew 1982).

Biological use of tidal/sand flats can be very high, with large numbers of invertebrates, including mollusks (conch, scallops, clams, mussels and oysters), crustaceans (crabs and shrimp) and worms (NOAA 2001a). Examples of species that may inhabit tidal/sand flats of the Keys include land crabs (*Cardiosoma guanhumi*), fiddler crabs (*Uca* spp.), the snail *Batillaria minima*, and the polychaete worm *Notomastus* sp. (Getter *et al.* 1981). In addition, these habitats are used heavily by foraging fish and roosting and foraging birds (NOAA 2001a).

Based on the FFWCC land cover data, tidal flats occur in the lower Keys. Specifically, tidal flats are located on Ohio Key, Bahia Honda Key, No Name Key, the southern portion of Big Pine Key, the Torch Keys, Summerland Key, Cudjoe Key, Sugarloaf Key, the Saddlebunch Keys, Big Coppitt Key, East Rockland Key, and Boca Chica Key.

Sand/Mud Bottom. Sand/mud bottom is incorporated into the "bare substrate" land cover classification. Based on the FMRI data, bare substrate comprises approximately one percent of the study area. The sand/mud subsystems include all non-live benthic habitats or those live benthic habitats with a low percent cover (less than ten percent) (NOAA 1998a). Sand/mud benthic habitats are distributed widely in coastal and shelf areas, and include sandy or muddy areas that serve as transitions between coral reefs and seagrass beds and shorelines, rocky substrates associated with rocky shorelines, and muddy bottom associated with mangrove shorelines (NOAA 1998a). The "White Bank," located east of the upper Keys, is an example of a calcareous sandy bottom habitat (Schomer and Drew 1982). Hawk Channel is an example of a calcareous mud bottom habitat in the Keys (Schomer and Drew 1982). These calcareous sand and mud bottom habitats have lower species density and diversity when compared with seagrass habitats (Schomer and Drew 1982).

Vegetation found in sand and mud bottom habitat might include algae such as *Penicillus* sp., *Halimeda tridans*, *Halimeda incressata*, *Halimeda tuna*, *Udotea* sp., and *Rhipocephalus* sp. (Schomer and Drew 1982). Animals that might be present include foraminifera such as

Peneroplis sp. and *Quinqueloculina* sp., corals such as rose coral (*Manicina areolata*) and thin finger coral (*Porites divaricata*), gastropods such as *Cerithium* sp. and *Olivell* sp., bivalves such as *Chione cancellata* and *Codakia* sp., crustaceans such as the tunneling shrimp (*Calinassa* sp.), and echinoids such as the sea biscuit (*Clypeaster rosaceus*), red heart urchin (*Meoma ventricosa*), cushion starfish (*Oreaster reticulatus*), and the sand dollar (*Clypeaster subdepressus*) (Schomer and Drew 1982). Based on the FMRI data, bare substrate habitat type, which represents the sand/mud bottom community, is found throughout the study area, landward of the patch and barrier coral reefs on the Atlantic side of the Keys.

Hardbottom. Based on the FMRI data, hardbottom comprises approximately 13 percent of the study area. Hardbottom communities of the study area occur nearshore, from the shoreline to as far as two miles offshore (Enos 1977). Hardbottom communities are generally dominated by calcareous algae and invertebrates such as sponges and soft coral (Schomer and Drew 1982). These communities may have a thin layer of sand or mud covering the rock surface, however it is not thick or stable enough to support seagrasses (FMRI 1998). Vegetation in these communities consists of macroalgal species such as the green algae (*Acetabularia crenulata*, *Halimeda* sp., *Penicillus* sp., and *Valonia dichotoma*), brown algae (*Dictyota dichotoma),* and red algae (*Champia parvula*, *Chondria* sp., *Eucheuma isiform*, *Goniolithon* sp., and *Laurencia poitei)* (Zischke 1973).

Wildlife that inhabit these communities include sponges such as the loggerhead sponge (*Spheciospongia vesparia*), *Spongia graminea*, *Ircinia* spp., and *Halicondria melanadocia*. Soft corals include the corky sea finger (*Briareum asbestinum*), sea rod (*Eunicea knighti*), angular sea whip (*Pterogorgia anceps*), and the Venus sea fan (*Gorgonia flabellum*). Stony corals such as branched finger coral (*Porites furcata*), golfball coral (*Favia fragum*), and massive starlet coral (*Siderastrea siderea*) also occur in hardbottom habitats. Other creatures include the brittlestar (*Astrophyton muricatum*), long-spined sea urchin (*Diadema antillarum*), and spiny lobster (*Panulirus argus*) (Voss and Voss 1955, Zischke 1973, Kissling 1965, Enos 1977).

Based on FMRI data, hardbottom communities occur throughout the study area. The most significant area of hardbottom habitat within the study area occurs in the middle and lower Keys. This extensive hardbottom habitat extends along the Florida Bay side of the study area, from Long Key to Little Pine Key.

Seagrasses. Patchy and continuous seagrasses together comprise approximately 48 percent of the study area and are mapped in Figure 3-3. Seagrasses are vascular flowering plants that live in shallow marine environments (Zieman 1982, Day *et al.* 1989). Seagrass beds are extremely productive and important nearshore habitats because they stabilize bottom sediments, which prevent erosion and resuspension maintaining water clarity, provide food and shelter for a multitude of species, and serve as nursery grounds for commercially important fishery species (USFWS 1999, Kenworthy and Haunert 1991, Allen *et al.* 1980, Klima *et al.* 1986, Thayer and Chester 1989, NOAA 2001b).

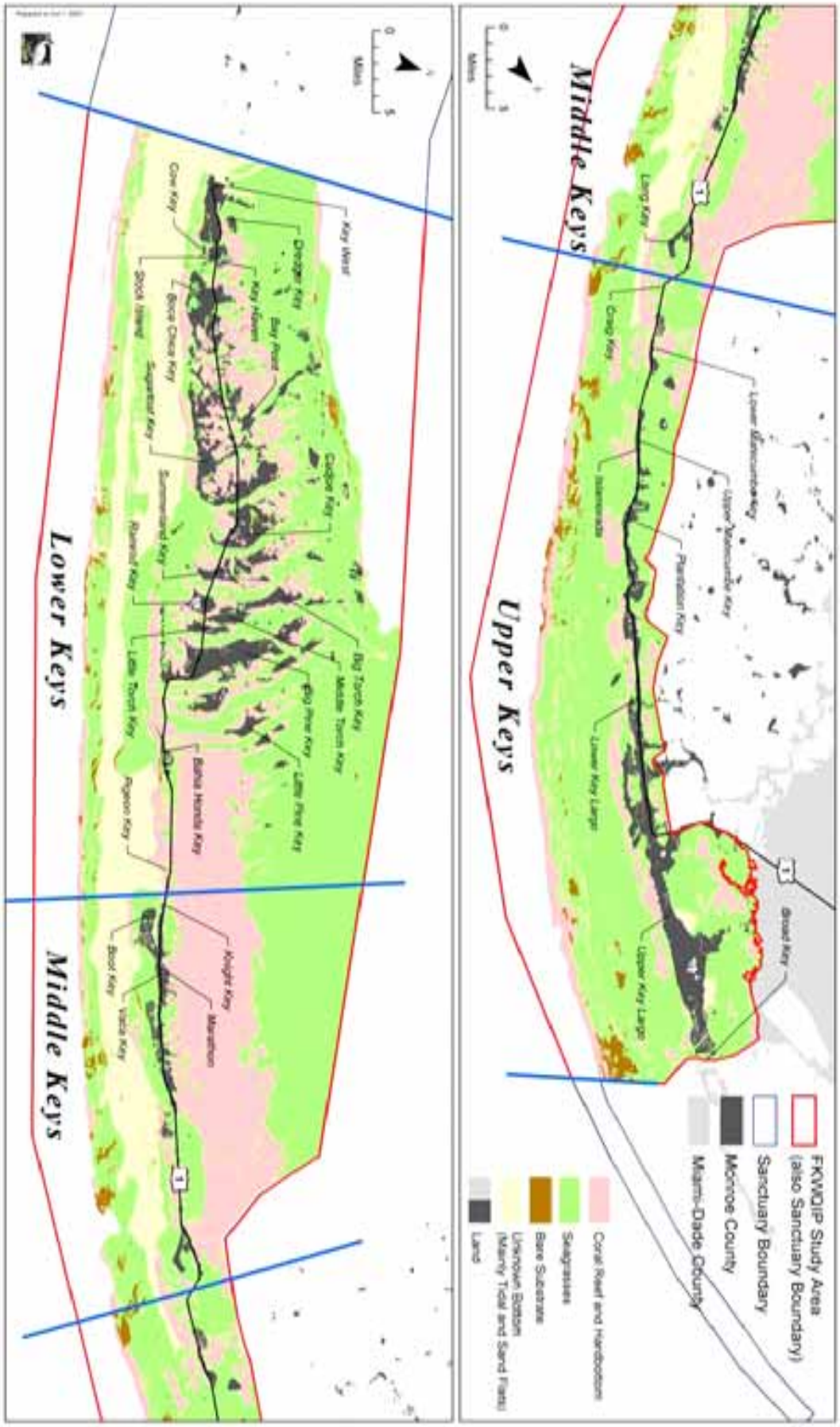


Figure 3-3

Location of Nearshore and Marine Habitats in the Study Area

Of the seven species of seagrasses in Florida, three are prominent in the Keys: turtle grass *(Thalassia testudinum)*, manatee grass *(Syringodium filiforme)*, and shoal grass *(Halodule wrightii*) (Zieman 1982, Fong and Harwell 1994). Turtle grass tends to be the dominant species throughout much of the Keys, although manatee and shoal grasses may occur within turtle grass meadows and may be dominant in some areas (Fong and Harwell 1994).

Like other plants, seagrasses require light in order to photosynthesize (Zieman and Wetzel 1980, Levinton 1995), making light the most important factor controlling both the survival of seagrasses and the depth at which they can occur (Morris and Tomasko 1993). Most seagrasses require more than ten percent of the solar energy reaching the water surface (Duarte 1995). Of the three predominant seagrass species in the Keys, turtle grass has the greatest light requirement and is found at the shallowest depths, followed by manatee grass and shoal grass (Fourqurean *et al.* 2002). The subtropical temperatures and near oceanic salinities found in the Keys are optimal for growth of seagrass.

The factors that determine the distribution of seagrasses include light, temperature, salinity, sediments, and nutrients.

Sediments must be sufficiently deep to allow the seagrass rhizomes (roots) to securely anchor the plant (Jaap and Hallock 1990). Secure anchoring allows the plant to withstand the effects of surge and currents (Zieman 1982). Sediments also provide nutrients to the plants and are necessary for reproduction (Zieman 1982). Shoal grass is most adept at colonizing shallower sediment depths (Fonesca *et al.* 1981), while turtle grass requires the greatest sediment depths, a minimum of three inches (Scoffin 1970).

Seagrasses generally thrive in low nutrient environments (Larkum *et al.* 1989) where they obtain nutrients primarily from the sediments with a minor amount from the water column (Levinton 1995). Although nutrients are necessary for seagrass growth and health, excessive nutrient levels can decrease water clarity, thereby decreasing light available for photosynthesis, growth, and reproduction in seagrasses.

As the leaf blades of the plants age, they become fouled with epiphytic micro- and macroalgae. These plants, as opposed to the rooted seagrass, use the nutrients in the water column for growth. When water column nutrients become elevated, these epiphytic plants can flourish, reducing the available light for the seagrasses, and reducing growth and reproduction.

Fong and Harwell's (1994) model of seagrass communities predicts that turtle grass will dominate in areas with high sunlight, intermediate seasonal temperature and salinity variability, low nutrient levels in the water column, and high nutrient levels in the sediment. These characteristics are typical of bay or estuary environments. The model predicts that shoal grass will dominate in areas with high nutrient levels in the sediment and high variability of temperature and salinity. According to the model, manatee grass will dominate in conditions of lower nutrient levels in the water column and a lower variability of temperature and salinity, which are characteristic of oceanic environments.

Other vegetation occurring within seagrass habitats include macroalgae such *Halimeda opuntia*, *Halimeda incrassata*, *Penicillus pyriformis*, *Penicillus capitatus*, *Caulerpa paspaloides*, *Avrainvillea nigricans*, *Jania* sp., and *Padina* sp. (Turmel and Swanson 1976, Enos 1977, Zieman 1982).

Wildlife frequently found in seagrass beds include the queen conch (*Strombus gigas*), West Indian sea star (*Oreaster reticulata*), sea urchins, sea cucumbers, pink shrimp (*Penaeus duorarum*), spiny lobster (*Panulirus argus*), the corals *Manicina areolata* and *Porites furcata,* sponges, clams, annelid worms, and fish such as drums, sea bass, porgies, grunts, snappers, and mojarras (Jaap and Hallock 1990).

Based on FMRI data, seagrass communities (both continuous and patchy) occur throughout the study area. These extensive seagrass beds are found on both the Atlantic and Florida Bay sides of the study area.

3.5.5 Coral Reefs

The shallow water coral reef system in the Florida Keys is "the most extensive living coral barrier reef system in North American waters and the third largest in the world" (NOAA 2000). These coral reefs are vital to the commercial and recreational fishing that support the economy of the Keys. Coral reefs and other hardbottom habitats in the study area are mapped in Figure 3-3. In addition to sport fishing, nonconsumptive recreational activities include boating, SCUBA diving, snorkeling, and natural history activities and are major revenue sources of the Keys (Jaap and Hallock 1990). The ecological significance of coal reefs is recognized in Executive Order 13089 (Coral Reef Protection), which directs federal agencies whose actions could potentially affect coral reef ecosystems to implement measures to reduce impacts from pollution, sedimentation and fishing. The location of these reefs in coastal waters, in some cases close to human populations, makes their successful management challenging.

The shallow water coral reef system in the Florida Keys is "the most extensive living coral barrier reef system in North American waters and the third largest in the world" (NOAA 2000).

Reef Structure. Coral reefs are wave resistant mounds of calcium carbonate formed by a thin layer of living organisms, scleractinian corals (Hubbard 1997) and are three-dimensional limestone frameworks produced principally by the coral skeletons. Upward growth of reef occurs because these organisms secrete calcium carbonate as they grow (Jaap and Hallock 1990). Reefs serve as living breakwaters, dissipating storm and hurricane wave energies before they reach the coast of the Keys (Jaap and Hallock 1990). At the same time as growth processes build reefs, destructive forces erode and undermine the structures gradually over time converting the framework to sediments and rubble.

Reef building corals are symbiotic organisms (i.e. the coral animal is associated with the symbiotic algae, the zooxanthellae, a dinoflagellate algae). The symbiotic relationship is of mutual benefit to the coral and zooxanthellae. Photosynthesizing zooxanthellae live within the tissue of the coral polyp and benefit from the environment in the photic zone (part of water

column where photosynthesis takes place), and a source of CO_2 (from animal respiration) and nutrients (Levinton 1995). The coral animal benefits from the carbon necessary for metabolic functions, including reproduction, growth and calcium carbonate secretion (Muscatine 1990). This last function is most important, as the zooxanthellae enhance the calcium carbonate calcification rate and therefore the growth rate of the reef structure itself (Muller-Parker and D'Elia 1997).

The general physical parameters under which coral reef systems occur are summarized in Table 3-10. Coral reefs occur in warm, nutrient poor, clear waters, at shallow depths (100 feet) (Knowlton and Jackson 2000). In nutrient poor waters, macroalgae is limited due to the low levels of nutrients, specifically dissolved inorganic nitrogen and soluble reactive phosphorus (Lewis 1977). High nutrients in the water column stimulate plankton growth and decrease water transparency. Consequently, the more nutrient deficient the water, the clearer it is, and the deeper the corals grow. In contrast, the more nutrients in the water column, the less transparent it is, and health of the corals can be compromised. Hence, healthy coral reefs occur in the most nutrient-deficient marine waters. In addition, increased plankton favors coral predators, competitors, and benthic algae that are harmful to the coral reef. The basic interactions among water quality and coral reefs are illustrated in Figure 3-4.

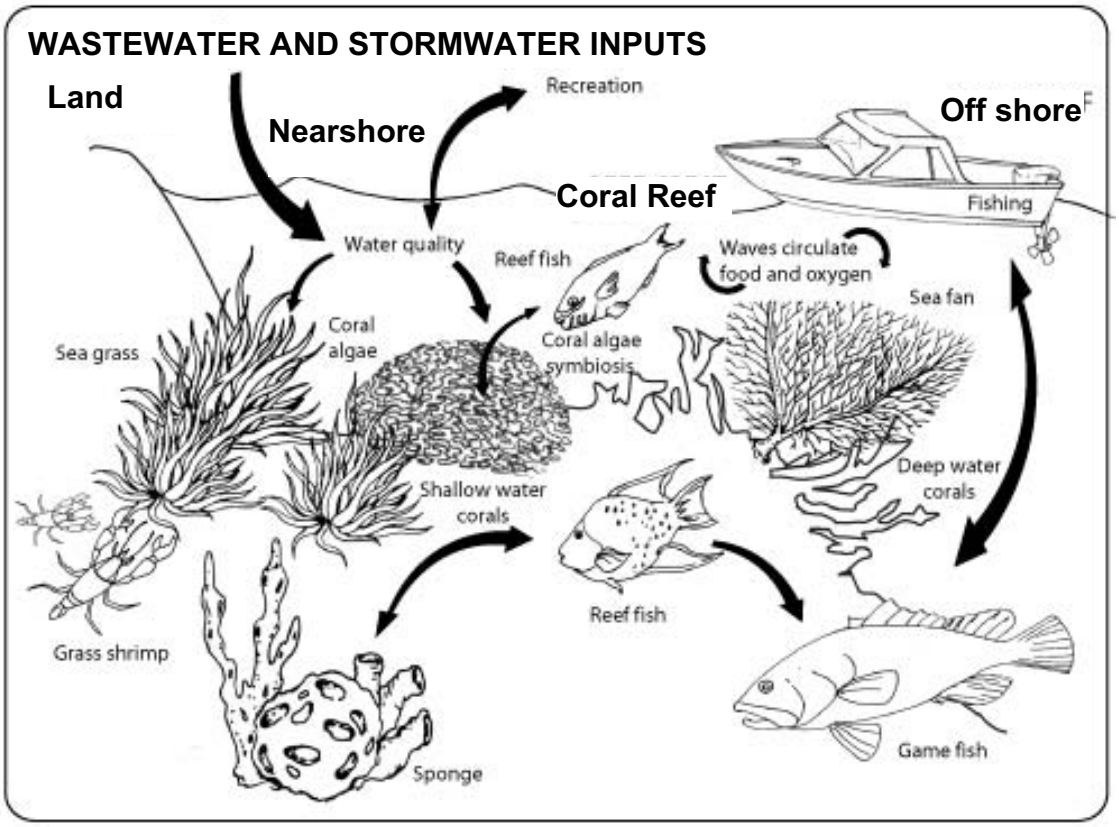
Table 3-10
Physical Parameters Contributing to Coral Reef Growth

Location	Temperature	Light (Depth)	Nutrients	Salinity
25° north to 25° south latitude	64-97°F 79-82°F (optimal)	generally less than 100 ft	low concentrations of phosphorus, nitrogen, and suspended solids	34-37 psu

Patch reefs and platform margin (bank) reefs are the primary reef systems in the Keys and together comprise approximately three percent of the study area. Coral reef communities occur parallel to the Keys on the Atlantic side of the Sanctuary and the largest reef systems are located east of large clusters of islands, such as Key Largo and the lower Keys, where the land acts as a barrier and prevents the transport of silts and other materials from Florida Bay (Schomer and Drew 1982).

Platform margin (bank) reefs are the major reef form in the Keys and generally form a more or less continuous structure parallel to the coastline. Platform margin reefs have a distinctive spur and groove formation, a vertical zonation of coral on the reef face, and may contain elkhorn coral (*Acropora palmata*) (Multer 1977). The area between the platform margin reefs and the islands generally supports seagrass meadows and patch reefs (Jaap and Hallock 1990). Patch reefs are generally found in waters less than 30 feet deep and consist of small to medium sized clusters of corals surrounded by areas of barren sand or seagrasses. Patch reefs of the Keys occur approximately two to four miles from land, between Hawk Channel and the platform margin reef (Marszalek *et al*. 1977). The patch reefs are usually either dome-shaped or linear in shape (Marszalek *et al*. 1977, Jaap 1982) and may range in size from 50 feet to over 2,000 feet (Schomer and Drew 1982).

Figure 3-4
Inter-relationships among Coral Reef Components in the Florida Keys



Ecosystem Components. Coral reefs are part of a complex ecosystem that, in addition to scleractinian (reef building) corals, is home to a variety of other organisms, including algae, seagrasses, anemones, octocorals, sponges, mollusks, worms, echinoderms, crustaceans and fish. Over 350 species of macrobenthic plants and animals have been identified on the reefs of the lower Keys (Kissling 1977). Starck (1968) identified 517 species of fish on Alligator Reef off Key Largo.

Relatively abundant food fish species occur on both the patch and platform margin reefs in the Keys, including the sheepshead (*Archosargus probatocephalus*, the porkfish (*Anisotremua virginicus*), black margate (*Anisortremus surinamensis*), mutton snapper (*Lutjanus analis*), gray snapper (*Lutjanus analis*), black sea bass (*Centropristis striata*), flounder (*Paralichthys dentatus*), and gray triggerfish (*Balistes capriscus*) (FEMA, 2002). Juveniles of commercially important fish include the gag grouper (*Mycteroperca microlepis),* red grouper (*Epinphelis morio*), and black grouper (*Mycteroperca bonaci*). Other species are collected for tropical fish aquariums, including angelfish (*Pomacanthidae*), butterflyfish (*Chaetodontidae*) wrasses (*Labridae)*, and damselfish (*Pomacentridae*). Nearshore reefs also provide habitat for the West Indian manatee and several species of sea turtles.

With more nutrients in the water column, it is less transparent and the health of the corals can be compromised. In addition, increased plankton

favors coral predators, competitors, and benthic algae that are harmful to long-term survival of the coral reef.

3.6 Protected Species

The Florida Keys are made up of a relatively small landmass in a subtropical to tropical island setting and provide habitat for many rare, threatened, and endangered plants and animals. The limited amount of undeveloped natural habitat in the Keys makes these areas and associated species vulnerable to development. Because there are so few remaining developable lands, any project that results in the loss of natural areas is likely to impact protected species. Protected species that occur or may occur in the study area and their associated habitats, regulatory framework affecting these species, and areas important to maintaining the biodiversity in the Florida Keys are addressed in the following sections as part of the PEIS.

Remaining natural areas in the Keys are limited and consequently, any project that results in the loss of natural areas is likely to impact protected species.

✓	✓	✓		✓	

Throughout this document "protected species" will refer to both federally and state listed endangered species, candidate and proposed species, threatened species and species of special concern.

3.6.1 Regulatory Framework

The Endangered Species Act (ESA) of 1973 (16 U.S.C 1531) was created to protect those species at risk of extinction throughout all or a significant portion of their range and to conserve the ecosystems on which those species depend. Section 7 of the ESA prohibits activities that would jeopardize a protected species or destroy or modify its critical habitat.

The USFWS is responsible for the listing and conservation of federally protected terrestrial and freshwater animals and plants, while the National Marine Fisheries Service (NMFS) is responsible for most marine and anadromous species. In the event that an individual wastewater or stormwater project in the study area may adversely affect or result in incidental take of a federally protected species, a formal Section 7 Consultation with the USFWS and/or NMFS would be required.

Similarly, state lists of animals are maintained by the FFWCC and categorized as endangered, threatened and of special concern, and constitute Rules 39-27.003, 39-27.004 and 39-27.005, respectively, Florida Administrative Code (F.A.C.). Any actions that may adversely impact a state listed animal require individual consultation with the FFWCC. The state lists of plants are categorized into endangered, threatened and commercially exploited, and are administered and maintained by the Florida Department of Agriculture and Consumer Services (Chapter 5B-40, F.A.C.).

3.6.2 Federally and State Protected Species in the Study Area

Threatened and endangered species data for Monroe County were obtained from the Florida Natural Areas Inventory (FNAI) database, which includes state and federally protected species designations. Eighty-two species of wildlife and 91 plant species are listed by federal and state agencies as potentially occurring in Monroe County. However, fewer species actually have a documented presence in Monroe County (FFWCC and FNAI).

A summary of the numbers of both state and federally protected species documented to occur in the study area is presented in Table 3-11. Seven of the 37 federally protected species known to occur in the mainland portions of Monroe County are not documented to occur in the Keys: Florida panther (*Felis concolor coryi*), puma (*Puma concolor*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), red-cockaded woodpecker (*Picoides borealis*), Everglades snail kite (*Rostrhamus sociabilis plumbeus*), shortnose sturgeon (*Acipenser brevirostrum*), Gulf sturgeon (*Acipenser oxyrhunchus desotoi*), and Chapman's rhododendron (*Rhododendron chapmanii*). A summary of protected species with documented occurrence(s) in the study area is listed in Table 3-12. A complete list of potentially occurring protected species and associated habitats in Montroe County is included in Appendix E, Table E-1. Recovery plans are also listed where applicable and are available on the USFWS website (http://endangered.fws.gov).

Several state protected species, for example the Florida black bear and gopher tortoise, are not protected at the federal level and therefore require only state-level consultation if adverse impacts are anticipated as a result of a project (Table 3-11). Many plant species with state protection are specific to a particular region, for example the Keys, and may be locally threatened or endangered.

Table 3-11
Summary of Numbers of Protected Species Documented to Occur in the Florida Keys

Taxonomic Group	Federally and State Protected*	State Protected Only	Total
Mammals	6	0	6
Birds	4	13	17
Reptiles	7	7	14
Amphibians	0	0	0
Fish	0	3	3
Invertebrates	0	1	1
Plants	5	39	44
Total	22	63	85

*All federally protected species are also state protected.

3.6.3 Protected Species Occurrences

The FFWCC and FNAI databases were reviewed to identify species occurrences in the study area recorded since 1985. A total of 375 wildlife species observations recorded in the study area

are documented in FFWCC records. Of these, 18 are rare or protected species. The FNAI database records include a total of 1,866 species occurrence locations, of which 131 are rare or protected species. Using these data sources, species occurrences can be mapped and evaluated for evaluation of possible wastewater and stormwater FKWQIP project locations.

Based on FFWCC Breeding Bird Atlas (BBA) survey data for 1986 - 1991 (Endries *et al.* 2001), 87 bird species have been recorded in the study area. Of these records, two are federally protected species (bald eagle, roseate tern). Bald eagle occurrences were recorded in the upper and lower Keys, primarily on the outer islands of the Keys, as well as over Big Pine Key, Summerland Key, and Cudjoe Key. The roseate tern, a federally protected threatened species occurred only in the middle and lower Keys, on Vaca Key and Key West.

Based on wading bird rookeries data (FFWCC 2002c) (Appendix E), 53 wading bird rookeries have been documented in the study area: three in the upper Keys (Key Largo, Cotton Key north of Windley Key, and Shell Key north of Upper Matecumbe Key); four in the middle Keys (Russel Key north of Vaca Key, Vaca Key, and Fanny Keys), and the remaining 46 rookeries in the outer islands of the lower Keys. None of the rookery observations included federally protected species. Only three of the 53 rookeries identified occur on the main, populated Keys: one on Key Largo and two on Vaca Key. The remaining 50 rookeries occur on outer islands of the Keys, away from population centers.

Table 3-12
Protected Species Occurrence Records

Common Name/ Scientific Name	Status	# of FNAI Records	# of FFWCC Records	Habitat
MAMMALS				
Key largo woodrat *Neotoma floridana smalli*	FE, SE	19	0	Terrestrial: deciduous forest 'dry tropical forest'
Key deer *Odocoileus virginianus clavium*	FE, SE	15	0	Terrestrial: pine and hardwood forests, hammock, buttonwood. Estuarine: marsh edges, tidal swamp
Key rice rat *Oryzomys palustris*	FE, SE	9	0	Terrestrial: Fresh and saltwater marshes
Key largo cotton mouse *Peromyscus gossypinus*	FE, SE	15	0	Terrestrial: deciduous forest
lower Keys marsh rabbit *Sylvilagus palustris hefneri*	FE, SE	18	0	Palustrine: titi swamps, floodplains. Terrestrial: tropical hammocks
Manatee *Trichechus manatus*	FE, SE	1	0	Estuarine and Marine: open water, submerged vegetation. Riverine: alluvial stream, blackwater stream, spring-run stream
BIRDS				
Roseate spoonbill *Ajaia ajaja*	SSC	14	0	Estuarine: mangrove-dominated pools. Palustrine: various freshwater areas
Snowy plover *Charadrius alexandrinus*	ST	1	0	Estuarine and Marine: exposed unconsolidated substrate. Terrestrial: dunes, sandy beaches, inlet areas
Piping plover *Charadrius melodus*	FT, ST	4	5	Éstuarine and Marine: exposed unconsolidated substrate. Terrestrial: dunes, sandy beaches, inlet areas
White-crowned pigeon *Columba leucocephala*	ST	83	0	Terrestrial: mangrove covered islands (nesting), tropical hardwood forest (feeding)

Common Name/ Scientific Name	Status	# of FNAI Records	# of FFWCC Records	Habitat
Little blue heron *Egretta caerulea*	SSC	18	1	Estuarine: marshes, shoreline. Palustrine: floodplain, swamp. Riverine: shoreline
Reddish egret *Egretta rufescens*	SSC	31	0	Terrestrial: coastal islands (nesting), sand and mud flats (feeding)
Snowy egret *Egretta thula*	SSC	13	1	Estuarine: marshes, shoreline, tidal swamp. Lacustrine: lake edges. Palustrine: swamp, floodplain, ruderal. Riverine: shoreline
Tricolored heron *Egretta tricolor*	SSC	18	0	Estuarine: marshes, tidal swamps, shoreline. Lacustrine: lake edges. Palustrine: swamp, floodplain, ruderal. Riverine: shoreline
White ibis *Eudocimus albus*	SSC	23	1	Estuarine and Terrestrial: various freshwater, brackish and saline environments.
Peregrine falcon *Falco peregrinus*	SE	5	0	Estuarine: winters along coasts. Lacustrine: various habitats. Terrestrial: various, ruderal
Southeastern American kestrel *Falco sparverius paulus*	ST	1	0	Estuarine: varius habitats. Palustrine: various habitats. Terrestrial: open pine forests, clearings, ruderal, various
Bald eagle *Haliaeetus leucocephalus*	FT, ST	3	0	Estuarine: marsh edges, tidal swamp, open water. Lacustrine: swamp lakes, edges. Palustrine: swamp, floodplain. Riverine: shoreline, open water. Terrestrial: pine and hardwood forests, clearings
Osprey *Pandion haliaetus*	SSC	9	0	Riverine and Palustrine: swamp forest, riparian woodlands, belts of cypress trees
Brown pelican *Pelecanus occidentalis*	SSC	23	26	Estuarine: islands for nesting, open water. Marine: open water
Black skimmer *Rynchops niger*	SSC	2	0	Estuarine and Terrestrial: dredge-material islands, natural sandbars, small coastal islands, beaches
Least tern *Sterna antillarum*	ST	39	90	Estuarine: various. Lacustrine: various. Riverine: various. Terrestrial: beach dune, ruderal.
Roseate tern *Sterna dougallii*	FT, ST	8	15	Estuarine and Terrestrial: bare limestone, sand-shell mixes, rock-marl fill, broken coral, dredge-material islands
FISH				
Key silverside *Menidia conchorum*	ST	23	0	Marine: salt to brackish water; coraline pools surrounded by mangroves and organic debris
Mangrove rivulus *Rivulus marmoratus*	SSC	7	0	Marine and Estuarine: saltwater, brackish, and freshwater; mangrove swamps and high saltmarsh areas
Key blenny *Starksia starcki*	SSC	1	0	Marine: surge channels between rows of coral
REPTILES				
American alligator *Alligator mississippiensis*	FT(S/A), SSC	13	0	Estuarine: marshes, various habitats. Lacustrine: marshes, swamps, various habitats. Palustrine: swamps, floodplains, marshes, various habitats. Riverine: open water, shorelines, various habitats
Loggerhead *Caretta caretta*	FT, ST	4	0	Terrestrial: sandy beaches; nesting
Green turtle *Chelonia mydas*	FE, SE	1	1	Terrestrial: sandy beaches; nesting
American crocodile	FE, SE	0	11	Marine: coastal estuarine swamps.

Common Name/ Scientific Name	Status	# of FNAI Records	# of FFWCC Records	Habitat
Crocodylus acutus				Lacustrine: landlocked saline lakes
Key ringneck snake *Diadophis punctatus acricus*	ST	7	0	Terrestrial: rocky pine scrub, tropical hardwood hammocks
Eastern indigo snake *Drymarchon corais couperi*	FT, ST	21	0	Terrestrial: mangrove swamps, wet prairies, xeric pineland and scrub
Red rat snake *Elaphe guttata*	SSC	23	0	Terrestrial: pine woods, mangrove forest, edificarian situations
Hawksbill *Eretmochelys imbricata*	FE, SE	1	1	Marine: open water; no nesting
Florida Keys mole skink *Eumeces egregius egregius*	SSC	17	0	Terrestrial: sandy shorelines
Key mud turtle *Kinosternon baurii*	SE	21	0	Palustrine: freshwater to slightly brackish ponds. Terrestrial: elevated hardwood hammocks
Lower Keys brown snake *Storeria dekayi*	ST	6	0	Terrestrial: rocky pine forests, hardwood hammocks, near aquatic situations
Rim rock crowned snake *Tantilla oolitica*	ST	5	0	Terrestrial: pine flatwoods, tropical hammocks, vacant lots and pastures
Lower Keys ribbon snake *Thamnophis sauritus*	ST	6	0	Estuarine and Terrestrial: mangrove and spartina habitats, occasional freshwater situations
Golden leather fern *Acrostichum aureum*	SE	7	0	Terrestrial: mangrove swamp, saltmarsh hydric hammock
Sea lavender *Argusia gnaphalodes*	SE	12	0	Terrestrial: beach dune, coastal strand
Blodgett's wild-mercury *Argythamnia blodgettii*	SE	11	0	Terrestrial: sunny gaps and edges in pine rockland, rockland hammock, coastal berm
Rockland orchid *Basiphyllaea corallicola*	SE	1	0	Terrestrial: pine rockland, rockland hammock
Little strongbark *Bourreria cassinifolia*	SE	2	0	Terrestrial: pine rocklands
Locustberry *Byrsonima lucida*	SE	8	0	Terrestrial: rockland hammock, pine rockland
Myrtle-of-the-river *Calyptranthes zuzygium*	SE	3	0	Terrestrial: Rockland hammocks, coastal berm
Wild cinnamon *Canella winteriana*	SE	12	0	Terrestrial: rockland hammock, maritime hammock
Big pine partridge pea *Chamaecrista lineata* var *keyensis*	SE	17	0	Terrestrial: pine rockland
Garber's spurge *Chamaesyce garberi*	FT, SE	10	0	Terrestrial: pine rockland, rockland hammock, coastal rock barrens, salt flats, grass prairie, beach ridge
Porter's broad-leaved spurge *Chamaesyce porteriana*	SE	21	0	Terrestrial: pine rockland, rockland hammock, coastal rock barrens, marl prairie
Silver palm *Coccothrinax argentata*	SE	42	0	Terrestrial: pine rockland, upland hammock
Cuban snake-bark *Colubrina cubensis var floridana*	SE	1	0	Terrestrial: rockland hammocks, pine rocklands
Christmas berry *Crossopetalum ilicifolium*	SE	10	0	Terrestrial: rockland hammock, pine rockland
Rhacoma *Crossopetalum rhacoma*	SE	20	0	Terrestrial: rockland hammock, pine rockland, coastal scrub
Cupania	SE	3	0	Terrestrial: tropical hammocks

Common Name/ Scientific Name	Status	# of FNAI Records	# of FFWCC Records	Habitat
Cupania glabra				
Tropical ironwood *Eugenia confusa*	SE	3	0	Terrestrial: rockland hammock
Red stopper *Eugenia rhombea*	SE	6	0	Terrestrial : rockland hammock
Rockland painted-leaf *Euphorbia pinetorum*	SE	1	0	
Wild cotton *Gossypium hirsutum*	SE	16	0	Terrestrial: coastal berm, shell mounds, maritime hammock
Manchineel *Hippomane mancinella*	SE	17	0	Terrestrial: brackish soils inland of the mangrove zone, coastal berms, hammocks
White ironwood *Hypelate trifoliata*	SE	11	0	Terrestrial: rockland hammocks
Joewood *Jacquinia keyensis*	ST	80	0	Terrestrial: coastal salt flat, coastal scrub, maritime hammock, pine rockland
Sand flax *Linum arenicola*	SE	12	0	Terrestrial: pine rockland, marl prairie
Wild dilly *Manilkara bahamensis*	ST	31	0	Terrestrial: upland hammock
Climbing vine fern *Microgramma heterophylla*	SE	1	0	Terrestrial: rockland hammock
Bahama brake *Pteris bahamensis*	SE	2	0	Terrestrial: pine rockland, upland hammock
Bahama sachsia *Sachsia polycephala*	SE	5	0	Terrestrial: pine rockland
West Indies mahogany *Swietenia mahagoni*	SE	17	0	Terrestrial: rockland hammock, maritime hammock
Brittle thatch palm *Thrinax morrisii*	SE	81	0	Terrestrial: rockland hammock, pine rockland
Florida thatch palm *Thrinax radiata*	SE	47	0	Terrestrial: maritime hammock, upland hammock, coastal scrub
Pineland noseburn *Tragia saxicola*	SE	8	0	Terrestrial: pine rockland
Florida gama grass *Tripsacum floridanum*	SE	1	0	Terrestrial: pine rockland
INVERTEBRATES				
Florida tree snail *Liguus fasciatus matecumbensii*	SSC	0	5	Terrestrial: native hammock trees

Source: FFWCC (date unavailable b). Total acreage was calculated multiplying total number of grid cells by the area of each grid cell. Each grid cell is approximately 2.5 acres. FE–Federally Endangered / SE–State Endangered / FT–Federally Threatened / ST–State Threatened / FC–Federal Candidate Species / FT (S/A)–Federally Threatened due to Similarity of Appearance / SSC–State Species of Special Concern

3.6.4 Existing and Potential Habitat Areas for Protected Species

Approximately 34 percent of the land cover in the Keys is designated as conservation areas, including the Sanctuary, National Wildlife Refuges, and local parks, and are intended to protect fish and wildlife resources. Facilites required for FKWQIP will most likely be constructed on vacant lands or other appropriate land use areas. Consequently, it is important that habitats of particular interest or importance be identified so that these habitats can be avoided during implementation of FKWQIP. Areas important to biodiversity and/or conservation have been identified by Cox *et al*. (1994) and are discussed below.

Existing and potential wildlife habitats in the Keys have been identified by the FFWCC, based on habitat and numbers of key species, many of which are protected. Importantly, biodiversity *hot spots* and Strategic Habitat Conservation Areas (SHCAs) have been developed by Cox *et al*. (1994) to identify conservation targets considered necessary to meet conservation goals in Florida. Information regarding biodiversity hotspots and SHCAs will be used to identify land areas to be avoided during the siting of wastewater treatment facilities.

Biodiversity *Hot Spots*. The FFWCC biodiversity *hot spots* data (FFWCC 2002b) reviewed for the study area represents areas of overlap among potential habitats of 54 rare or focal species of wildlife and four important natural communities. Overlap among greater numbers of species indicates higher biodiversity (a thorough description of these *hot spots* is available in Cox *et al.* 1994). A review of the biodiversity *hot spots* reveals that the highest levels of biodiversity (7+ Focal Species Overlap) tend to be more frequent in the upper and lower Keys. In the upper Keys, most of Upper Key Largo has the 7+ species biodiversity level, and in the lower Keys, the 7+ species biodiversity level is mostly found on No Name Key, Big Pine Key, and the Torch Keys. Areas of the middle Keys are identified as the three to four species biodiversity level with small pockets of the 7+ species biodiversity level. Areas of highest biodiversity should be avoided in siting of new facilities.

The Keys contain areas that represent four of the six conservation goals targeted by the state to maintain biodiversity in Florida and will be addressed in supplemental NEPA documentation for specific projects.

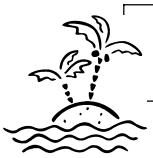
Strategic Habitat Conservation Areas (SHCAs). To identify significant natural resources in the study area, SHCAs were reviewed. SHCAs delineate habitat areas in Florida that should be conserved if key components of the biological diversity in the state are to be maintained. Using habitat and distribution maps, public land boundaries, and literature-based density estimates, Cox *et al*. (1994) developed maps of under-represented species merged into a single statewide map of SHCAs to recommend minimum conservation goals. In the study area, SHCAs represent four of the six minimum conservation goals targeted to maintain biodiversity in Florida. These SHCAs serve as targets for future protection, based on lands needed to meet minimum conservation goals listed in Table 3-13.

Table 3-13
Habitat and Species SHCA Conservation Targets and Presence in Keys

SHCA Conservation Target	Presence of Area or Species in Keys
30 species of wildlife inadequately protected by the current system of conservation lands	Black-whiskered vireo, American crocodile, mangrove cuckoo, and white-crowned pigeon
High quality sandhill, scrub and pine rockland sites	Rare plant SHCAs are identified on Big Pine Key and No Name Key
High quality examples of tropical hardwood hammocks	Tropical hardwoods identified from Key Largo south to the Saddlebunch Keys.
Bat maternity caves and winter roost caves	None identified in study area
Wetlands critically important to breeding success of eight species of wading birds	Wading bird SHCAs identified in Key Largo
Lands critically important to the long-term survival of 105 globally rare species of plants	None identified in study area.

3.7 Essential Fish Habitat (EFH)

The 1996 Magnuson-Stevens Fishery Conservation and Management Act (Act) is intended to conserve and enhance essential fish habitat (EFH) and focus conservation efforts on areas that are particularly important to the life cycles of federally managed fish and shellfish. Increasing concern about impacts of bottom trawling, scallop dredging, and other mobile fishing methods has focused primarily on effects of commercial fisheries. However, these activities also impact benthic habitats, including coral reefs, seagrasses, and other habitats that provide refuge from predation and feeding places for fishes and other species. Coral reefs and other benthic habitats are identified as EFH and must be considered as part of any federal action.



Coral reefs and other benthic habitats are identified as EFH and must be considered as part of any federal action.

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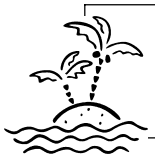
The Act requires federal agency consultation on activities that may adversely affect EFH. NMFS, a service of the U.S. Department of Commerce-National Oceanic and Atmospheric Administration (NOAA), is responsible for implementing this mandate. Informal consultation with NMFS was initiated as part of the preparation for this PEIS. The following species and associated habitats were identified as pertinent to the FKWQIP and will be addressed in supplemental NEPA documentation for specific projects.

- *Panaeid* and Rock Shrimp
- Red Drum
- Snapper-Grouper Management Unit
- Golden Crab
- Spiny Lobster
- Coral, Coral Reefs, and Live/Hard Bottom Habitats

3.8 Air Quality and Noise

Sunny beaches, clear skies, and the natural setting attract visitors from around the world and support the recreation- and tourism-based economy of the Keys. As such, it is important that both air and noise quality be considered in an analysis of the action alternatives. The Keys presently meet or exceed all federal air quality standards. Noise levels are typical of urban areas dominated by commercial and recreational activities.



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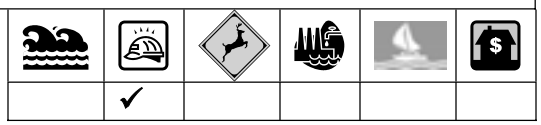


3.8.1 Air Quality

Air pollution is defined as the presence in the atmosphere of a substance or substances added directly or indirectly by a human act, in such amounts to adversely affect humans, animals, vegetation, or materials. The federal Clean Air Act is a legal mandate designed to protect human health and welfare from air pollution. National Ambient Air Quality Standards (NAAQS) are defined in the Clean Air Act as levels of pollutant above which detrimental effects on human health or welfare may result. NAAQS have been established for the following air pollutants: particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO) and lead (Pb). An area that is found to be in violation of NAAQS is called a non-attainment area. Pollution sources contributing to non-attainment areas are subject to tighter restrictions.

Air quality in Monroe County meets or exceeds National Ambient Air Quality Standards for each of the six established pollutant parameters.

The state of FDEP and Monroe County can set more stringent standards for their jurisdictions, but have chosen to utilize the NAAQS as their standard. Air quality in Monroe County meets or exceeds NAAQ standards for each of the six air quality parameters.

Table 3-14
NAAQS and Maximum Recorded Criteria Pollutant Levels for Monroe and Dade Counties - 2002

Location	CO (Maximum 1 hr)	Pb (Quarterly Average)	NO_2 (Annual Average)	O_3 (Maximum 1 hour)	PM_{10} (Maximum 24 hour)	SO_2 (Maximum 24 hour)
NAAQS (Primary)	35 ppm	1.5 ugm^3	0.053 ppm	0.12 ppm	150 ugm^3	0.14 ppm
Monroe Co.	NA	NA	NA	NA	NA	NA
Miami-Dade Co.	6.0 ppm	NA	0.014 ppm	0.095 ppm	51 ugm^3	0.04 ppm

Source: United States Environmental Protection Agency 1999; J. Wheeler 2003.

3.8.2 Noise

Noise in the Florida Keys is typical of areas with urban activities such as traffic, construction, aircraft (near airports), and boats. In addition to air and water contaminants, noise has been recognized as a serious pollutant. Since 1982, responsibility of noise abatement and control has been delegated to state and local governments, but the noise levels and exposure recommendations developed by EPA under the Noise Control Act are still relevant (FEMA 2002). The state of Florida addresses noise control in Title XXIX, Chapter 403 (Public Health, Environmental Control) of the Florida Statutes. The FDEP has been assigned the responsibility of preparing rules for this statute.

Chapter 62-600 of the F.A.C. addresses rules for siting and operation of wastewater treatment facilities. The code indicates that new plants should be sited to minimize the adverse effects of noise produced by the facility. Sensitive noise receptors would include residences, schools, hospitals, churches, parks, and other areas where noise pollution would be intrusive.

In addition, the FDEP has also issued the *General Code of Safe Work Practices,* which states that hearing protection is required at the workplace when an employee's noise exposure is equal to or exceeds an 8 hour time weighted average sound level of 85 decibels (dB) measured on the A scale (FDEP 2001). Monroe County has adopted an ordinance that prohibits noise equal to or exceeding 60 dB beyond the property line of the sound source (Monroe County 2000b). Violators can be fined up to $500 per day.

Ambient noise levels at each project location would vary depending on the land uses in the surrounding area. Typical noise levels of land uses are listed in Table 3-15. The EPA has identified noise levels requisite to protect public health and welfare against hearing loss, annoyance, and activity interference. Noise levels over a 24 hour period should be less than 70 dB to prevent any measurable hearing loss over a lifetime. Likewise, maximum levels of 55 dB outdoors and 45 dB indoors are identified as preventing activity interference and annoyance.

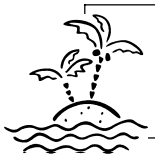
Table 3-15
Typical Noise Levels for Land Uses

Land Use	Decibels
Rural Residential	39
Wooded Residential	51
Old Urban Residential Area	59
Urban Row Housing on Major Avenue	68
Urban High Density Apartment	78
Downtown with some Construction Activity	79
Apartment Next to Freeway	88

Source: EPA 1974a.

3.9 Cultural Resources

Cultural resources may include any historic and prehistoric sites, districts, buildings, structures and objects that are considered significant to a culture for scientific, traditional, religious, or other reason. Cultural resources are generally subdivided into prehistoric and historic archaeological resources, architectural resources, and traditional resources. Archaeological resources are places where human activity has altered the surroundings, and can include such features as campsites, villages, cemeteries, trails, battlefields, and the remains of buildings.



The myriad of cultural resource in the Keys represent environmental features that will be avoided during the siting of wastwater treatment facilities.

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Architectural resources are standing structures of historic significance and may include houses, forts, churches, bridges, commercial buildings, or other structures. The structure must be more than 50 years old to be considered for protection, but the structure's future historical significance can be considered. Traditional resources are cultural resources that native American groups or similar entities consider essential for their traditional culture to persist. Examples of traditional resources include artifacts, sacred areas, traditional hunting areas, or sources of the raw material used to produce tools and sacred objects.

Regulations and Policies. Several state and federal laws have been enacted to ensure consideration of historic values and to protect significant resources from destruction, vandalism or theft. Major federal laws protecting cultural resources include the National Historic Preservation Act (NHPA), Archaeological Resources Protection Act (ARPA), the Native American Graves Protection and Repatriation Act (NAGPRA), and the American Indian Religious Freedom Act of 1978 (AIRFA). Section 106 of the NHPA requires federal agencies to consider the effects of the *Proposed Action* on identified and potentially present cultural resources. In addition, the State Historic Preservation Office, relevant tribal historic preservation officers, and if necessary, the Advisory Council on Historic Preservation, must be allowed to review and comment on the action.

Prehistoric Resources. Human occupation of south Florida may date back as far as 12,000 years. The presence of black earth middens, shell mounds, evidence of transient camps, and features containing stone tools and implements indicate that humans have used this area for many centuries. Paleo-Indians may have traveled to Florida and the Keys from South America or the West Indies. These Indian cultures were thought to be hunter-gatherers, leading a nomadic existence. Unfortunately, the result of that nomadic existence is that there is little evidence of their culture (Wilkinson 2000). Only one Paleo-Indian site, the Grass Key Rock Pit site (8MO1297) has been identified within the Keys, according to the Florida State Historic Preservation Office Master Site Files database.

The state of Florida was approximately twice its current area at that time due to the amount of water tied up the large glacier mass over much of North America. Since the majority of the Paleo-Indians are believed to have lived near the coast, former settlements may be underwater, 30 to 100 miles from the current shoreline (FEMA 2002).

By approximately 4,000 years before present the ocean was probably near its present level and the Keys had become islands. By this time, and before the arrival of the Europeans during the 16th century, the Calusa and Tequesta Indians, as well as other groups, appeared in south Florida and subsisted on fish and shellfish captured from their dugout canoes. These Indians are thought to have had a complex social and political culture and are even thought to have traveled to Cuba and the Bahamas on trading expeditions (Terrell 1999). Only four known sites in Monroe County date from this period. The Key Largo site (8MO25) is a multi-component shell midden site; other sites include the Bear Lake site (8MO33), Upper Matacumbe Key site (8MO17), and the Rock Mound site (8MO26-27).

Cultural resources in the Keys include submerged resources such as old shipwrecks in addition to the historic home of Ernest Hemingway, lighthouses, and Indian middens.

Historic Resources. When the European settlers first arrived in south Florida in the mid-1500s there were an estimated 20,000 Indians, predominantly of the Tequesta and Calusa tribes (FEMA 2002). Over the next 300 years, Florida was traded back and forth among the Spanish and the British, both of whom tended to consider it as a land of little value. The Keys especially were avoided due to their treacherous waters, marauding pirates, dangerous hurricanes, and lack of cultivatable land or fresh water. By the early 1800s most of the Native Indians were gone, either lost to disease or having fled to Cuba, and the first permanent white settlers arrived in Key West. These first settlers made a living by fishing, pirating, and salvaging ships lost to the treacherous reefs and storms.

By 1890, cigar making and sponging had replaced the pirating and Key West had become the largest and wealthiest city in Florida. Transportation between the islands was limited to boats, and life in the "outside Keys" was difficult (FEMA 2002). In 1905, Henry Flagler began construction of the Overseas Railroad south through the Everglades and into Key West. The railroad took seven years and over 500 laborers to construct, and it ran continuously until 1935 when it was destroyed by a hurricane. The damage was so great that the railroad system was sold to the state of Florida and in 1938, the Overseas Highway was constructed on the remnants (Florida Keys Virtual Traveler 2003).

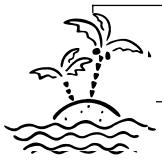
The Keys have had an interesting, colorful, and diverse history and as a result, the Florida Master Site Files (FMSF) has a listing of 449 archaeological sites and over 1000 historic sites in Monroe County, dating from nearly every time period. These sites range from historic homes of famous residents such as Ernest Hemingway, to shipwrecks, monuments, lighthouses, and sinkholes.

In the Keys, in addition to land-based cultural resources, old shipwrecks are numerous and comprise an important cultural resource. The U.S. National Park Service began documenting the location and condition of shipwrecks in the 1960s, and in 1980, the Submerged Cultural

Resources Unit was formed and staffed by underwater archaeologists and photographers. Renamed the Submerged Resources Center in 1999 to include natural resources, the core mission of the program has remained the same: to inventory and evaluate submerged resources in the National Park System and to assist other agencies, nationally and internationally, with underwater heritage resource issues.

3.10 Demographics and Socioeconomics

While the demographics of the permanent population in the Keys are similar to those for Florida in general, the economy of the Keys is based on a tourist industry that attracts three million visitors a year from around the country and the world. The tourist industry relies on water related recreation, including diving, snorkeling, and fishing, and provides an estimated $22 billion to the local economy and supports 23,500 jobs in the Keys. While much of Monroe County is located on the mainland, most of the population and commerce occur in the Keys, and approximately one-third of the population resides in the city of Key West.



The economy of the Keys is based on a tourist industry that attracts three million visitors a year and supports 23,500 jobs.

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3.10.1 Demographics

Monroe County's permanent population in the year 2001 was 79,556 (U.S. Census Bureau 2002), ranking it 35 out of 67 counties in the state. Population increased two percent from 1990 to 2000 and decreased 1.3 percent from 2000 to 2001 (U.S. Census Bureau 2002). Table 3-16 lists the most recent available basic population, income, and business characteristics of Monroe County and Florida as a whole. While the permanent population in Monroe County is somewhat less than 80,000, the functional population expands greatly with the presence of visitors, reaching 150,000 (Leeworthy and Wiley 1996). About ten percent of the residents of Monroe County, or about 8,000 people, are living below the U.S. Census Bureau designated poverty level, which is based on national averages for income and cost of living (Table 3-16).

The definition of poverty applied by the Census Bureau does not indicate the number of Monroe County residents with little or no discretionary income. Since the cost of living in Monroe County is about 10 percent higher than the Florida average, the actual effective number of people in Monroe County living below the poverty level, and consequently impacted by higher utility costs, is much greater than 8,000. As a result, programs have been developed to assist residents with incomes considerably higher than the designated poverty level in paying for utility and other services.

The Monroe County permanent population in the year 2001 was 79,556, ranking it 35 out of 67 counties in the state in terms of population.

Also, as part of the implementation of the wastewater improvements funded by FEMA, a Housing and Urban Development income level system for identifying residents eligible for financial assistance was developed. The system defines low-income residents as those with 80 percent of the median family income, and very low-income residents as those with household income of 50 percent of the median. Based on these definitions, very low-income residents have no discretionary income. Those designated as low-income households have discretionary income levels of about $750 per month (FEMA 2002).

Outside of Key West, there are few areas with large concentrations of non-white permanent residents. Only one Census Block, located in Marathon, had a population greater than 22 percent minorities based on year 2000 Census data (FEMA 2002).

Table 3-16
Monroe County & State of Florida Population, Income, & Business Characteristics

Characteristic	Monroe County	State of Florida
People		
Population, 2001 estimate	78,556	16,396,515
Population percent change, April 1, 2000-July 1, 2001	-1.3	2.6
Population, 2000	79,589	15,982,378
Population, percent change, 1990 to 2000	2.0	23.5
Persons under 5 years old, percent, 2000	4.3	5.9
Persons under 18 years old, percent, 2000	17.1	22.8
Persons 65 years old and over, percent, 2000	14.6	17.6
Female persons, percent, 2000	46.8	51.2
White persons, percent, 2000	90.7	78.0
Black or African American persons, percent, 2000	4.8	14.6
Other	4.5	7.4
Persons of Hispanic or Latino origin, percent, 2000	15.8	16.8
White persons, not of Hispanic/Latino origin, percent, 2000	77.2	65.4
Language other than English spoken at home, pct age 5+, 2000	21.4	23.1
Persons per household, 2000	2.23	2.46
Income		
Median household money income, 1999	$42,283	$38,819
Per capita money income, 1999	$26,102	$21,557
Persons below poverty, percent, 1999	10.2	12.5
Businesses		
Minority-owned firms, percent of total, 1997	17.0	22.0
Women-owned firms, percent of total, 1997	22.0	25.9

Source: U.S. Census Bureau 2002a

3.10.2 Public Health

The Florida Department of Public Health compiles and maintains public health conditions data for each Florida County that indicate that public health conditions in Monroe County were

similar to or better than averages for the state of Florida with the exception of AIDS cases (Table 3-17).

Table 3-17
Public Health Indicators for Monroe County and State of Florida

Health indicator	Monroe County	State of Florida
Infant mortality rate per 1000 live births, year 2001	4.23	7.26
Enteric disease cases per 10,000 population, year 2000	4.26	4.71
Enteric disease cases per 1,000 children under 6, year 2000	1.79	2.00
Reported AIDS cases per 100,000 population, 2000	62.71	31.16
Percent of low income persons with access to preventive and restorative dental care, 2000	9.99	21.72

Source: Florida Department of Health 2003.

While Monroe County statistics for infant mortality and enteric disease were lower when compared with the state of Florida, reported AIDS cases were higher and percent of low-income persons with access to preventive and restorative dental care was lower. In cases where the County health indicator was better than the state of Florida, it was also better than Miami-Dade County. These and other indicators suggest that general health conditions in Monroe County, except for reported AIDS cases, are similar to or better than the state of Florida as a whole.

3.10.3 Socioeconomics

Large portions of the south Florida economy are dependent on healthy coral reefs in the Florida Keys, which are a major attraction for visitors to south Florida. More than 3 million tourists visited south Florida and the Florida Keys from all over the U.S. and spent an estimated $1.3 billion in 1991 (Crosby 1997). In addition, the Florida coral reefs are the number one ranked diving destination in the world, attracting more than 1.2 million divers a year and adding over $220 million a year to the local economy. Commercial fishing is also an important part of south Florida's economy, and in a good year, pink shrimp catches have produced over $120 million, while spiny lobster catches produced $24 million. Recreational fishing produces more than 23,500 jobs.

More than 3 million tourists visited south Florida and the Florida Keys from all over the U.S. and spent an estimated $1.3 billion in 1991 (Crosby 1997).

Employment and Income. Reported employment in Monroe County in 1999 was 32,619, persons working for 3,756 non-farm firms, or an average firm employment of 8.7 persons per firm (U.S. Census Bureau 2002). This compares to the state of Florida average of 14.0 persons per firm, reflecting the much smaller nature of businesses in the Florida Keys when compared with the state as a whole.

In 1997, local governments in Monroe County employed an estimated 4,229 persons, or 5.4 percent of the population, as compared to approximately 3.3 percent of the state population employed. Unemployment rates in Monroe County have historically been lower than the state of

Florida, and as recently as December 2002, the unemployment rate for Monroe County was 2.3 percent, less than one-half the state figure of 4.9 percent. The strong employment demand is supported by a higher proportion of residents in the working age group, (between the ages of 18 and 65), when compared other areas of in the state. The principal industry sectors in Monroe County, based on 2000 employment and payroll figures are listed in Table 3-18.

Table 3-18
Monroe County Employment and Payroll by Industry Sector

Industry Sector	Employment in 2000		Payroll in 2000	
	Number	Percent of Total	Amount	Percent of Total
Fishing*	63	0.2	$ 1,491,000	0.2
Mining	not reported		not reported	
Utilities	not reported		not reported	
Construction	2,335	7.2	$ 54,658,000	7.6
Manufacturing	606	1.9	$ 15,912,000	2.2
Wholesale trade	817	2.5	$ 22,726,000	3.1
Retail trade	6,876	21.2	$ 128,008,000	17.7
Transportation and warehousing	833	2.6	$ 17,733,000	2.4
Information	614	1.9	$ 16,930,000	2.3
Finance and insurance	1,247	3.9	$ 55,749,000	7.7
Real estate and rental and leasing	976	3.0	$ 23,526,000	3.3
Professional, scientific, and technical services	1,148	3.5	$ 38,058,000	5.3
Management of companies and enterprises	115	0.4	$ 5,182,000	0.7
Administration, support, waste management, remediation services	1,043	3.2	$ 26,785,000	3.7
Educational services	235	0.7	$ 4,781,000	0.7
Health care and social assistance	2,585	8.0	$ 78,011,000	10.8
Arts, entertainment, and recreation	905	2.8	$ 25,943,000	3.6
Accommodation and food services	9,993	30.9	$ 169,315,000	23.4
Other services except public administration	1,793	5.5	$ 31,760,000	4.4
Total	**32,364**		**$ 723,854,000**	

*Sector also includes forestry, hunting, and agriculture. Source: U.S. Census Bureau 2001.

Cost of Living. The 2001 Florida Price Level Index identified Monroe County as having the highest cost of living in Florida. With an index value of 110.51, Monroe County cost of living is 10.51 percent higher than the state average. A number of factors account for the high cost of living and include, but are not limited to, elevated costs of real estate, insurance, transporting goods and services, sales tax, and utilities.

Real estate costs in the Florida Keys, addressed in more detail below, are higher than elsewhere in Florida. The cost of owning real estate is strongly affected by property taxes, which are also higher on a per household basis in Monroe County. Finally, the cost of owning real estate in Monroe County is increased by the high cost of insurance that results from a hurricane-prone area.

Goods and services are generally more costly in the Florida Keys than elsewhere in Florida, mainly due to the high cost of transportation to and from the area. With no rail transportation or commercial seaport, virtually all goods are shipped by truck from the mainland.

Utility Costs. One of the principal factors affecting the cost of living in the Florida Keys and a factor that would be impacted by any of the project alternatives is the cost of utility services. Rates for utility services are elevated for residents in the Keys due to the distance of utility lines required to provide service to residents. In addition, the cost of sewer service is relatively high in the Keys due to infrastructure requirements for collecting wastewater, treatment, and disposal of treated effluent.

One of the principal factors affecting the cost of living in the Florida Keys and a factor that would be impacted by any project alternatives is the cost of utility services.

There are currently five central wastewater treatment facilities operating in Monroe County. Only two, in the cities of Key West and Key Colony Beach, comply with future state of Florida wastewater treatment standards (FEMA 2002). Wastewater customers in the service areas of these plants would be affected by the project alternatives only with respect to stormwater management. However, in the rest of the Florida Keys, residents and business operators would be affected by both the increased cost for wastewater management and stormwater management improvements.

In the three wastewater treatment plant service areas currently not complying – Key Haven Utilities, Ocean Reef Club, and KW Resort Utilities - residents pay from $1,215 to $2,700 to connect, and from $55 to $64 per month for sewer service. The costs for installation and monthly operating of aerobic treatment units (ATUs) are estimated to be $7,800 and $73, respectively (FEMA 2002). As noted above, ATUs will not be permitted to operate in the Florida Keys after the year 2010.

The costs for installation and monthly operating of ATUs have been estimated to be $7,800 and $73, respectively.

Where on-site wastewater nutrient reduction systems (OWNRS) are installed, the cost of wastewater treatment will often be greater than the cost of compliant central wastewater treatment facilities. For OWNRS, the capital cost may be expected to range from $2,500 to $8,200 per unit served, with monthly charges of from $63 to $118 (FEMA 2002). Residents and businesses using cesspits and septic tanks currently spend very little for maintaining and operating their systems. Maintenance typically includes only occasional pumping and minor repairs.

The estimated fraction of income that a resident can afford to pay for sewer service is two percent (FEMA 2002). Based on the median household income in Monroe County ($42,273 per year, or $3,524 per month), a resident can afford $70 per month for sewer. Excluding the cost of connection, which in existing residential units is generally included in the unit's capital cost, the

monthly sewer bills paid by customers of central wastewater treatment facilities are within the target amount for sewer bills for persons with median household income or above. However, for persons with household incomes substantially below the median, the monthly cost of sewer service could greatly exceed the generally accepted affordability level.

Affordability indices focus on the ability to pay for continuing service. However, another expense to residents of equal or greater significance is the cost of connecting to a central sewer system. While no affordability index for connection charges has been developed, this cost could be a major issue for low-income residents. These costs are usually addressed through financing arrangements that allow customers to pay the cost over a five or ten year period.

No estimates of affordability of wastewater management costs have been developed for businesses in the Keys because each business has very different operating and financial conditions. Generally, wastewater service, like water, electric power, and other utility services, is considered a cost of doing business.

Home Ownership. The home ownership rate in Monroe County (62.4 percent) is well below the state of Florida average (70.1 percent) (U.S. Census Bureau 2002). Several factors contribute to this discrepancy, one of which is the median value of housing units. The average cost of a housing unit in Monroe County is $241,200, more than twice the state average of $105,500. Another factor is the transient nature of the population. Monroe County estimated that the temporary population, on average, is equal to 86 percent of the permanent residents on any given day of the year. As a result, in the year 2000, 37.6 percent of occupied housing units were renter-occupied (U.S. Census Bureau 2000b).

The income generated by tourism amounted to an estimated 47 percent of the County total, while the employment supported by tourism was estimated to be nearly 37 percent of the County total.

Tourism. Tourism is the principal economic force in Monroe County. While efforts are underway to develop more recent data on tourism in Monroe County, data from the late 1990s illustrate the importance of this industry. During the 12 month period between June 1997 through May 1998, a reported 2.29 million visitors spent an estimated 14.3 million days in the Florida Keys. About three-fourths of these people arrived by automobile. Furthermore, visitors spent an estimated $1.38 billion in the County during this period and generated an estimated $1.55 billion in total output and sales. In turn, this provided approximately $565,000,000 in income, and supported nearly 19,000 jobs (Leeworthy and Vanesse 1999). The income generated by tourism amounted to an estimated 47 percent of the County total, while the employment supported by tourism was estimated to be nearly 37 percent of the County total.

3.11 Recreation

The year-round warm temperatures and marine waters of the Keys support tourism and recreational fishing. While local geology limits the formation of sandy beaches found along much of coastal Florida, the primary natural attraction in the Keys is the coral reef. The coral reef is the most extensive living coral reef in the continental U.S., the third largest reef in the world, and the number one diving destination in the world.

In a survey conducted during 1995 and 1996, 90 percent of all visitors in both summer and winter seasons responded that recreation or vacation was their primary purpose for visiting the Keys.

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The 2.29 million visitors to the Keys rely on clean water and beaches as well the abundant fish and wildlife that characterize this popular vacation spot. These visitors provide the basis of the tourism industry on which the economy of the Keys relies. Consequently, potential impacts to recreation amenities, and therefore tourism, that may result from the implementation of FKWQIP must be examined. A discussion of recreation activities and their importance to the Key's economy is presented here. Further discussion of tourism and the economy in the Keys was presented in *Section 3.10*.

In a survey conducted during 1995 and 1996, 90 percent of visitors to the Keys in both summer and winter seasons responded that recreation or vacation was their primary purpose for visiting the Keys. The survey was part of a study by the Monroe County Tourist Development Council (TDC), The Nature Conservancy (TNC), Florida Keys Initiative, and NOAA to establish contributions made by tourism to Monroe County's economy, and to measure the importance of outdoor recreation and marine resources to the visitor industry. The range of recreational pursuits directly related to these reefs and marine resources includes fishing, boating, snorkeling, SCUBA diving, eco-tourism, and sightseeing.

The Florida coral reefs are the number one ranked diving destination in the world, attracting more than 1.2 million divers a year and adding over $220 million a year to the local economy.

Historical and cultural resources associated with the Keys that support tourism include ships that have become stranded along the islands during Key West's early history of wreckers and pirates. Historical attractions include the remnants of the Overseas Railroad constructed in the early 1900s, Fort Zachary Taylor in Key West, and Fort Jefferson in the Dry Tortugas, 68 miles west of Key West. Construction of both forts began before the Civil War. Other recreational amenities include entertainment along Duval Street, museums, quality local seafood, and live entertainment in numerous cafes and legendary pubs, including Ernest Hemingway's favorite, Sloppy Joe's in Key West.

Recreation days in Monroe County (Table 3-19) indicate that most activities are somehow related to saltwater. This information illustrates the importance of saltwater recreational opportunities in the County.

Table 3-19
Recreation Days in Monroe County: 12-Month Period 1995-1996

Activity	Recreation Days Reported	Percent of Total Days Reported[1]
Boating Activities		
Snorkeling	1,010.8	7.9
SCUBA diving	190.0	1.5
Offshore fishing	859.2	6.7
Personal watercraft	239.8	1.9
Viewing nature & wildlife	796.0	6.2
Non-Boating Activities		
Snorkeling from shore	548.1	4.3
Fishing from shore	359.9	2.8
All beach activities	2,867.6	22.4
Swimming in outdoor pools	2,489.2	19.4
Wildlife & nature studys	1,789.8	14.0
Museums & historic sites	1,665.9	13.0

Note: The totals reported are less than actual totals because in some cases the sample size was not sufficiently large to produce a reliable estimate. Source: Leeworthy and Wiley 1996.

A commitment to the protection of recreational resources of the Keys is evident in the large percentage of lands dedicated to conservation and recreation. As referenced in the land use section (*Section 3.14*) Monroe County contains over 1.3 million acres of public conservation and recreational land owned by federal, state and local governments.

Federal- and state- owned conservation lands in the Keys comprise approximately 1.2 million and 82,000 acres, respectively, and include predominately water.

Monroe County has over 1.3 million acres of public land and water available for recreation, most of which is water (Monroe County 1997a). In addition to the recreational opportunities provided to local residents, public access to these areas has led to the development of a major tourism and recreation industry in Monroe County. Recreation areas provide active and passive recreation opportunities, focusing on recreation rather than resource conservation and are usually smaller and more densely developed (Monroe County 1997a). In addition, Monroe County has acquired from private landowners approximately 500 acres of land now designated for conservation. An additional 370 acres has been acquired by two private not-for-profit organizations, The Nature Conservancy and the Florida Keys Land and Sea Trust (Monroe County 1997a).

The state of Florida owns about 82,000 acres of conservation land in Monroe County. By far the state's largest holding is John Pennekamp Coral Reef State Park (45,010 acres) (Monroe County 1997a). Other sizable state holdings include Lignumvitae Key State Aquatic Preserve (8,320 acres) and Coupon Bight State Aquatic Preserve (6,000 acres) on Big Pine Key (Monroe County 1997a). Similar recreation areas and land uses are described in *Section 3.14*, Land Use and Planning.

3.12 Open Space and Aesthetic Resources

Visual resources are an aesthetic quality of a community and are those physical features that make up the landscape, and include land, water, vegetation, and other features such as buildings. The visual resources in the Florida Keys are numerous. The chain of islands over 100 miles in length connected by bridges provides a unique sightseeing experience for the Florida Keys visitor. Land use on the islands ranges from intense urban to sparsely developed, but even the urban areas contain extensive natural areas. The marine resources are conspicuous in the urbanized areas, and includes boats, canals, marinas, resorts, and other nautical establishments.

The chain of islands over 100 miles in length connected by bridges provides a unique sightseeing experience for the Florida Keys visitor.

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The Keys are also made up of numerous natural areas with mangrove forests, salt marshes, and upland areas containing hardwood hammocks and pine communities. From the numerous bridges, the view consists of the open water, along with the beaches and near shore waters which attract visitors year round.

In addition to visual resources, recreation and open space are important to the aesthetic environment in the Keys. In recognition of this, the Monroe County specifies a minimum neighborhood and community park acreage for each housing unit, or acreage based on functional population.

3.13 Environmental Justice

Issues and concerns regarding environmental justice vary depending on the project and the community, however, the core issue is one of fairness in the siting of facilities and the regulation of environmentally hazardous activities. One of the primary factors contributing to environmental inequities is the location of many minority and lower income populations in more densely developed and industrialized areas with greater concentrations of environmental hazards. While this suggests that environmental equity is more of an urban issue, there are other factors such as siting decisions which apply to all areas.

The purpose of this section is to characterize the racial and economic make up of the Keys so that environmental justice can be evaluated for the project alternatives. This section describes the conditions relating to any potential environmental justice issue associated with the project alternatives.

Environmental justice means that no group of people, including racial, ethnic or socioeconomic group, should bear a disproportionate share of the connection for service fees associated with FKWQIP projects.

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Federal Executive Order 12898, issued in 1994, requires each federal agency to make environmental justice a part of the planning process, ensuring greater public participation, and identifying differences in resource consumption patterns of minority and low-income portions of the population. The USEPA Office of Environmental Justice has defined environmental justice as:

> *The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, policies*.

Fair treatment means that no group of people, including racial, ethnic or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

A review of the demographic profile of Monroe County indicates that approximately 25 percent of the population is considered non-white. This includes 4.8 percent black or African American, 15.8 percent Hispanic or Latino, and 4.5 percent other minorities. Minorities are generally evenly distributed throughout the population, although minorities make up more than 22 percent of some Census Blocks in the cities of Marathon and Key West.

In terms of economics, income of approximately 10.2 percent of the population in Monroe County is below the poverty level and is less than the state average of 12.5 percent. The median age of residents in Monroe County was 38.7 years as of the 1990 Census and an estimated 15.3 percent of the population is over the age of 65. Persons of retirement age are typically on fixed incomes and while their income may not be below the poverty level, they are affected by cost of living factors. In regard to the Executive Order mandate to identify differences in resource use patterns of minorities and low-income portions of the population, it is assumed that the entire population of the Florida Keys has access to and opportunities to use the environmental resources.

As described previously, a high number of Keys residents would be significantly impacted by much higher utility costs. Minority, low income, and fixed income residents of the Keys currently occupy a disproportionate number of dwellings with cesspits or failing septic tanks because they do not have the financial resources to properly maintain these wastewater treatment units. As wastewater and stormwater improvements are undertaken by municipalities in the Keys, this segment of the permanent population may be challenged to pay assessed fees.

3.14 Land Use and Planning

This section addresses the current land use patterns in the Keys and land use regulations developed to control future growth and protect water resources. Many of the water quality problems in the Keys are closely associated with land uses implemented prior to existing environmental regulations. Consequently, untreated stormwater runoff and improper wastewater disposal practices continue to adversely affect wetlands and nearshore waters. To ensure the sustainability of the resources unique to the Keys, Monroe County comprehensive land use

planning provisions have been developed. These include objectives and policies establishing the Permit Allocation System and the ROGO (see Appendix D) to control future growth.

Many of the water quality problems in the Keys are closely associated with land uses implemented prior to existing environmental regulations. Consequently, untreated stormwater runoff and improper wastewater disposal practices continue to adversely affect wetlands and nearshore waters.

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The Florida Keys Carrying Capacity Study, sponsored jointly by the Florida DCA and the Corps, established a planning tool to assist in determining the level of development activities that will provide a means to avoid further irreversible and/or adverse impacts to the Keys (Florida Administrative Weekly 1996).

3.14.1 Current Land Use

The mainland portions of Monroe County are comprised of major conservation and recreational areas (e.g. Everglades National Park) and are relatively unpopulated. The population centers within the County are located on the Florida Keys, a 112 mile chain of islands, stretching from Key Largo to Key West. Land uses within the Keys reflect evidence of historical development patterns. Key West was an active seaport before the turn of the century and the historical fishing villages of the upper and middle Keys are still population nodes within Monroe County. The advent of the railroad and subsequent construction of U.S. Highway 1 helped foster the land boom in south Florida beginning in the 1920s, during which large tracts in south Florida, including the Keys, were platted as residential and commercial developments. Today land uses along the Keys are a mix of residential and commercial, linearly distributed along the 30 islands accessed by U.S. Highway 1.

Residential land uses account for 17.6 percent of the Keys land area (Table 3-20). The residential land uses accommodate the permanent residents as well as the seasonal and recreational residents, all of whom comprise the functional population of the Keys that is estimated at 159,000 individuals. Residential development occurs throughout the Keys, with the more urban concentrations in the communities of the upper Keys and the lower Keys, especially Key West, whose population accounts for more than one-third of the County total. Many of the residential land uses are situated along the shoreline of Florida Bay or the Florida Straits, taking advantage of the scenic resources and recreational access afforded by these waterfront locations.

Commercial land uses include general commercial, commercial and recreational boating and fishing, as well as tourist oriented land uses. As with the residential land uses, hotels and motels are widely distributed along the Keys, many with water access and/or scenic views. Other commercial land uses such as marinas and restaurants also sought waterfront locations. Most of the industrial and military land uses occur in the lower Keys, specifically within the City of Key West. Based on information provided in the 1995 Monroe County Soil Survey, there are no prime farmland soils in the County and therefore no action is required under the Farmland Protection Policy Act (Hurt *et al.* 1995).

Together, conservation (33.7 percent) and vacant (34.4) lands make up 68 percent of the land uses in the Keys. Conservation areas include both federal and state sanctuaries, wildlife management areas, and parks. Conservation areas are concentrated in the upper and lower Keys. These conservation lands are an important land use within the Florida Keys, with each management area, sanctuary, or park providing for the protection or conservation of the resources within its boundary, as well as public recreational facilities.

Vacant lands occur throughout the Keys, but are most concentrated in the upper and lower Keys. In 1997, 44 percent of the unincorporated lower Keys were classified as vacant, although with the inclusion of Key West that figure would drop somewhat (Monroe County 1997b).

Together, conservation (33.7 percent) and vacant (34.4) lands make up 68 percent of the land uses in the Keys.

In addition to the undeveloped platted lots, there are a number of vacant privately owned offshore islands. However, for the most part, these islands are either not developable or will support a minimal amount of development. Monroe County has designated several areas as Areas of Critical County Concern: Big Pine Key, North Key Largo, Windley Key/Holiday Isles, and Ohio Key. Windley Key/Holiday Isles received this designation due to traffic and parking issues, while the other Keys are of concern due to environmental sensitivity (Monroe County 1997b).

Table 3-20
Florida Keys Land Use

Land Use	Acres	Percent of Total
Residential		
Single family	8,378.9	13.7
Mobile homes	1,062.8	1.7
Multi-family	637.7	1.0
Mixed residential	710.9	1.2
Subtotal	**10,790.3**	**17.6**
Commercial		
General commercial	994.1	1.6
Commercial fishing	247.1	0.4
Tourist commercial	1,028.9	1.7
Subtotal	**2,270.1**	**3.7**
Other		
Industrial	514.8	0.8
Agricultural/maricultural	41.9	0.1
Educational	106.4	0.2
Institutional	116.3	0.2
Public buildings/grounds	60.8	0.1
Public facilities	539.1	0.9
Military	3,288.7	5.4

Table 3-20
Florida Keys Land Use

Land Use	Acres	Percent of Total
Historic	0.5	0.0
Recreation	1,791.3	2.9
Conservation	20,685.7	33.7
Vacant	21,127.2	34.4
Subtotal	**28,272,7**	**78.7**
Total	**61,333.1**	**100.0**

Source: Monroe County 1997a. Note: Acreages exclude incorporated cities.

3.14.2 Conservation Areas

Approximately 34 percent of the lands in Monroe County are identified as conservation areas and include federally designated National Wildlife Refuges (NWRs) and Ecological Reserves (ERs), state parks such as John Pennecamp Coral Reef State Park, state Aquatic Preserves, and other areas intended to protect fish and wildlife resources (Figure 3-5). Importantly, the Sanctuary includes the most extensive coral reef in North America including the 2,600 square nautical miles of federally designated coastal waters. Consequently, these resources must be evaluated in the context of impacts that may occur as a result of the FKWQIP.

Under Public Law 101-605, 2,600 square nautical miles of coastal waters are designated under the Florida Keys National Marine Sanctuary. The Sanctuary includes extensive shoreline and marine resources such as mangroves, coral reef formations, seagrass beds, wetlands, and fish and wildlife, all of which may be adversely impacted by poor water quality due to stormwater and wastewater discharges. In recognition of the importance of these systems, several protection, preservation, and management areas have been designated in the study area and are described in the following sections.

Florida Keys National Marine Sanctuary. The Sanctuary contains vast natural resources and astounding beauty. The Sanctuary contains the most extensive living coral reef in the U.S. and the third largest reef system in the world. There are also cultural resources in the Sanctuary, including centuries old shipping routes with a high concentration of shipwrecks and an abundance of cultural artifacts (NOAA 2003a). Tourism and commercial fishing are important resources of the Sanctuary and support a large portion of the economy in the Keys. Over the past two decades, tourism has grown to over three million visitors annually to enjoy the Keys and the Sanctuary.

National Wildlife Refuges (NWR) within the Sanctuary. The Key West NWR includes numerous islands known locally as the "backcountry" and is accessible only by boat. Key West NWR is located west of Key West at the southern most point in the continental U.S. This refuge, encompassing over 375 square miles of open water and 2,019 acres of land, was the first NWR established in the Keys (USFWS date unavailable).

The Great White Heron NWR includes nearly 7,500 acres of the Sanctuary and the islands themselves are, like the Key West NWR, located in the local backcountry of the Keys. This

NWR includes pristine, isolated islands, extending across more than 264 square miles of open water in the Gulf of Mexico. Access to these islands is difficult and low mangroves are the dominant habitat. Established in 1938, the refuge provides permanent protection to the great white heron, and other birds, such as the white-crowned pigeon, roseate spoonbill, and the only known colony of laughing gulls in the lower Keys, occur here.

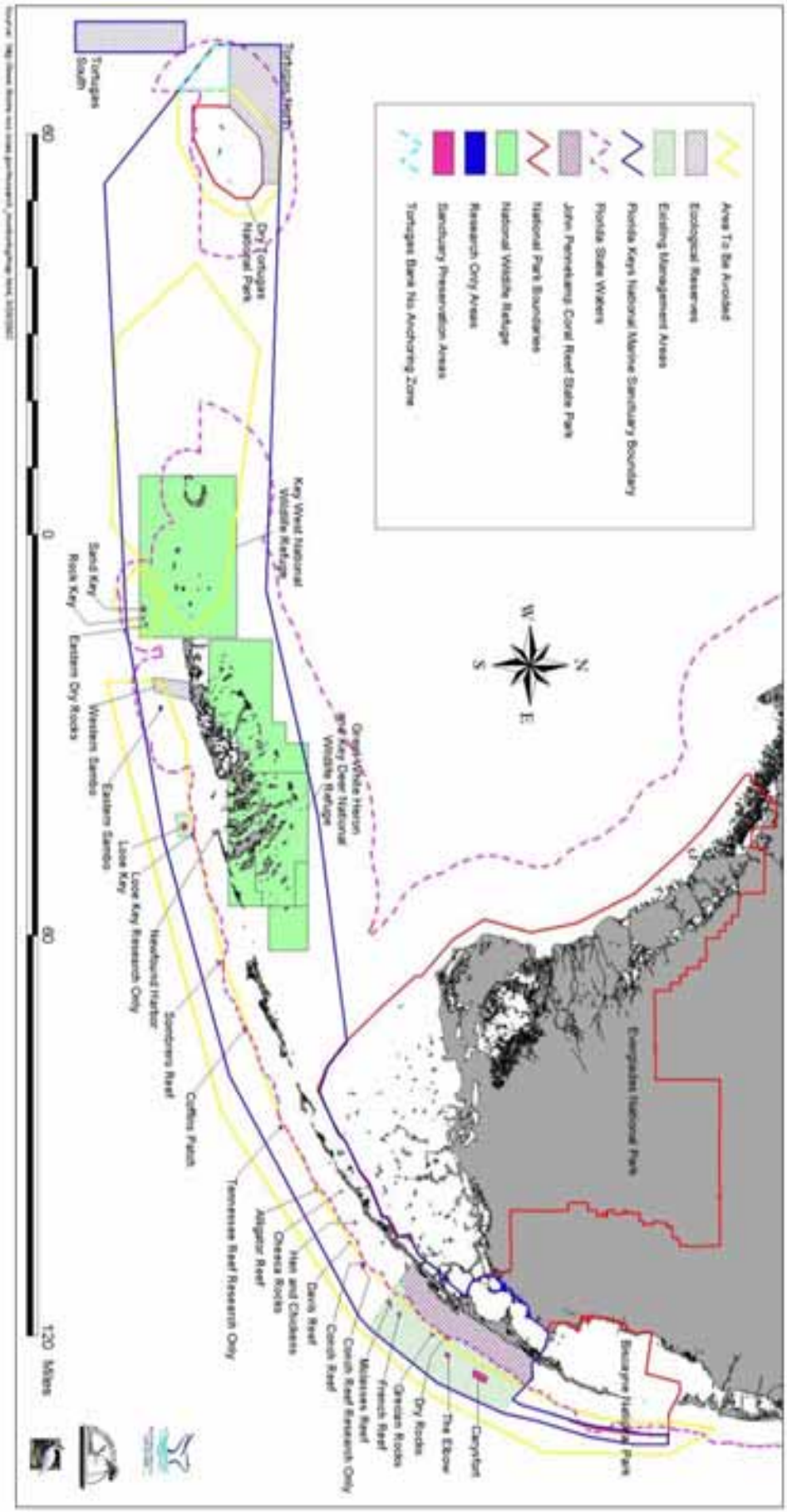
The Key Deer NWR is located in the lower Keys and consists of a patchwork of small and large mangrove swamps, pine rockland, hardwood hammocks, and freshwater wetlands. The establishment of this refuge in 1957 was the result of conservation efforts that began in the 1940s to protect a herd of less than 50 Key deer. Today the population is approximately 300 individuals (USFWS date unavailable).

Crocodile Lake NWR is located in the upper Keys and is closed to public access to protect critical habitat for the endangered American crocodile, Key Largo woodrat, Key Largo cotton mouse, and other wildlife (USFWS date unavailable).

Ecological Reserves (ER) within the Sanctuary. The Western Sambo ER is also located in the Sanctuary. As a designated Ecological Reserve, spearfishing, shell collecting, tropical fish collecting, and other marine life harvesting activities, including fishing, are prohibited. In addition, direct physical impact to corals in this area (whether through breakage, take, damage or disturbance) is prohibited.

Sanctuary Preservation Areas (SPAs) within the Sanctuary. There are 18 small SPAs established to protect popular shallow coral reefs (listed below). Activities prohibited in the SPAs include spearfishing, shell collecting, tropical fish collecting, fishing, and other harvesting activities. In addition, direct physical impacts to corals in these areas (whether through breakage, take, damage or disturbance) are prohibited.

- Carysfort SPA
- Alligator Reef SPA
- Elbow Reef SPA
- Key Largo Dry Rocks SPA
- Grecian Rocks SPA
- French Key SPA
- Molasses Reef SPA
- Conch Key SPA
- Davis Reef SPA
- Hens and Chickens SPA
- Cheeca Rocks SPA
- Coffin's Patch SPA
- Sombrero Reef SPA
- Newfound Harbor SPA
- Looe Key SPA
- Eastern Dry Rocks SPA
- Rock Key SPA
- Sand Key SPA



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Location of Conservation Areas in the FKWQIP Study Area

Wildlife Management Areas (WMAs) within the Sanctuary. There are 27 WMAs in the Sanctuary. Twenty of the 27 WMAs fall under the jurisdiction of USFWS and Sanctuary regulations. WMAs have been established to complement the existing USFWS management plan. Public access restrictions in these areas include idle speed only/no wake, no access buffer, no motor, and limited closures.

Existing Management Areas within the Sanctuary. Regulations have been established to complement the Management Area regulations (as developed in the Sanctuary Management Plan). Some areas of the Sanctuary are designated as research-only areas (ROAs). Only those authorized by a valid permit may enter such areas. The ROAs in the Sanctuary are the Eastern Sambo and Tennessee Reef ROAs.

The following existing Management Areas in the Sanctuary receive additional protection as a result of the Sanctuary designation. These additional protections include prohibitions on spearfishing, shell collecting, tropical fish collecting, fishing, and other harvesting activities, along with public watercraft restrictions. Previously designated management areas in the Sanctuary are listed below.

- Looe Key Management Area
- Key Largo Management Area
- Great White Heron National Wildlife Refuge
- Key West National Wildlife Refuge
- All State Parks and Aquatic Preserves

State Parks. The Florida State Park system was established in 1935 and has expanded to become one of the largest and most heavily used park systems in the U.S. Containing over 43,000 acres in more than 150 separate parks, with an annual operating budget in excess of $40 million, Florida's State Parks represent a major commitment by the state to preserve scenic resources and provide outstanding recreational opportunities for park visitors. The following State Parks occur within the Sanctuary.

- John Pennecamp Coral Reef State Park
- Bahia Honda State Park
- Overseas Heritage Trail State Park
- Indian Key State Historic Park
- Lignumvitae Key Botanical State Park
- Long Key State Park
- Windley Key Fossil Reef Geological State Park
- San Pedro Underwater Archaeological Preserve State Park
- Fort Zachary Taylor Historic State Park

3.14.3 Future Land Use

Monroe County and the incorporated cities of Islamorada, Marathon, Layton, Key Colony Beach, and Key West are responsible for the preparation and administration of the local government comprehensive plans and land development regulations under Chapter 163, F.S. The comprehensive plans of these cities and Monroe County are specifically structured to control and direct future land use development to areas with sufficient services to accommodate the

growth. Under the system developed by Monroe County, the total number of building permits issued per year is limited in unincorporated areas and the incorporated areas of Marathon and Islamorada (FEMA 2002). Public facilities must serve the development at the adopted level of service (LOS) standards concurrent with the impacts of the development. LOS standards are established for the following: traffic and circulation, potable water, solid waste, sanitary sewer, drainage, and recreation and open space (Monroe County 2000).

As discussed in *Section 3.10* (Demographics and Socioeconomics), projected growth in the Keys is low or negative. Future development will occur primarily on existing platted and buildable lots and will also include redevelopment within the existing developed areas. Based on an inventory conducted by Monroe County in 1991, the vacant properties included an estimated 15,359 platted lots. Of these, 436 were considered non-buildable, leaving an estimated 14,923 buildable lots. An estimated 5,823 of those buildable lots were located in the upper Keys, 2,345 in the middle Keys, and 6,755 in the lower Keys. For the period prior to 1997, the average number of building permits issued per year in the unincorporated area of the Keys was an estimated 552. Of these, only about two-thirds, or 359, were actually developed each year. In 1997, Monroe County estimated that the vacant lot inventory would be sufficient to meet demand for 42 years (Monroe County 1997b).

Policy 101.2.13 of the Monroe County Comprehensive Plan establishes an interim permit Allocation System that is to remain in place until it is determined that future growth capacity based on hurricane evacuation, public safety and environmental needs including water quality and habitat protection are adequate to support growth. To implement this policy, Monroe County has adopted a ROGO that specifically allocates credits towards obtaining building permits. Nutrient reduction credits are necessary to qualify for a building permit. Each year this interim permit allocation system limits the number of building permits issued for new residential development to the number of nutrient reduction credits earned within the same ROGO area.

In 1995 a Final Order and Recommendation was issued by a Florida Administrative Hearing office on the Monroe County 2010 Comprehensive Plan. As a result of this Order, the Florida Administration Commission enacted Rule 28-20.100, which created a Work Program as part of the 2010 Comprehensive Plan for the preparation of a carrying capacity study for the Florida Keys. This study was implemented in 1998 under a contract co-sponsored by the Corps and Florida Department of Community Affairs (DCA) and completed in September 2002. Monroe County is currently reviewing the carrying capacity study and intends to implement the findings by adopting amendments to the ROGO, Land Development Regulations, and the Comprehensive Plan Future Land Use Maps. The existing ROGO is expected to remain in effect while the carrying capacity study is under review. Future efforts will include amendments to the County zoning maps, revisions to permit allocation system, development of a land acquisition strategy, and a land maintenance program. The Florida Keys Carrying Capacity Study is intended to provide an information database and an analysis of consequences (i.e. a planning tool) that may be used to determine the level of land development activities that will avoid further irreversible and/or adverse impacts to the Florida Keys ecosystem.

3.14.4 Coastal Barrier Resources

The Coastal Barrier Improvement Act of 1990 (CBIA) reauthorizes and amends the Coastal Barrier Resources Act (CBRA) of 1982 (16 U.S.C 3501-3510). The original act established a policy that coastal barriers, in certain geographic areas of the U.S., and their adjacent inlets, waterways and wetlands resources are to be protected by restricting Federal expenditures which have the effect of encouraging development of coastal barriers. Although the Act restricts Federal expenditures for coastal barrier development, Section 6(a)(6)(A) contains a broad exemption for projects relating to the study, management, protection, or enhancement of fish and wildlife resources and habitats, including recreational projects. Under the 1990 amendments, the Secretary of the Interior has consultation responsibilities for additional exemptions from funding prohibitions under CBRA, including water resource development projects.

Coastal barriers are unique landforms that support diverse aquatic, estuarine, and marine habitats, and buffer the mainland from impacts of coastal storms. Areas so designated are ineligible for direct or indirect federal financial assistance, such as flood insurance or other actions that might encourage development on the islands, except for emergency life-saving activities. Exceptions are made for certain activities, such as fish and wildlife research, and National Wildlife Refuges and other protected areas are provided.

The Federal Coastal Barrier Resource System designation has been incorporated into the Monroe County Year 2010 Comprehensive Plan. Monroe County discourages the extension of facilities and services, such as telephone or electricity, to designated coastal barrier areas. Siting of any wastewater treatment facility or stormwater management structure will require compliance with CBRA.

3.15 Infrastructure

This section provides an overview of the infrastructure features of the Florida Keys that would be impacted by the FKWQIP. U.S. Highway 1 is the dominant infrastructure feature of the Keys providing transportation service and corridor access for conveyance of potable water and electrical service from the mainland. No centralized wastewater treatment system or facilities currently provide service to the Florida Keys. This is one of the contributing factors to degradation of nearshore waters.

No centralized wastewater treatment system or facility currently provides service to the Florida Keys. This is one of the contributing factors to degradation of nearshore waters.

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3.15.1 Transportation

Transportation includes roadways that link the Keys to the mainland and provide for the movement of people and goods by vehicular traffic, as well as air transportation and boat transport through the numerous waterways. Hurricane evacuation is an important consideration

in the Keys, as it is to other coastal communities throughout the state. The primary transportation objective of Monroe County is to reduce the time required for hurricane evacuation to 24 hours by the year 2010 (Monroe County 1997b).

Roadways. U.S. Highway 1 (U.S. 1) is the major roadway connection for the Florida Keys. The highway stretches 112 miles from Key West to the Miami-Dade County line and provides a means of transporting food, supplies, and tourists between the mainland and the Keys. Approximately 80 percent of U.S. 1 is a two-lane roadway. Four-lane segments of U.S. 1 occur from Key West to Boca Chica, on Bahia Honda, in Marathon, on Tavernier, and on Key Largo. In addition, there are approximately 450 miles of secondary roads in the Keys that are maintained by Monroe County (Monroe County date unavailable).

The Monroe County Comprehensive Plan mandates that U.S. 1 be maintained to provide LOS "C" travel conditions (Monroe County 1997b). The U.S. 1 Level of Service Task Force, with members from Monroe County, FDOT, and Florida DCA, monitors service levels along U.S. 1. Traffic counts are collected during peak tourist season (February – March) and then adjusted to reflect average daily traffic (ADT) conditions. The Task Force has determined that most of the segments along U.S. 1 operated at LOS "C" or better for 2002 ADT conditions (Monroe County date unavailable). However, two sections of U.S. 1 operated at LOS "D" for average daily conditions in 2002. The 3.5 mile Big Pine Key segment has no reserve capacity and is considered inadequate, while the two mile Tea Table segment has some reserve capacity and is considered marginal (Monroe County date unavailable).

Monroe County has no roadway improvements planned that will increase the capacity of the existing network although a new high-level bridge is programmed for construction over Jewfish Creek in the Key Largo area. This improvement is designed to improve the tidal flow in the surrounding wetlands rather than the capacity of the highway.

Public Transportation. The city of Key West has a public transportation system that provides service to Key West and Stock Island. In addition, daily fixed route service is provided by Julia Garcia Transportation bus service for commuters between Marathon and Florida City in Dade County.

Air Transportation. The two airports in Monroe County, Key West International Airport and Florida Keys Marathon Airport, have regular scheduled commercial passenger service. Major air carriers include U.S. Airways, Delta, and American Eagle Airlines. While major carriers often route passengers through Miami International Airport, some smaller carriers offer direct flights to Key West and Marathon from major Florida cities and the Bahamas. Both airports provide services for private aircraft at the general aviation fixed base operations.

Waterways. Key West has a deep-water port with a maintained channel depth of 33.5 feet which runs north into the Port from the Florida Straits and provides access for ocean vessels. Mallory Dock, Pier B, and the Outer Mole pier at the Truman Waterfront provide deep-water mooring capable of accommodating commercial cruise ships near the historical center of the City. Key West has become an increasingly popular destination for cruise ships and in 1999 handled nearly 600,000 passengers (City of Key West 2003).

The Coast Guard station at Key West maintains navigational aids, provides emergency search and rescue services, and patrols coast waters to promote boating safety. The U.S. Coast Guard Group in Key West includes the Cutter Nantucket, and nine 110 foot Island class patrol boats based at boat stations in Key West, Marathon, and Islamorada.

The network of waterways, proximity to deep waters, and the numerous marinas and boating facilities makes water transportation an important function in the Keys. Monroe County has 25,862 registered commercial and pleasure boats, or one boat for every three residents of the County. In addition to the deep-water marine port in Key West, there are two main marina facilities in Key West that provide service to commercial and pleasure boaters, including the City Marina and the historic Key West Bright Marina. The City Marina at Garrison Bight, located on the Palm Avenue causeway in Garrison Bight, provides a 5 foot water depth for 250 permanent slips, and 30 transient slips. The Key West Bright Marina provides a 30 foot water depth within a 20 acre marine port facility located near the historic old town center. The Bright Marina is homeport for charter and party boats engaged in fishing, diving, cruising and other water related activities. The Key West Bright Marina also accommodates a ferry terminal that provides daily service between Key West and Naples.

3.15.2 Utilities and Services

Electrical Power. Two electrical service providers serve the Florida Keys. To the north and east of the Seven Mile Bridge, service is provided by the Florida Keys Electric Cooperative (FKEC). In 2001, FKEC had over 30,000 customers in Monroe County and supplied 639,000,000 kilowatt hours of electricity to those customers (Florida Keys Electric Cooperative 2002). FKEC purchases power generated on the mainland by Florida Power and Light. This power is distributed to the Keys by two 138,000-volt transmission lines. A small power plant in Marathon supplies approximately two percent of the FKEC power requirements.

Keys Energy Services (KEYS) provides electrical power to the southern portion of the Florida Keys. KEYS is a municipal utility operated by a state authorized utility board and imports most of its power from the mainland, but has the capacity to provide 60 percent of its power with an on-island emergency generator used for backup in case of power interruption along the transmission line (Keys Energy Services 2003). KEYS power is distributed along a transmission line paralleling U.S. 1 jointly owned with FKEC to the north of the Seven Mile Bridge.

Potable Water. The Florida Keys Aqueduct Authority (FKAA) is the sole provider of potable water for the Florida Keys (FKAA 2002). Potable water is transported through a 130 mile transmission pipeline (24 to 36 inches in diameter) and an additional 649 miles of distribution pipeline to over 42,000 customers. The water supply for FKAA is the Biscayne aquifer tapped from a well field located west of Florida City in Miami-Dade County. The well field contains some of the highest quality ground water in the state of Florida (FKAA 2002). Electrical powered pumps are used to push the water into the Florida Keys, with diesel pumps as backup. Water storage facilities are located at various locations throughout the Keys in case of a pipeline rupture. Desalinization plants are being constructed in Marathon and on Stock Island.

Wastewater Treatment. No centralized wastewater treatment system or facilities currently provide uniform service to the Florida Keys. Systems currently operating in the Keys are

administered by municipal governments or private developments. The City of Key West has a wastewater treatment facility with a design capacity of 10 million gallons per day (gpd) (City of Key West 2003). Recent flows have ranged between 4 mgd and 8 mgd. This facility provides AWT level of treatment with discharge to a Class 1 deep injection well. Open ocean outfall is available as a backup to the deep injection well until it is phased out completely in 2006. Recent maintenance to the sanitary sewer collection system has reduced saltwater intrusion into the system and reduced the volume of wastewater to the treatment plant (City of Key West Utilities 2000).

No centralized wastewater treatment system or facilities currently provide uniform service to the Florida Keys.

The city of Key Colony Beach has a wastewater treatment facility that serves that community. The Village of Islamorada currently has no waste treatment facility, but plans to implement a system in the future (Village of Islamorada 2001). The City of Marathon has no wastewater treatment facilities at this time, but is currently working with the FKAA to plan and construct wastewater collection and transmission systems and centralized wastewater treatement facility that would meet advance wastewater treatment standards.

In addition to the centralized systems referenced above there are four basic methods for wastewater management and treatment presently utilized in the Florida Keys.

- Cesspit or cesspool underground tanks are usually masonry or concrete, with small openings to allow liquid material to seep into the surrounding soil, providing essentially very little if any treatment benefit.
- Septic tank underground tanks are usually concrete, with drain fields designed to provide waste retention time for biological treatment prior to discharge to the surrounding soil for some filtering, providing limited removal of organic waste and solids but virtually no removal of nutrients. These systems are often found to be defective.
- Aerobic treatment units (ATUs) consist of a chamber for aerobic biological treatment and disposal of treated effluent usually by means of injection at a depth of at least 90 feet, providing substantial but inadequate treatment of organic waste and solids but no significant removal of nutrients. These systems often have inadequate injection systems.
- On-site nutrient reduction systems (OWNRS) provide biological and chemical treatment and filtration, including disinfection and nutrient removal, and disposal through an injection well or subsurface drip irrigation. Few of these systems are in use in Monroe County at this time.

Owners of cesspits incur virtually no cost for operation and maintenance, and almost all systems have been in place for many years. Septic tank systems also require very little cost to maintain and operate, generally only pumping the septic tank every few years. Depending on location and installation, these septic systems have varying impacts on ground and surface water quality.

Current developments must use one of the three other wastewater treatment methods – ATUs, on-site nutrient reduction systems, or central wastewater treatment facilities. However, ATUs

will be legal in Monroe County only until the year 2010, at which time all development must be connected to a central wastewater treatment plant.

At the time a development permit is issued, adequate sanitary wastewater treatment and disposal facilities, including wastewater treatment facilities and on-site sewage treatment and disposal systems, must be available to support the development at the adopted LOS, concurrent with the impacts of the development (Monroe County 1997b). The LOS is stipulated by state of Florida standards and reflects the County's intention to reduce the use of phosphate-containing products and require that septic tanks be pumped out periodically and that contractors must properly dispose of pumped septage.

The Monroe County Comprehensive Plan includes provisions for eliminating cesspools and improving failing septic systems and package treatment facilities (Monroe County 1997b). The program calls for systematic inspections and requirements of necessary improvements. This provision, which focuses first on cesspools and unpermitted septic tanks, bears directly on property redevelopment, but has no direct affect on land use development. Complementing this policy is the County's encouragement of development that uses existing central wastewater treatment facilities. While the expressed purpose of this policy is to discourage urban sprawl, it also has the effect of reducing the proliferation of less effective wastewater management systems (Monroe County 1997b).

The Monroe County Comprehensive Plan includes provisions for eliminating cesspools and improving failing septic systems and package treatment facilities (Monroe County 1997b).

3.16 Hazardous Materials and Domestic Waste

The Resource Conservation and Recovery Act (RCRA) of 1974 Subtitle C, established a federal program for the handling of hazardous wastes in a manner that will prevent impacts to human health and the environment. The federal government has encouraged states to develop their own hazardous waste programs, and Florida has responded with the development of the FDEP Division of Waste Management, Bureau of Solid and Hazardous Wastes. Florida Statues, Chapter 403, Florida Public Health Section, Resource Recovery and Management, and Florida Administrative Code, Rule 62-730 provide the regulations for the handling of hazardous materials and waste.

Federal and state regulations require property purchased for utility development or construction easements be assessed to characterize environmental hazards.

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To evaluate potential risk due to hazardous materials, Phase I Environmental Site Assessments will be conducted for each specific project funded by the FKWQIP to characterize potential environmental hazards before construction activities are initiated, if conditions warrant. Phase I environmental site assessments will be conducted in accordance with American Society of Testing and Materials (ASTM) standard E 1527-97. The purpose of a Phase I site assessment is to identify and record any obvious existing and potential suspect conditions resulting from the use, handling, and disposal of hazardous substances within the project boundaries which may pose an environmental liability. Site assessments will be conducted as part of the supplemental NEPA documentation prepared for each project and potential risk, if any, determined based on project design, site conditions and construction techniques to be employed.

Monroe County collects solid wastes at three locations: Key Largo, Cudjoe Key and Key Largo. Waste material is collected at these locations by four private contractors and then separated and either shipped to a landfill in Broward County, or recycled. Household hazardous wastes are collected at these three locations and handled separately. Hazardous wastes from commercial, institutional, and industrial facilities in the Keys are collected at the generation site and disposed of according to stringent regulations regarding the specific material. Treated wastewater sludge materials are not considered hazardous wastes. Adequate collection, disposal, and resource recovery for solid waste is essential for future developments. No building permits will be issued unless adequate solid waste collection and disposal facilities needed to support the development are available concurrent with the impacts of the development.

4.0 Environmental Consequences

This chapter provides an analysis of the environmental consequences anticipated as a result of implementing the alternatives considered for this PEIS. A matrix (Table 4-1) is used here to compare impacts among issues identified as significant during initial scoping meetings and communications with regulatory agencies and stakeholders. Issues are listed by relative importance in Table 4-1 and impacts are presented for each alternative.

As indicated in the matrix, the vast majority of potential environmental impacts associated with the FKWQIP are positive, consistent with the intent of the program. Temporary, short-term negative impacts are anticipated as a result of the siting and construction of new wastewater treatment facilities and would be addressed with mitigation. Mitigation required for individual projects implemented under FKWQIP would be specified in supplemental NEPA documentation.

The vast majority of potential environmental impacts associated with the FKWQIP are positive, consistent with the intent of the program.

Based on results of the impact analysis, distinct differences among the alternatives are apparent. A summary comparison was presented in *Chapter 2* (see Table 2-1). Implementation of the *No Action* alternative (Alternative 1) is expected to result in continued adverse impacts to the existing environment described in *Chapter 3.0, Affected Environment*. The remaining two alternatives, implementation of FKWQIP with federal funding (Alternative 2), and implementation with other funding sources (Alternative 3), are anticipated to benefit the environment, although to differing degrees, as discussed in this section. Alternative 2 includes an integrated, area-wide approach to improving wastewater treatment and stormwater management throughout the Keys, using priority rankings based on readiness to proceed and environmental benefits. In contrast, without federal funding under Alternative 3, local municipalities would pursue other funding options for water quality improvements and implementation would occur as funding becomes available, likely resulting in fewer, smaller, and less integrated systems.

The benefits of implementing the *Proposed Action* would be significant. Currently approximately 23,000 private on-site systems and 250 small wastewater treatment plants are operating throughout the Florida Keys (Monroe County 2001(b)). The on-site systems contribute approximately 4.88 million gallons per day (mgd) of wastewater to Florida Bay, and the small treatment plants contribute another 2.4 mgd. Many of these systems provide only a minimum of nutrient removal, and ongoing research has determined that these discharges have contributed to the decline in water quality in the canals and nearshore waters surrounding the Keys. Additionally, stormwater runoff discharges in the Keys are largely untreated and also contribute pollutants to the nearshore waters and canals. These water quality impacts have been determined to be major contributors to the decline in water quality in the Florida Keys National Marine Sanctuary.

Although potential results of implementing of the *Preferred Alternative* are not directly quantifiable, it has been determined that reductions in nutrient loads would be the single most beneficial action toward water quality improvement in the nearshore waters surrounding the Keys.

Table 4-1
Summary of Potential Impacts of FKWQIP Project Alternatives

Scoping Issue	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Alternative Funding
1. Water Quality	Adverse impacts due to continued discharge of untreated waste- and stormwater runoff and associated nutrients, toxins, bacteria, and viruses to canals and nearshore waters in the Sanctuary. State and federal mandates to improve water quality in the Sanctuary may not be addressed.	Benefits of centralized storm- and wastewater treatment in-clude water quality improve-ments due to decreased load-ings of nutrients and other contaminants into canals and nearshore waters of the Sanctuary. These improvements would address state and federal legislation.	Continued degradation of water quality is anticipated until funding is obtained to implement storm- and waste- water improvement projects. Piece-meal implementation of projects may not address priority water quality areas, e.g. pollutant *hot spots*.
2. Facility Siting	No impacts are anticipated. No lands would be required for the location and construction of storm- and wastewater facilities. Therefore, existing residences, fish and wildlife habitats, and land uses would not be disrupted or displaced.	Minor impacts expected due to lands required for construction of treatment facilities. Facility land require-ments may displace existing residents and encroach on sensitive lands and protected species. Centralized projects would allow coordinated land acquisition.	Similar to Alternative 2 except that implementation would occur over time and likely require smaller, but more numerous, parcels of land. Coordinated efforts for land acquisition would not occur.
3. Protected Species	Adverse impacts to protected species anticipated as a result of continued runoff of untreated storm- and wastewater into canals and nearshore waters and subsequent water quality degradation. Because no new facilities would be required, no impacts to habitat for protected species are anticipated.	Minimal adverse impacts are anticipated, primarily due to land required for treatment facilities. Consultations with USFWS/ NMFS and FFWCC on protected species would occur for individual projects. Based on preliminary discussions, agency's support treatment and have provided input on sensitive areas. Major benefits include improved water quality as well as coordinated mitigation efforts.	Impacts similar to those described under Alternative 1 are expected due to delays in treatment implementation. In addition, the absence of coordinated efforts for land acquisition may result in smaller piece-meal areas of mitigation for impacts due to loss of habitat for facility construction.
4. Effluent Disposal	Adverse impacts anticipated as a result of unchanged effluent disposal practices. Runoff from cesspools and septic tanks would continue to enter canals and nearshore waters in the Sanctuary. Elimination of cesspools would progress at a slow pace.	Benefits include reduced effluent discharges into Sanctuary as a result of more deep well injection of treated water from larger, centralized WWTFs. Construction of centralized sewers would expedite the removal of cesspools and associated pollutants in pollutant *hot spots* throughout the Keys.	Adverse impacts anticipated due to the absence of centrally-managed WWTFs. Fewer and smaller WWTFs may rely more heavily on shallow injection wells. Construction of sewers would be less effective due to fragmented approach. Delays in construction are also anticipated.
5. Tourism	Increasing impacts anticipated related to water quality degradation. Continued beach health advisories would adversely affect immediate recreational and tourist opportunities, and long-term impacts could be detrimental to tourism and the local economy.	Improved water quality would decrease the incidence of beach advisories and closings, thereby increasing the opportunity for saltwater-based recreation. Temporary adverse impacts would include transportation delays due to construction activities	Some growth in tourism due to improved nearshore water quality could be expected, however, at a slower pace as compared with Alternative 2.
6. Environmental Justice	Adverse impacts to low-income households who would have difficulties affording the cost of meeting 2010 mandates for wastewater treatment are expected.	Possible disproportionate impacts to low-income residents due to facility sitings in minority or low-income neighborhoods may occur. Without special consideration and financial assistance, low-income and fixed income households would have difficulty paying for wastewater and stormwater management improvements, hook up and service fees.	Possible disproportionate impacts to low-income residents due to facility sitings in minority or low-income neighborhoods. Without special consideration and financial assistance, low-income and fixed income households would have difficulty paying for wastewater and stormwater management improvements, hook up and service fees.

Unavoidable impacts to environmental resources are expected to occur as a result of implementing Alternative 2 or 3, and mitigation would be required. Mitigation may include avoidance or minimization of impacts, restoration of the affected environment, or compensation for the impact in the form of substitution or replacement of resources. Mitigation may include one or, more frequently, a combination of the above measures. Mitigation for impacts would be determined during the preparation of supplemental NEPA documentation, on a case-by-case basis, or during the design and permitting of the individual projects.

Avoidance and minimization of impacts for individual projects would include the preparation of siting feasibility studies for those projects that have yet to be located. Care would be taken to locate facility sites and infrastructure in areas that have already been disturbed, in order to avoid impacts to environmental resources. During construction, best management practices (BMPs) would be used to prevent erosion, or the accidental discharge of sediments or other pollutants into adjacent waters.

4.1 Climate

Climate is a regional environmental characteristic that would not be affected by the FKWQIP project alternatives. Climate was discussed in *Chapter 3* to describe the environmental setting for the study area and document seasonal rainfall patterns.

4.2 Topography, Geology, and Soils

Topography and geology would not be affected by the project alternatives. These two resources were discussed in *Chapter 3* to describe the environmental setting,

Impacts to soils are important in the Keys due to the sparse distribution and lack of abundant topsoil. The soils in the Keys have been impacted by the pollutants in the seepage from cesspits and septic tanks, and from stormwater runoff. The potential effects of the three alternatives on soils are discussed in the following paragraphs.

4.2.1. Alternative 1 (No Action)

Under the *No Action* alternative, continued adverse impacts to soils in the study area would be anticipated. Existing wastewater and stormwater practices in the Keys would continue and continued seepage from cesspools and septic tanks would elevate nutrient levels in soils in the study area. Additionally, contaminants and toxins such as heavy metals, polychlorinated biphenyls (PCBs), pesticides, and herbicides from stormwater runoff would continue to accumulate in and contaminate soils and subsequently impact vegetation and wildlife. Additionally, accumulated soil contaminants may be carried in surface water runoff and delivered to marine, estuarine, and freshwater environments. These impacts to soils would be direct, relatively minor and localized, but the effects would be long-term for some of the contaminants.

Impacts to soils are important in the Keys due to the sparse distribution and lack of abundant topsoil.

4.2.2 Alternative 2 (Proposed Action)

Under this alternative, the priority FKWQIP wastewater and stormwater improvement projects would be implemented. Implementation of these projects would decrease or eliminate the discharge from cesspools and septic systems into soils and subsequently into wetlands and nearshore waters, thus improving the nearshore water quality within the Sanctuary. In addition, the proposed stormwater improvements that decrease or eliminate current inputs of sediments, contaminants and toxins in surface water runoff would also result in improved water quality in the Sanctuary.

Implementation of these projects would decrease or eliminate the discharge from cesspools and septic systems into soils and subsequently into wetlands and nearshore waters, thus improving the nearshore water quality within the Sanctuary.

Benefits to soils and associated vegetation are anticipated under this alternative due to reduced nutrient and pollutant loadings. Reductions in nutrients, pathogens, and other pollutants would reduce the likelihood of soil contamination and subsequent adverse impacts to ecological communities. While the existing accumulations of non-biodegradable pollutants would not be reduced, implementation of the FKWQIP would decrease the future rate of accumulation of pollutants and potential toxins. In addition, reductions in stormwater runoff would decrease erosion and sediment inputs into canals and nearshore waters.

Potential adverse impacts to soils may result from short-term and temporary disturbances due to individual stormwater and wastewater project construction and construction staging activities. Implementing BMPs would reduce erosion and sedimentation, minimizing the potential adverse impacts. These temporary impacts would therefore be short-term, and negligible to minor. The implementation of this alternative would benefit the condition of the soils in the Keys, and reduce pollutants in surface water runoff. Mitigation would be limited to compensation for those unavoidable impacts that may occur during construction.

4.2.3 Alternative 3 (Alternative Funding Sources)

Effects on the soils under this alternative would be similar to those described under the *No Action* alternative for a period of approximately two to three years until the wastewater and stormwater improvement projects are implemented with alternative funding sources. The time delay would result in continued soil degradation with potential adverse effects as described under the *No Action* alternative. Once alternative funding sources were available and the proposed wastewater and stormwater projects were implemented, the effects would be similar to those described under Alternative 2. As with Alternative 2, mitigation would be limited to compensation for those impacts occurring during construction that could not be avoided or minimized.

4.3 Water Resources

Potential impacts to water resources as a result of implementing program alternatives are limited to water quality impacts discussed below in *Section 4.4*. No impacts to potable water supply or other aspect of water resources are anticipated with respect to the implementation of the FKWQIP.

4.4 Water Quality

Water quality improvements within the Sanctuary are the primary objective of FKWQIP implementation, and will rely primarily on reducing nutrient loading to nearshore waters. This section demonstrates a clear distinction between the environmental consequences of the *No Action* alternative, or continued reliance on septic tanks and cesspools for wastewater treatment, and the beneficial impacts of implementing the priority projects of the FKWQIP. The *Proposed Action* would eliminate the most significant sources of nearshore contamination.

Water quality improvements within the Sanctuary are the primary objective of FKWQIP implementation, and will rely primarily on reducing nutrient loading to nearshore waters.

4.4.1 Alternative 1 (No Action)

The *No Action* alternative would essentially result in the continued reliance on individual treatment systems (septic tanks and cesspools) and privately owned cluster or package treatment facilities. Under this alternative, individual property owners and businesses would be responsible for meeting the defined level of service standards prescribed by county ordinance or state regulation.

Groundwater Quality. Under the *No Action* alternative, continued adverse impacts to the shallow waters of the Biscayne Aquifer are anticipated. Existing wastewater and stormwater practices in the Keys would continue. As a result, seepage from cesspools and septic tanks would continue to elevate nutrient levels in this aquifer. While continued contamination of the Biscayne Aquifer would not impact potable water supplies, it would negatively impact the water quality of the canals and nearshore waters of the Keys.

Surface Waters and Stormwater Runoff. Under the *No Action* alternative, continued adverse impacts to inland water quality, particularly canal water quality, would occur. Existing wastewater and stormwater practices in the Keys would continue, and seepage of nutrients and other pollutants from cesspools and septic tanks would elevate nutrient levels in inland receiving waters throughout the study area. Additionally, contaminants and toxins such as heavy metals, polychlorinated biphenyls (PCBs), pesticides and herbicides from fugitive stormwater runoff would continue to enter the shallow waters of the Biscayne Aquifer.

Nearshore and Offshore Water Quality. Under the *No Action* alternative, continued adverse impacts to nearshore water quality are anticipated. Existing wastewater and stormwater practices in the Keys would continue. As a result, discharge from cesspools and septic tanks with

associated nutrients and other pollutants may elevate nutrient levels in nearshore waters of the study area. Additionally, contaminants and toxins such as heavy metals, PCBs, pesticides and herbicides from stormwater runoff would continue to contaminate nearshore waters. Nearshore habitats, particularly seagrasses, would be adversely affected by continued water quality degradation. Continued nutrient enrichment and contaminant introduction would lead to algal blooms, decreased water clarity and light penetration and subsequent loss of seagrasses. Finally, continued release of pathogens into the marine environment would create human heath concerns.

The continued input of nutrients to the nearshore system would result in increasing dysfunction of the impacted areas and the impacts would extend farther from shore (Kruczynski and McManus 2002), impacting offshore water quality and the health of coral reef ecosystems. Historic extinctions of entire trophic levels in coastal ecosystems make them more vulnerable to other natural and human-induced disturbances such as nutrient loading and hypoxia, disease, storms, and climate change (Jackson *et al*. 2001). Implementing wastewater and stormwater treatment projects is necessary to alleviate some of the cumulative impacts of excessive nutrient loading to estuarine and marine habitats within the Sanctuary. Excessive nutrient loading in nearshore waters of the Sanctuary can only exacerbate historic problems related to coral reef health.

Hardbottom communities and coral reefs thrive in oligotrophic environments (Kruczynski and McManus 2002). Nutrient-enrichment in these environments can stimulate nutrient limited phytoplankton, leading to algal blooms in the water column. Both algal blooms and TSS can reduce water clarity by decreasing light penetration and subsequently reducing photosynthesis and production in seagrass beds. Besides decreasing water clarity, eutrophic conditions can stress corals by promoting macroalgal growth (Lapointe *et al*. 1994). It is reasonable to conclude that nutrients in poorly flushed nearshore waters in the Florida Keys have and would continue to exceed assimilative capacity of the coral reef tract found in the Keys. In addition, the continued release of pathogens, such as fecal coliform bacteria and viruses, into the marine environment would create human heath and safety concerns.

4.4.2 Alternative 2 (Proposed Action)

Under Alternative 2, federal funding would be provided to assist local municipalities in funding priority projects of the FKWQIP for the purpose of developing and implementing wastewater treatment and stormwater management improvements. The proposed wastewater and stormwater improvement projects would be implemented on a timely basis. Implementation of these projects would decrease or eliminate discharges from cesspools and septic systems, which would improve water quality in the Sanctuary. In addition, stormwater improvements would decrease or eliminate the current inputs of sediments, contaminants and toxins associated with stormwater runoff.

Groundwater Quality. Replacing existing cesspools and septic systems with OWNRS and centralized WWTFs under the *Proposed Action* in compliance with Florida Statuary Treatment Standards would benefit the Biscayne Aquifer by substantially reducing the amount of nutrients and contaminants seeping or discharged into the aquifer. Subsequent benefits would include improved water quality in canals and nearshore waters and a reduced potential for human health concerns. As part of a similar NEPA analysis for wastewater improvements in the Keys (FEMA

2002), an analysis was conducted to estimate the extent of water quality improvements that might be expected by improving wastewater treatment within an existing service area of the Keys. The analysis focused on a proposal to construct four small wastewater treatment facilities meeting AWT standards to replace an area currently served entirely by septic tanks (no cesspools were assumed to exist) for the City of Islamorada. Results of the analysis indicated a 92 percent reduction in TN input to ground water and 86 percent reduction in TP input to ground water (reader should refer to Appendix D of the FEMA programmatic environmental assessment for more details pertaining to the results of this analysis.) It should be noted that treated effluents would still contain limited nutrients even under conditions that meet the 2010 treatment standards. With implementation of the *Proposed Action*, low levels of contaminants can be anticipated to reach the ground water due to domestic sewer and collection system leakage and stormwater runoff; however, the overall result would be a substantial benefit to groundwater quality when compared to the *No Action* alternative.

Replacing existing cesspools and septic systems with OWNRS and centralized WWTFs under the Proposed Action in compliance with Florida Statuary Treatment Standards would benefit the Biscayne Aquifer by substantially reducing the amount of nutrients and contaminants seeping or discharged into the aquifer.

Generally, wastewater treatment facilities in the Keys dispose of their treated effluent into shallow injection wells (cased 0 to 60 feet with open holes from 60-90 feet). This effluent is discharged directly into the highly permeable Upper Water-Bearing Zone limestone of the Biscayne Aquifer. This disposal system is categorized as a Class V well by the state of Florida and is designated for treatment facilities with less than 100,000 gpd capacity. These treatment facilities are required to meet BAT limitations (i.e. 10 mg/L BOD, 10 mg/L TSS, 10 mg/L TN, and 1 mg/L TP). These effluent limitations represent a major improvement in potential qroundwater quality when compared to continued reliance on treatment of wastewater by cesspools and septic tanks

Wastewater treatment facilities constructed under the FKWQIP over 100,000 gpd capacity would be required to meet more stringent AWT effluent limitations (i.e. 5 mg/L BOD, 5 mg/L TSS, 3 mg/L TN, and 1 mg/L TP) and would use deep well injection for effluent disposal. Under this alternative, the Floridan Aquifer would be targeted for added wastewater and stormwater disposal through deep well injection of treated effluent. Consequently, some adverse impacts to the Floridan Aquifer would be anticipated under this alternative. However, the aquifer is highly confined and therefore impacts to other aquifers would not be anticipated.

With implementation of the Proposed Action, low levels of contaminants can be anticipated to reach the ground water due to domestic sewer and collection system leakage and stormwater runoff; however, the overall result would be a substantial benefit to groundwater quality when compared to the No Action alternative.

Surface Waters and Stormwater Runoff. Benefits to water quality in the study area, particularly canals, would be expected under the *Proposed Action*. A consolidated programmatic

implementation of wastewater and stormwater quality improvement plans would improve overall surface water quality. The focus on community and regional WWTFs in "*hot spot*" or densely populated areas and OWNRS in lower density areas would reduce nutrient loading, improve human health and welfare concerns in canals, meet federal and state regulatory water quality standards, and ultimately assist in protecting water quality in the Sanctuary. As described above for ground water, improvements in water quality are anticipated to be in the range of 92 and 86 percent reductions in TN and TP loading respectively (FEMA 2002). However, a number of uncertainties such as exact length of flush time, localized hydrogeological characteristics, and effectiveness of limestone in removing phosphorus from injected effluent, would determine the exact extent of anticipated improvements (FEMA 2002).

The focus on community and regional WWTFs in "hot spot" or densely populated areas and OWNRS in lower density areas would reduce nutrient loading, improve human health and welfare concerns in canals, meet federal and state regulatory water quality standards, and ultimately assist in protecting water quality in the Sanctuary.

Nearshore and Offshore Water Quality. The environmental consequences to inland, nearshore, and offshore waters are closely related to those described under ground water because of the direct link between ground water, canal and nearshore waters. Substantial benefits to nearshore water quality within the study area would be anticipated under the *Proposed Action*. Nutrient load and TSS reductions would reduce the potential for algal blooms. Likewise, water clarity and dissolved oxygen concentrations would improve. Improved water quality creates the potential for an increase in the overall health of seagrass habitats that are closely connected to other nearshore and offshore communities.

The local sponsor would be responsible for development and implementation of a stormwater management plan as part of the design specifications for any of the FKWQIP priority projects in order to adequately accommodate stormwater flows during construction activities. If any proposed treatment facility would disturb more than five acres during construction, an NPDES permit would be required. Erosion control BMPs would be employed during construction to reduce soil erosion from entering inland and nearshore waters. Additionally, NPDES permits would be required from the FDEP to control treated effluent during operations.

Potential benefits of the *Proposed Action* to the Sanctuary would include reduced nutrient and TSS loadings and commensurate improvements in water quality. Nutrient load and TSS reductions would reduce the potential for algal blooms and enhance the health of photosynthesizing organisms. Water clarity and oxygen concentrations would improve. Although implementation of the *Proposed Action* would not provide quantifiable improvements to the quality of offshore waters, the benefits would contribute to a healthier coral reef system due to improved water clarity and increased oligotrophic (nutrient poor) conditions.

4.4.3 Alternative 3 (Alternative Funding Sources)

Under this alternative the beneficial consequences described for Alternative 2 would also be recognized, however there would be an estimated two to three year delay while the

municipalities of Monroe County secure other funding sources. This time delay would effectively allow further water quality degradation, particularly of nearshore waters, increasing the cost and time to implement recovery. Additionally, with the added delay in implementing water quality improvements, the likelihood of meeting the mandated treatment standards by 2010 would be reduced.

4.5 Ecological Habitats

Effects on ecological habitats due to implementation of the proposed FKWQIP project (Alternative 2) and associated water quality improvements will benefit terrestrial and nearshore environments in the Keys by reducing nutrient loading to these habitats. While lands will be required for facilities, construction activities will generally be limited to temporary and short-term adverse impacts. Importantly, the *No Action* alternative will result in continued nearshore water quality degradation and subsequent adverse impacts to ecological habitats. Under Alternative 3, water quality degradation will continue until alternate funding is available to implement individual wastewater treatment and stormwater management improvements, although improvements will not be part of an integrated, system-wide management approach.

Effects on ecological habitats due to implementation of the proposed FKWQIP project (Alternative 2) and associated water quality improvements will benefit terrestrial and nearshore environments in the Keys by reducing nutrient loading to these habitats.

Impacts to wildlife and natural habitat as a result of construction will be temporary and followed by restoration along any pipeline routes. Permanent habitat loss will occur if natural habitats are displaced by a new wastewater or stormwater treatment facility, the installation of centralized wastewater collection systems, access roads, or the removal or refurbishment of outdated or obsolete treatment facilities. Permanent impacts will require some form of mitigation action for the impact, while temporary impacts may not.

Direct impacts would include the permanent loss or degradation of habitat as a result of the construction of a facility, pipeline, or associated infrastructure, which are anticipated to require five to 25 acres of land. Indirect impacts would be those that lead to the ultimate loss or degradation of habitat over time, for example, if a portion of habitat was left intact but was isolated or fragmented from other habitats as a result of construction or clearing.

The habitat categories addressed here include upland, freshwater and estuarine wetlands, marine and benthic habitats, and coral reefs. The importance of each of these habitats was discussed in detail in *Chapter 3, Affected Environment*. Potential environmental consequences of implementing the alternatives presented in this PEIS are described in detail in this chapter. Impacts that may result from individual projects will be addressed in required supplemental NEPA documentation.

Depending on the type and extent of wetland impacts from construction activities, a local, state, and/or Corps permit may be required. Corps policy requires wetland impacts be avoided or minimized prior to issuing a Department of the Army Permit. The Florida Department of

Environmental Protection (FDEP) also regulates activities within wetlands through the Environmental Resource Permit (ERP) process (Chapters 62 to 341, 343, and 330, F.A.C.). The state permit process includes other stormwater systems and related activities that may affect wetlands or surface waters. The Monroe County Land Development regulations require county review of wetlands as potential habitat areas. The net effect of the various wetland permit requirements is to avoid or minimize adverse impacts.

4.5.1 Alternative 1 (No Action)

Upland Habitats. Under the *No Action* alternative, adverse impacts to upland habitats as a result of existing wastewater and stormwater practices in the Keys would continue. Adverse impacts to tropical hardwood hammock and pinelands would be limited to locations with direct upland discharges, seepage, and overland stormwater runoff of nutrients and associated pollutants. In these instances, increased nutrient levels would stimulate plant growth and lead to changes in species composition over time. Contaminants and toxins introduced by overland stormwater runoff would adversely affect upland vegetation and organisms associated with these habitats.

The No Action alternative will result in continued nearshore water quality degradation and subsequent adverse impacts to ecological habitats.

Estuarine and Freshwater Wetlands. Mangroves, coastal salt marshes, and canals in the study area would continue to receive untreated wastewater and stormwater from adjacent uplands under this alternative. Elevated nutrient inputs to estuarine wetlands from terrestrial runoff would initially enhance the growth (height and biomass) of mangroves (Lugo and Snedaker 1974), as discussed in *Section 3.2.3*, however, nutrient-rich conditions can also inhibit plant growth and resistance to infection. Sediment deltas formed from terrestrial runoff could lead to changes in elevation of estuarine wetlands and subsequent shifts in species composition, e.g. upland or invasive non-native plants may replace salt marsh vegetation. Changes in vegetation composition would directly affect wildlife habitat and wildlife use. For example, increased macroalgal growth as a result of nutrient loading from ground water has been shown to decrease the cover of eelgrass and subsequently impact benthic fauna composition in Waquoit Bay, Massachusetts (Valiela *et al*. 1992).

Indirect impacts to freshwater marshes, wet prairie, shrub swamp, hardwood swamp, canals, and inland ponds as a result of continued stormwater and wastewater discharges include altered hydrology, increased pollutant loading, and/or altered natural vegetation. All three alternatives would impact the wetlands to some degree, but benefits imposed by Alternatives 2 and 3 would substantially outweigh adverse impacts. As described in *Section 3.2.3*, increased nutrients and toxins would likely adversely affect freshwater wetland vegetation and could lead to bioaccumulation and biomagnification of toxins in aquatic and marine organisms. Elevated nutrient levels could be exploited by opportunistic species and species composition may shift. Sedimentation from terrestrial runoff could potentially change the elevation of freshwater wetlands and possibly displace or shift the species composition.

Marine and Benthic Habitats. Marine and benthic habitats include seagrass beds, tidal/sand flats, sand/mud bottom, and hardbottom communities. These communities are sensitive, complex ecosystems influenced by many different sources. Under the *No Action* alternative, continued adverse impacts to marine habitats, including seagrasses, are anticipated. Existing wastewater and stormwater practices in the Keys would continue. As a result, seepage of nutrients from cesspools and septic tanks would elevate existing nutrient levels in marine waters of the study area. Additionally, contaminants and toxins such as heavy metals, polychlorinated biphenyls (PCBs), pesticides, and herbicides from stormwater runoff would continue to contaminate marine habitats. This nutrient enrichment and other pollution would continue to degrade water quality and habitat value in nearshore waters of the Sanctuary. The continued input of nutrients to the nearshore system would result in increasing dysfunction of the affected areas, and the impacts would extend farther from shore (Kruczynski and McManus 2002).

Under the No Action alternative, continued adverse impacts to marine habitats, including seagrasses, are anticipated. Existing wastewater and stormwater practices in the Keys would continue.

Changes in water temperature, pH, and clarity levels all affect the health and survival of marine and benthic communities. With respect to the FKWQIP, adverse impacts to benthic and marine habitats would occur as a result of land-based activities and changes in the water quality through discharges to inland and nearshore waters. While direct impacts of diver contact, over fishing, or boats contribute to the decline of seagrasses, indirect impacts, such as the nutrification of local waters, results in increased growth of algae and subsequent shading and gradual decline of seagrass beds.

The impact to marine habitats as a result of the lack of adequate stormwater and wastewater treatment in the Keys has not been quantified. However, water quality degradation in the nearshore waters and the substantial decline of these habitats are well documented. For the most part, impacts to the marine habitats as a result of the implementation of the FKWQIP would be highly beneficial, indirect, and long-term.

Nutrient loadings from continued seepage of contaminated ground water and stormwater runoff into nearshore waters can stimulate nutrient-limited phytoplankton growth and lead to algal blooms in the water column. Both algal blooms and sediments can reduce water clarity and decrease light penetration, thereby shading light-dependent organisms such as seagrasses. Under the *No Action* alternative, harmful algal blooms and fish kills would continue to occur and would increase in frequency as the population increases over time.

When dead algae decompose, oxygen is depleted and can create hazardous or toxic conditions for organisms, resulting in adverse impacts such as fish kills and species shifts. Large algal blooms would also cause hypoxic (low oxygen) or anoxic (oxygen depleted) conditions in shallow, poorly flushed locations. In addition, elevated nutrient loads can induce changes in species composition of a community and can stress seagrasses by promoting epiphyte growth.

Water quality degradation due to the release of contaminants and pathogens from wastewater and stormwater can result in bioaccumulation and biomagnification of the pollutants as the pollutants "build-up" as individual organisms and are consumed by larger and larger organisms and

transferred up the food chain. In addition, the continued release of pathogens, such as bacteria and viruses into the marine environment creates human heath and safety concerns.

Coral Reefs. Under the *No Action* alternative, continued adverse impacts to nearshore waters in which coral reefs occur are anticipated as a result of nearshore water quality degradation associated with nutrients from untreated wastewater and stormwater. Corals typically thrive in marine environments where oligotrophic (nutrient poor) conditions include clear waters and low turbidity. Excess nutrients, whether from natural or anthropogenic sources, may negatively impact marine and coral reef ecosystems in several ways. Consequently, coral reefs would be adversely affected by continued nutrient loading to nearshore waters of the Sanctuary caused by continued use of septic tanks and cesspits for wastewater treatment and the discharge of untreated stormwater runoff in the study area.

Excess nutrients increase the growth of phytoplankton and result in algal blooms that reduce water clarity, decrease light penetration, and decrease seagrass and coral growth. Additionally, high nutrient concentrations tend to favor the growth of non-symbiotic mat-forming macroalgae that are not symbionts with the coral and will shade the coral, eliminating the ability of the zooanthellae to photosynthesize, resulting in bleaching and eventual death of corals.

4.5.2 Alternative 2 (Proposed Action)

Upland Habitats. Under the proposed alternative, some degree of adverse impact to upland communities is anticipated as a result of facility construction. Effects on ecological habitats due to implementation of the proposed FKWQIP project (Alternative 2) and associated water quality improvements will benefit terrestrial environments in the Keys by reducing pollutant loading to these habitats. Construction activities will generally be limited to temporary and short-term adverse impacts and a wastewater facility would occupy an estimated two to five acres depending on specific site design. Construction of new stormwater treatment facilities, wastewater facilities, and sewer collection systems, or additions to existing wastewater facilities could result in vegetation and/or habitat loss.

Assessing the potential impacts to upland habitats requires the knowledge of individual project details. Prior to the construction of any new facility, the appropriate NEPA documentation would be prepared and coordination with the appropriate local, state, and federal agencies would be conducted for each individual wastewater and stormwater project that is part of the FKWQIP.

A review of land use data in the Monroe County Year 2010 Comprehensive Plan Technical Document indicated that approximately 34 percent of the study area is vacant land, which is defined as lands that have been designated or zoned for development but for which development has not been approved or approved development has not yet occurred. In addition, 34 percent of the area was identified as conservation lands because they are environmentally sensitive or provide habitat to rare and/or protected species. The remaining 32 percent of the land cover is developed with residential, commercial, industrial or other facilities. Based on the FFWCC Integrated Wildlife Habitat Ranking System, 52 percent of the developable land in the study area is considered moderate to high quality habitat. A majority of this high quality habitat is located in the Upper and Lower Keys (Figure 4-1).

Based on the percentage of vacant land designated for conservation, it is likely that the proposed individual stormwater and wastewater projects would have at least some effect on these conservation lands. Based on the percentage of moderate to high quality habitat present in the study area, it is likely that quality upland habitat (e.g. tropical hardwood hammocks and pinelands) would be adversely impacted, to some extent, during construction activities. The potential for adverse impacts to high quality upland habitat is higher for the Upper Keys study area because the majority of undeveloped land in this area is high quality habitat. In addition to construction activities, adverse impacts to terrestrial vegetation would result from short-term and temporary disturbances due to individual stormwater and wastewater project construction and construction staging activities.

Based on the percentage of vacant land designated for conservation, it is likely that the proposed individual stormwater and wastewater projects would have at least some effect on conservation lands.

If federal appropriations are granted to implement the proposed stormwater and wastewater improvements, funding would be applied to the priority improvement projects. These priority projects would likely be sited near water quality *hot spots* (described in *Section 3.4.4*) located in the vicinity of densely populated areas. Therefore, priority project sites would also likely have reduced habitat value as a result of the proximate development.

The Monroe County Code (MCC), Chapter 9.5, Division 8 has developed regulations and provisions "to provide for the conservation and protection of the environmental resources of the Florida Keys by ensuring that the functional integrity of natural areas is protected when land is developed." Compliance with the MCC would minimize adverse effects to protected vegetation communities.

Appropriate siting of facilities is the most effective way to avoid and/or minimize impacts to sensitive habitat. USFWS recommended that project applicants avoid certain habitat types in siting wastewater management activities (FEMA 2002, Appendix F). This includes avoiding parcels that have significant areas of tropical hardwood hammock, pine rocklands, buttonwood grasslands, or freshwater marshes. Accordingly, feasible alternatives for siting of the proposed wastewater/stormwater facilities outside of these areas would be recommended and evaluated as part of NEPA documentation for individual projects. Both NMFS and USFWS stated support of advanced wastewater treatment facilities in the Keys and the resulting nearshore environmental improvements. Compliance with the USFWS recommendations is necessary to minimize adverse affects to upland habitats.

Unavoidable impacts will be minimized where possible with appropriate and habitat-friendly site planning. Variances for set backs, landscaping, sodding, and other land planning issues would be applied for, in order to reduce the land area needed or to alter the site to retain habitat. When locating corridors for transmission lines or other utilities, co-locating the corridor with other utilities reduces the potential for fragmentation or isolation of habitat. Wildlife corridors of contiguous habitat or greenways are necessary for the survival of many endangered and threatened species. Use of BMPs is always recommended for minimization of construction impacts such as erosion, sedimentation, and loss of native vegetation.

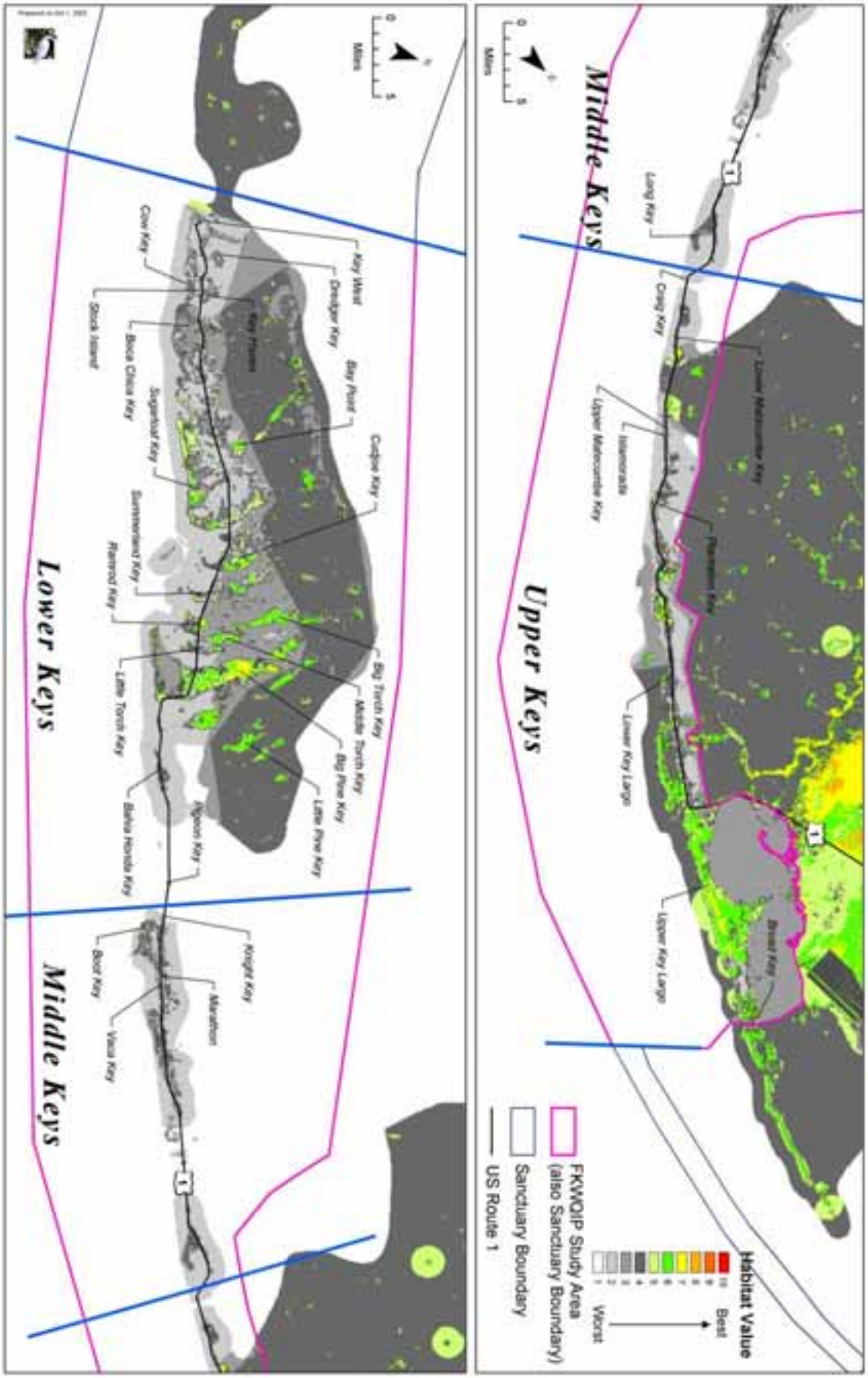
If impacts are not avoidable, and if minimization is not sufficient, then mitigation in the form of enhancement of existing habitat is possible. Nuisance and non-native vegetation are prevalent in the Keys and construction activities may exacerbate this problem. Consequently, the removal of this vegetation would greatly enhance the remaining habitat and maintenance may be required following construction. However, mitigation would be determined on a case-by-case basis during the planning and permitting of the individual project.

Estuarine and Freshwater Wetland Habitats. Under the proposed alternative, reductions in the amount of nutrients and other pollutants seeping or discharging into the aquifer would benefit both estuarine and freshwater wetlands in the study area. Substantial reductions in stormwater runoff would reduce the potential for adverse affects on wetland vegetation from herbicides and would reduce the potential for bioaccumulation and biomagnification of contaminants in wetland organisms. In addition, restoring natural nutrient levels in freshwater wetlands would slow the expansion of non-native and invasive species in these areas.

Although mangrove productivity and growth may benefit from increased nutrient levels, there is no evidence to support that mangrove communities are nutrient limited (Odum and McIvor 1990). Thus, existing mangroves would not be adversely affected by the reduction in nutrient levels that is expected to occur as a result of the implementation of Alternative 2.

Adverse impacts to wetlands as a result of the implementation of Alternative 2 would likely be direct, minor, and short-term as a result of construction activities. Potential adverse impacts to estuarine and freshwater wetlands may occur as a direct result of filling, dredging, or other physical alterations that may be required for construction of new stormwater treatment facilities, wastewater facilities and sewer collection systems, or improvements to existing wastewater facilities. A wastewater facility requires approximately two to five acres depending on specific site design. In addition to construction activities, adverse impacts to wetland vegetation would result from short-term and temporary disturbances due to individual stormwater and wastewater project construction and construction staging activities. Assessing the potential impacts to wetland habitats requires the knowledge of the individual project details which are not available at this time. As discussed in *Section 1.7*, the appropriate NEPA documentation would be prepared and coordination with the appropriate local, state, and federal agencies would be conducted for each individual wastewater and stormwater project that is part of the FKWQIP.

If federal appropriations are granted to complete the proposed stormwater and wastewater improvements, funding would be applied to the priority improvement projects. These priority projects would likely be sited near water quality *hot spots* (described in *Section 3.4.4*), which are located in the vicinity of densely populated areas. Therefore, priority project sites would likely be previously disturbed and with already reduced habitat value associated their proximity to population centers.



4-1

Habitat Rankings for the FKWQIP

Unavoidable impacts will be minimized where possible with appropriate and habitat-friendly site planning. Given the assumption that the treatment facilities would be built on existing water quality *hot spots*, and therefore previously disturbed lands, it is unlikely that high quality wetlands would be impacted. Variances for set backs, landscaping, sodding, and other land planning issues would be applied for, in order to reduce the land area needed or to alter the site to retain habitat. When locating corridors for transmission lines or other utilities, co-locating the corridor with other utilities reduces the potential for fragmentation or isolation of habitat. Wildlife corridors of contiguous habitat or greenways are necessary for the survival of many endangered and threatened species. Use of BMPs is always recommended for minimization of construction impacts such as erosion, sedimentation, and loss of native vegetation.

If impacts are unavoidable and if minimization is insufficient, then mitigation in the form of enhancement of existing habitat is possible. The prevalence of nuisance and non-native vegetation throughout the Keys provides the opportunity for habitat enhancement through the removal of nuisance and non-native vegetation. However, mitigation would be determined on a case-by-case basis during the planning and permitting of the individual project.

Marine and Benthic Habitats. No adverse impacts to marine and benthic habitats are anticipated as a result of the proposed alternative. Under the proposed alternative, implementation of wastewater and stormwater improvement projects would decrease or eliminate existing inputs of sediments, contaminants, nutrients, and other pollutant inputs from cesspools and septic systems into nearshore marine waters. Consequently, water quality in the Sanctuary would be improved.

Substantial benefits to the marine habitats in the study area would be anticipated under this alternative. Reductions in nutrients and TSS loads would reduce the potential for algal blooms. Likewise, water clarity and dissolved oxygen concentrations would improve, and commensurate improvements in the overall health of benthic marine communities would be expected. No mitigation would be required due to the positive effects of this program.

Coral Reefs. No adverse impacts to corals reefs in the Sanctuary are anticipated as a result of implementing the proposed alternative. Benefits of the proposed alternative include improved water quality of nearshore waters in the Florida Keys and commensurate improvements in ecosystem health in the Sanctuary.

Marine flora in nearshore waters of the Sanctuary are primarily responsible for the uptake of nutrient inputs from canals and nearshore waters (Hallock *et al*. 1993) and will benefit most from the implementation of the FKWQIP. However, nutrients released into the water column from anthropogenic sources (e.g. septic tanks and cesspits) have also contributed to the decline of water quality-dependent marine organisms, including corals, in the Sanctuary and implementation of the FKWQIP will potentially contribute to the recovery of the only living coral reef system in North America.

Recent assessments of the condition of the coral reef tract in the Florida Keys have indicated accelerating degradation. A number of factors, including hurricane damage, bleaching, sedimentation, algal overgrowth, and nutrient release from tidal upwelling, have been identified

as contributing to this observed decline. The decline has also been attributed to African dust that is carried across the Atlantic from the Sahara Desert. The dust transports a fungus, *Aspergillus sydowii*, that attacks coral reefs, and minerals, such as iron and silicates, that in turn increase the growth of algae (Shinn 2001). The algae, as described earlier, reduce water clarity and decrease coral growth. However, the scientific community agrees that anthropogenic nutrients reaching the reef tract are a major cause of this degradation (Leichter *et al*. 2002). Thus, implementation of this alternative would benefit the coral reef tract of the Keys and contribute to recovery of this important national resource.

Implementation of the priority projects of the FKWQIP that meet Florida Statutory Treatment Standards would result in reduced nutrient loading to nearshore waters and commensurate improvements in ecosystem health, including coral reefs, in the Sanctuary.

The major impetus for improving wastewater treatment and stormwater management in the Keys is the subsequent improvement of the ecological health of the marine ecosystems in the Sanctuary. Implementation of the priority projects of the FKWQIP that meet Florida Statutory Treatment Standards would result in reduced nutrient loading to nearshore waters and commensurate improvements in ecosystem health, including coral reefs, in the Sanctuary.

4.5.3 Alternative 3 (Alternative Funding Sources)

Upland Habitats. Effects on upland habitats under this alternative would be similar to those described under the *No Action* alternative for a period of approximately two to three years until the wastewater and stormwater improvement projects are implemented with alternative funding sources. Once alternative funding sources are available and the proposed projects are implemented, the effects would be similar to those described under Alternative 2. Mitigation for Alternative 3 would be similar to that described for Alternative 2.

Estuarine and Freshwater Wetland Habitats. Adverse impacts to wetland habitats under this alternative would be similar to those described under the *No Action* alternative for a period of approximately two to three years until the wastewater and stormwater improvement projects are implemented with alternative funding sources. The delay in implementation would allow continued wetland habitat degradation with potential adverse effects as described under the *No Action* alternative. Once alternative funding sources are available and the proposed projects are implemented, benefits would occur as described under Alternative 2. Mitigation would be similar to that described in Alternative 2.

Marine and Benthic Habitats. Adverse effects on marine habitats under this alternative would be similar to those described under the *No Action* alternative for a period of approximately two to three years until the wastewater and stormwater improvement projects are implemented with alternative funding sources. The time delay would allow continued marine habitat degradation with potential adverse effects as described under the *No Action* alternative. Once alternative funding sources are available and the proposed wastewater and stormwater projects are implemented, benefits to these habitats would occur as described under Alternative 2. No mitigation would be required.

Adverse effects on marine habitats under this alternative would be similar to those described under the No Action alternative for a period of approximately two to three years until the wastewater and stormwater improvement projects are implemented with alternative funding sources.

Coral Reefs. Delayed implementation of the FKWQIP under Alternative 3 would result in continued adverse impacts to water quality in nearshore environments and associated coral reefs. Following implementation after two to three years and then construction of facilities, water quality improvements would be anticipated as described under Alternative 2.

4.6 Protected Species

Existing adverse impacts to protected species and their habitats due to nutrient and other pollutant inputs into nearshore waters in the Sanctuary are anticipated to continue under the *No Action* Alternative. Potential adverse impacts to protected species or their habitat under the *Proposed Alternative* are anticipated to be limited to facilities construction as part of the proposed projects. Under Alternative 3, existing adverse impacts to protected species and associated habitat will continue until alternative funding sources are available and water quality improvements are eventually implemented.

Protected species in the study area include a minimum of 85 plants and animals listed as endangered, threatened, or of special concern by federal and/or state agencies. Protected species can be impacted directly through a "take" action, which would include the actual loss of an individual organism or loss of federally designated critical habitat. Indirect impacts would include the loss or degradation of the habitat that the organism requires to sustain its population.

Because of the limited lands available for construction and implementation of FKWQIP projects, any construction on natural lands is likely to impact a protected species or associated habitat at some point during the implementation of FKWQIP. The Florida Keys are made up of a relatively small land mass distributed among numerous tropical and subtropical islands. The conservation areas comprise 34 percent of that land mass and this limited area supports 85 species of plants and animals that are protected by state and federal laws. Given the large number of protected species in such a small area, impacts would likely be unavoidable despite the avoidance and minimization precautions taken. Unavoidable impacts to critical habitat may be the most challenging issue to address with the implementation of the FKWQIP. Consultation with the USFWS, the FFWCC, local authorities and non-governmental organizations (NGOs) will be undertaken during the planning process for each of the individual projects in the FKWQIP program.

Potential adverse impacts to protected species or their habitat under the Proposed Alternative are anticipated to be limited to facilities construction as part of the proposed projects.

4.6.1 Alternative 1 (No Action)

Adverse impacts to protected species may occur as a result of continued discharges of untreated wastewater and stormwater into the Sanctuary, particularly in nearshore habitats, under the *No Action Alternative*. As discussed previously, continued discharges of nutrients, sediments, and other pollutants into canals and nearshore waters of the Sanctuary would likely increase the potential for algal blooms, degrade water clarity and light penetration, decrease dissolved oxygen, and increase the likelihood of fish kills, bioaccumulation and biomagnification, and encourage macroalgal growth. This would in turn decrease light penetration and adversely affect benthic habitats and those protected species using them.

Adverse impacts to protected species may occur as a result of continued discharges of untreated wastewater and stormwater into the Sanctuary, particularly in nearshore habitats, under the No Action Alternative.

4.6.2 Alternative 2 (Proposed Action)

Under the *Proposed Action*, FKWQIP would be implemented and both beneficial and adverse impacts to protected species would be anticipated. Reductions in nutrients, contaminants and other pollutants would result in improved water quality and commensurate improvements in habitats in the study area. These improved habitats would directly benefit the health and status of protected species.

Adverse impacts would occur as a result of facilities and facilities construction. Minor adverse impacts to protected species habitat would likely occur under the *Proposed Action* due to the construction of new stormwater and wastewater treatment facilities, sewer collection systems, or additions to existing wastewater facilities. These activities would result in vegetation or habitat loss, which would directly affect the availability of habitat for fish and wildlife. Assessing potential impacts to fish and wildlife resources requires knowledge of the individual project details. The appropriate NEPA documentation would be prepared and coordination with the appropriate local, state, and federal agencies for each individual wastewater and stormwater project that is part of the FKWQIP would occur.

Compliance with USFWS recommendations for avoiding areas of tropical hardwood hammock, pine rocklands, buttonwood grasslands, or freshwater marshes would occur. Feasible alternatives for siting proposed wastewater and stormwater improvement projects outside of these areas would be recommended as part of individual projects.

Minor adverse impacts to protected species habitat would likely occur under the Proposed Action due to the construction of new stormwater and wastewater treatment facilities, sewer collection systems, or additions to existing wastewater facilities.

In order to evaluate the effects of individual projects on protected species and critical habitat, an integrated wildlife habitat ranking system would be used during the preparation of the supplemental Environmental Assessments. The ranking system was developed by the FFWCC

Office of Environmental Services (FFWCC 2002(a)). The FFWCC applied GIS technology and remote sensing data to identify and rank landscape level habitat areas important to a broad array of wildlife species, including many protected and/or rare mammals, birds, amphibians and reptiles. The ranking system is displayed as a color-coded GIS map of habitats and corresponding rank values. The habitat values are based on a composite score of several variables, including, but not limited to, land cover, protected species occurrences/habitat, Strategic Habitat Conservation Areas (SHCAs) and species richness (Endries *et al.* 2001). The ranking system is intended to assist in long-range planning efforts by targeting sensitive or rare habitats. Ranks of one to ten would be assigned to each land cover class represented in the study area. A rank of one would indicate the lowest relative habitat value, while a rank of ten would indicate the highest relative habitat value.

The FFWCC Wildlife Potential Species Habitat Models are based on occurrence records, species range maps, and land cover data. These data (FFWCC 2002(b)) can be used to identify and calculate potential habitat areas for those wildlife species that may potentially occur in the study area. The information obtained from these models will be used to identify concerns and constraints for the individual sitings of facilities and wastewater collection systems with respect to protected species. The model uses ArcInfo grid files to calculate total acres of potential *preferred* habitat for each potentially occurring species by multiplying the total number of occurrence grid cells by the area of each grid cell. Each grid cell is 100 meters by 100 meters (10,000 square meters), or approximately 2.5 acres. Therefore, acres of potential habitat are based on whole grid cells and are estimates of habitat area. The habitat models reveal potential habitat for 23 protected species in the study area. Of these species, ten species (five mammals, two birds and three reptiles) are federally protected and all 23 species are state protected. Table 4-2 lists those protected species for which potential habitat models have been developed, their federal and state protected status, acres in the study area for each habitat model, and the model output.

Mitigation for adverse impacts to protected species would initiate with the avoidance of their habitat. If unavoidable impacts are expected to occur, minimization of those impacts would be required. If impacts are minimized but still unacceptable to the reviewing agencies, mitigation must be proposed to offset the impacts. As stated previously, mitigation would be determined on a case-by-case basis with the planning and permitting of each individual project component of the program. Mitigation may take the form of habitat creation, restoration, preservation, or enhancement. Recommendations from the USFWS and FFWCC may include restoration of habitat by the removal of non-native vegetation from public lands, or preservation of habitat through the purchase and preservation of undeveloped lands linking habitats.

As stated previously, the implementation of the FKWQIP will significantly improve the water quality in the nearshore habitat, which will in turn enhance the habitat for the numerous species of wildlife that rely on that ecosystem for their continued survival. Among the species of wildlife that would benefit are the numerous state-listed piscivorous avian species and the Florida manatee. The long-term benefits that this program would provide substantially offset the unavoidable impacts to habitat.

Table 4-2
Wildlife Species Potential Habitat Models

Scientific Name	Common Name	Status	Total Grid Cells	Total Acres	Potential Species Habitat Model (Limited to Study area)
MAMMALS					
Mustela vison mink	mink (south FL population)	ST	2	5	An extremely small area of potential habitat is present on Key Largo.
Neotoma floridana smalli	Key Largo woodrat	FE, SE	934	2,308	Habitat present in Upper Keys, specifically Key Largo and Lignumvitae Key.
Odocoileus virginianus clavium	Key deer	FE, SE	3,209	7,929	Habitat present in Lower Keys, specifically from Little Pine Key south to Sugarloaf Key.
Oryzomys palustris	Key rice rat	FE, SE	2,033	5,024	Habitat present in Lower Keys, specifically from Little Pine Key south to the Saddlebunch Keys (north of Boca Chica Key).
Peromyscus gossypinus allapaticola	Key Largo cotton mouse	FE, SE	934	2,308	Habitat present in Upper Key Largo, Lignumvitae Key and Lower Matecumbe Key.
Ursus americanus floridanus	Florida black bear	FC, ST	450	1,112	Habitat present in Lower Keys, specifically Big Pine Key and No Name Key.
BIRDS					
Ajaia ajaja	roseate spoonbill	SSC	990	2,446	Habitat present in Upper Keys, specifically from Key Largo south to Upper Matecumbe Key.
Charadrius alexandrinus	snowy plover	ST	34	84	Habitat present on Bahia Honda Key (Lower Keys).
Charadrius melodus	piping plover	FT, ST	34	84	Habitat present on Bahia Honda Key (Lower Keys).
Columba leucocephala	white-crowned pigeon	ST	8,998	22,234	Habitat present throughout entire study area.
Egretta rufescens	reddish egret	SSC	2,097	5,182	Habitat present in Upper Keys, specifically from Key Largo south to Tavernier.
Egretta thula	snowy egret	SSC	2,097	5,182	Habitat present in Upper Keys, specifically from Key Largo south to Tavernier.
Egretta tricolor	tricolored heron	SSC	2,097	5,182	Habitat present on Key Largo.
Eudocimus albus	white ibis	SSC	2,600	6,425	Habitat present in Upper Keys, specifically from Key Largo south to Tavernier.
Haliaeetus leucocephalus	bald eagle	FT, ST	80	198	Habitat present in Lower Keys, specifically Stock Island, Cow Key and Key West.
Pandion haliaetus	osprey	SSC	12,289	30,366	Habitat present throughout entire study area.

Scientific Name	Common Name	Status	Total Grid Cells	Total Acres	Potential Species Habitat Model (Limited to Study area)
Pelicanus occidentalis	brown pelican	SSC	304	751	Habitat present in Broad Key and Upper Key Largo.
REPTILES					
Alligator mississippiensis	American alligator	FT(S/A), SSC	17,154	42,387	Habitat present throughout entire study area.
Crocodylus acutus	American crocodile	FE, SE	862	2,130	Habitat present mostly on Key Largo and Shell Key (Upper Keys), and Boot Key and Long Key (Middle Keys).
Drymarchon corais couperi	eastern indigo snake	FT, ST	10,477	25,889	Habitat present throughout entire study area.
Gopherus polyphemus	gopher tortoise	SSC	549	1,357	Habitat present in Lower Keys, specifically Little Pine Key, No Name Key, Big Pine Key, Cudjoe Key and Sugarloaf Key.
Pituophis melano-leucus mugitus	Florida pine snake	SSC	2	5	Habitat present in two extremely small areas on Key Largo.
Storeria dekayi victa	Lower Keys brown snake	ST	3,225	7,969	Habitat present in Lower Keys, specifically from Little Pine Key south to Boca Chica Key.

Source: FFWCC (date unavailable (b)). Total acreage was calculated multiplying total number of grid cells by the area of each grid cell. Each grid cell is 100 meters by 100 meters (10,000 m^2) or approximately 2.5 acres.
FE – Federally Endangered, SE – State Endangered, FT – Federally Threatened, ST – State Threatened, FT (S/A) – Federally Threatened due to Similarity of Appearance, SSC – State Species of Special Concern, FC – Federal Candidate Species

4.6.3 Alternative 3 (Alternative Funding Sources)

Under Alternative 3, the lack of federal funding would result in a delay in the implementation of the individual projects under the FKWQIP. There would be no concerted effort to integrate or prioritized the construction of the projects, which would be initiated only upon funding availability. This less integrated approach would not likely result in additional impacts to protected species, but the delays in implementation may result in even more constraints with respect to available, developable lands as development in the Keys continues. It is anticipated that the alternative funding sources will not be available for two or three years and during that time the negative impacts to wildlife habitat as a result of the discharge of untreated wastewater will continue as described in the *No Action* alternative. However, when the proposed wastewater and stormwater projects are implemented with funds from the alternative sources, the effects on the protected species will be similar to those described under Alternative 2. Mitigation, if necessary, would also be similar to that recommended with Alternative 2.

4.7 Essential Fish Habitat (EFH)

The Magnuson-Stevens Fishery Conservation and Management Act requires federal agency consultation with the National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. Informal consultation was initiated as part of the preparation effort for this EIS and several species and associated habitats were identified as pertinent to the FKWQIP (see *Section 3.7*). During preparation of supplemental NEPA documentation, consultation with the NMFS will be formalized for each project to address applicable species and habitats of concern.

Appropriate mitigation will be implemented for any potential negative impacts on EFH resources that cannot be avoided.

4.8 Air Quality and Noise

Noise and air quality impacts would occur as a result of the construction and operation of the facilities proposed for the FKWQIP, but these impacts would not differ from any other typical wastewater or stormwater treatment facilities. The operation and maintenance of these facilities would generally produce fewer impacts than during construction

4.8.1 Alternative 1 (No Action)

Air Quality. There would be no additional air quality impacts resulting from the *No Action* alternative

Noise. There would be no noise impacts resulting from the *No Action* alternative.

4.8.2 Alternative 2 (Proposed Action)

Air Quality. The construction of new WWTFs would result in minor, temporary impacts to the air quality in the vicinity of construction sites. The operation of heavy equipment during construction may result in minor, temporary adverse impacts to local air quality from heavy equipment engine exhaust. In addition, heavy equipment operation during construction can also result in windblown dust and particles. Fugitive dust can be minimized by adding moisture to the soil, mulch, and re-vegetation soon after construction completion. The duration of construction activities would range from one year for smaller treatment systems to two years for larger plants. Potential impacts will vary between sites due to location, size and design of each treatment facility. Operation of the facilities would also produce minor, long-term impacts and mitigation would consist of odor abatement measures integrated into the design of each facility.

Noise. The construction of new wastewater treatment facilities would result in temporary noise impacts to land uses in the vicinity of construction sites. Heavy equipment operation and heavy trucks accessing construction sites would add additional noise to the ambient noise levels described in Section 3.6. Common construction practices can create significant noise levels. Noise impacts will be discussed on a case-by-case basis in supplemental NEPA documentation.

Noise impacts as a result of the construction of the wastewater and stormwater treatment facilities would be minor, temporary and short-term. Minimization of impacts would preclude the need for mitigation. Operation of the facilities would also produce minor, long-term impacts and mitigation would consist of the noise abatement measures appropriate for each specific treatment facility or pump station.

4.8.3 Alternative 3 (Alternative Funding Sources)

Air Quality. Since there would be fewer centralized WWTFs constructed than with Alternative 2, air quality impacts would be similar but less focused at specific sites and extended over a longer period of time. As with Alternative 2, the air quality impacts would be addressed on a case-by-case basis during the preparation of supplemental NEPA documentation.

Noise. It is likely that smaller and less centralized WWTF projects would be constructed under this alternative. As a result, in comparison with Alternative 2 facilities, noise impacts would be less than those caused by Alternative 2. Noise impacts will be analyzed and addressed for each individual project as it is implemented.

4.9 Cultural Resources

Potential impacts to cultural resources resulting from implementing the FKWQIP are primarily related to disturbance of resources and effects on the historic viewshed. The construction of new facilities and the modification of existing facilities would require excavation and earthmoving activities for the installation of wastewater collection systems and for site preparation. These ground disturbing activities have the potential to impact undocumented, buried archaeological and historical resources. In addition, the construction and operation of the proposed facilities may detract from the visual interest of historic resources by intruding on the viewshed. As the planning and design of each site is initiated, the potential for impacts to cultural resources would be addressed. Coordination with the Florida State Historic Preservation Office (FSHPO), and compliance with Section 106 of the National Historic Preservation Act (NHPA) would be required to determine the extent of potential impact on the cultural resources in the vicinity of each specific FKWQIP project.

As each project is initiated, supplemental NEPA documentation would be prepared to analyze the project individually and in sufficient detail to avoid or minimize potential impacts to cultural resources. Potential impacts to buried resources would be mitigated by site surveys, if necessary, and potential impacts to the viewshed would be buffered by plantings or screening. Preliminary siting studies have identified previously disturbed lands as locations for new facilities whenever possible, in order to avoid impacts to unknown cultural resources.

4.9.1 Alternative 1 (No Action)

Under this alternative, no wastewater treatment plants, wastewater collection systems or stormwater management facilities would be constructed, consequently unidentified cultural resources would not be impacted.

4.9.2 Alternative 2 (Proposed Action)

Under this alternative, cultural resources may be adversely affected in areas where new treatment facilities are constructed or wastewater collection systems installed. Proposed activities would be reviewed to locate areas designated for ground disturbance in previously undisturbed areas. Coordination with the FSHPO will be completed as part of the supplemental NEPA document preparation effort prior to any construction activity that involves new ground disturbance.

Coordination with the Florida State Historic Preservation Office (FSHPO), and compliance with Section 106 of the National Historic Preservation Act (NHPA) would be required to determine the extent of potential impact on the cultural resources in the vicinity of each specific FKWQIP project.

4.9.3 Alternative 3 (Alternative Funding Sources)

This alternative has similar implications to Alternative 2, as described above, and would likely have similar impacts. Potential impacts would be evaluated at the project specific level during preparation of supplemental NEPA documentation and coordinated with the FSHPO.

4.10 Demographics and Socioeconomics

The economy of the Keys is based on a tourist industry that attracts 2.2 million visitors per year and is dependent on water-related recreation. Implementation of the FKWQIP will improve the quality of nearshore waters and reduce public health concerns. This section describes potential demographic and socioeconomic impacts that would result from implementation of project alternatives.

4.10.1. Alternative 1 (No Action)

As stated in Section 3.10, Demographics and Socioeconomics, Monroe County's permanent population declined between the years 2000 and 2001. Under Alternative 1, wastewater and stormwater management infrastructure improvements would not be implemented and could result in further population decline. As mandated in the Monroe County Comprehensive Plan, future growth is permitted only when adequate wastewater and stormwater facilities are in place or concurrently provided. In the absence of central wastewater systems, development would be dependent on on-site treatment facilities, many of which would be adequate only through the year 2010. These limitations on wastewater treatment capacity would constrain growth in land development and permanent population. However, while permanent population could be expected to remain stable or even decline, transient or tourist populations may continue to grow at a slow pace even with growing inadequacy of the wastewater and stormwater infrastructure systems.

Employment and Income. Very slow urban development and population growth combined with a reduced ability to serve visitors would be expected to lower employment and wages in the Keys under the *No Action* alternative. While the economy of the Keys is largely driven by tourism, the demand for goods and services by the permanent population is also an important economic force. The sector of the county economy that supports permanent residents would stagnate under Alternative 1, and the overall economy could become more heavily reliant on the health of the tourism industry.

Home Ownership. Alternative 1 may result in reduced home ownership due to inadequate wastewater infrastructure and limited growth in the housing market. The high price of real estate in Monroe County has already contributed to a lower incidence of home ownership. Higher housing prices would be expected to further reduce the home ownership rate. This, in turn, may result in an increase in the average number of persons per household in the Keys, which is relatively low at the present time.

Tourism. The tourism industry in the Keys is largely centered around local marine resources, which are dependent on water quality. Under Alternative 1, nearshore water quality degradation would continue due to nutrient loading and result in adverse impacts to recreation and tourism. Over time, if serious water quality degradation were to occur, visitor activity could decline.

However, a significant decline in visitation to the Keys is unlikely under Alternative 1. The demand for tourism activity is largely a function of the level of population and economic growth in south Florida, which is not expected to slow in the foreseeable future. As a result, growth in tourism in the Keys should be expected to grow regardless of water quality or even infrastructure constraints.

Wastewater Management Costs in Monroe County. Implementation of Alternative 1 would not increase existing wastewater management costs in Monroe County because wastewater and stormwater improvement projects would not be implemented.

Cost of Living. Implementation of Alternative 1 is anticipated to increase the cost of living in the Keys. The absence of adequate stormwater and wastewater infrastructure would slow allowable developments in the Keys. Continued slow development, along with a continued demand for housing and commercial services in Monroe County, would increase the cost of real estate. Because the cost of housing is a principal component of the cost of living in Monroe County, the imbalance between the supply and demand for housing could have a significant impact on the cost of living in Monroe County. The effects of a growing imbalance have already become apparent in the rapidly escalating price of real estate in Monroe County during the last few years. Alternative 1 would exacerbate these effects.

Public Health Conditions. Under the *No Action* alternative, FKWQIP would not be implemented and continued discharge of inadequately treated wastewater and stormwater would be expected to result in a decline in public health conditions. Public health indicators generally suggest the overall level of public health affected by water quality in the Keys is high in comparison to state of Florida averages. A decline in water quality, with higher levels of fecal coliform bacteria, could eventually contribute to a modest decline in public health, although any such decline would be expected to be minor because of provisions in place to protect the public from contaminated waters.

4.10.2 Alternative 2 (Proposed Action)

Alternative 2, the *Proposed Action* alternative, would result in the implementation of an area-wide, integrated managed wastewater and stormwater management system necessary for continued land development at a modest pace and in accordance with Monroe County ordinances, e.g. ROGO. The wastewater and stormwater improvements would also permit improved service to both permanent and transient residents, facilitating some additional growth in functional population – the total of resident and transient populations.

Employment and Income. Implementation of FKWQIP under Alternative 2 could potentially result in increased employment and income. With the availability of funding for wastewater and stormwater management facilities and a somewhat greater rate of land development, the economy of the Keys would continue to grow at a modest pace, maintaining a stronger demand for employment and steady increases in wages and salaries. As a result, tourism may strengthen in the Keys and support further economic growth, employment and income.

Home Ownership. Alternative 2 might result in reduced home ownership due to increased cost of utility services necessary to implement FKWQIP and subsequent increases in the cost of living for many Florida Keys residents and businesses. The increases would disproportionately

impact low-income households in terms of the location of facilities, although the cost of implementation would be shared equally among residents (further discussion in *Section 3.10*).

Tourism. Alternative 2 would likely improve the tourism industry, both by allowing continued development in visitor-related economic sectors as well as through the improvement in the quality of nearshore waters and the attendant benefit to recreation. Potential adverse impacts to tourism from Alternative 2 include temporary road closings and detours for construction of sewer lines and stormwater management facilities.

Alternative 2 would likely improve the tourism industry, both by allowing continued development in visitor-related economic sectors as well as through the improvement in the quality of nearshore waters and the attendant benefit to recreation.

Wastewater Management Costs. Under Alternative 2, an increase in the cost of utility services to most residents of the Florida Keys is anticipated. Although federal funding would fund a very significant portion of the total cost of developing wastewater and stormwater infrastructure, local utilities would be required to fund, and recover their costs, for some development costs, including land acquisition, and all operation and maintenance expenses associated with the improvements. These costs would be passed along to residents and businesses in the form of higher utility service charges, although some of the costs of maintaining the stormwater utility might be funded through property taxes. In either event, the cost for utility services would increase.

Cost of Living. An increase in the cost of utility services to most residents of the Florida Keys is anticipated under Alternative 2 due to implementation of stormwater and wastewater improvements. Although federal funding would provide a significant portion of the total cost of developing wastewater and stormwater infrastructure, local utilities would be required to fund, and recover their costs, for some development costs. These costs include land acquisition and all operation and maintenance expenses associated with the improvements. Costs would be passed along to residents and businesses in the form of higher utility service charges, although some of the costs of maintaining the stormwater utility might be funded through property taxes. In either event, the cost for utility services would increase, therefore affecting the cost of living.

Public Health Conditions. Because of the water quality improvements in nearshore waters under Alternative 2, reductions in the incidence of water borne disease would potentially result in a modest improvement in public health. Any such improvement would be expected to be quite small, however, because most public health indicators in Monroe County suggest that the overall level of public health is currently very good.

4.10.3 Alternative 3 (Alternative Funding Sources)

Under Alternative 3, the anticipated delay in the installation of wastewater and stormwater management infrastructure would slow land development and population growth in the study area. Depending largely on local funding, the residents and business operators in the Keys would be poorly prepared to fund all or proportions of the facilities needed to allow any

significant additional development. Similarly, growth in visitor population levels would be reduced with the delayed implementation of wastewater and stormwater improvements.

Because of the water quality improvements in nearshore waters under Alternative 2, reductions in the incidence of water borne disease would potentially result in a modest improvement in public health.

Employment and Income. Under Alternative 3, implementation of wastewater and stormwater improvements would be delayed until adequate funding was acquired. The installation of infrastructure improvements needed to support continued residential and commercial growth would be delayed. This alternative would, in turn, slow the rate of residential and commercial growth and result in modest growth in employment and income.

Home Ownership. Alternative 3 might also result in reduced home ownership due to slow infrastructure development. The slow growth in the cost of utility services would have a direct impact on the cost of living for Florida Keys residents. Also, the slow economic growth associated with Alternative 3, combined with the increasing demand for housing and business locations in the Keys, would cause some increase in the cost of real estate, further increasing the cost of living in the Keys. This, in turn, would potentially cause a decline in home ownership in the county.

Tourism. Under Alternative 3, continued growth of tourism in the Florida Keys is anticipated, although at a slower pace. By funding wastewater and stormwater improvements needed to permit residential and commercial development that would eventually lead to improved nearshore water quality, additional permanent residents as well as visitors would be accommodated, providing a boost to recreation and tourism. Some adverse impact may result from road closings needed to install wastewater collection systems and stormwater facilities.

Wastewater Management Costs in Monroe County. Under Alternative 3, the cost of wastewater and stormwater management utility services would increase as the necessary improvements were implemented. Cost increases would consequently be passed along to Keys residents and businesses.

Cost of Living. Under Alternative 3, the cost of wastewater and stormwater management utility services would increase as the necessary improvements were implemented. Cost increases would be passed along to residents and businesses in the Keys, therefore increasing the cost of living.

Public Health Conditions. Alternative 3 would result in delayed improvements in water quality, in turn delaying potential improvements in public health conditions. However, any improvement would be minor, as overall public health relating to water quality is currently good.

4.11 Recreation

The 2.2 million annual visitors to the Keys rely on clean water and beaches as well as the abundant fish and wildlife that characterize this popular vacation destination. These visitors provide the basis of the tourism industry on which the economy of the Keys relies.

Consequently, potential impacts to recreation amenities that may result from the implementation of FKWQIP are examined below.

4.11.1 Alternative 1 (No Action)

Under Alternative 1, a steady decline in recreational opportunities could be expected. Without implementation of water quality improvement projects, continued water quality problems in Sanctuary nearshore waters would lead to additional beach advisories and closings and potentially further damage to coral reefs. These effects in turn would likely result in adverse impacts to recreational opportunities in the Keys. Moreover, the perception of the quality of recreational opportunities by both residents and visitors to the Keys would decline, reducing overall recreational demand and activity.

4.11.2 Alternative 2 (Proposed Action)

Implementation of the *Proposed Action* would have a beneficial impact on recreational opportunities in the Florida Keys. Decreased loadings of nutrients and other pollutants into nearshore waters as a result of implementing stormwater and wastewater improvements under Alternative 2 would be expected to improve water quality and subsequently, recreational resources in much of the Florida Keys. The majority of outdoor recreation activity in Monroe County relates directly to marine resources. With improvements in nearshore water quality, the incidence of beach advisories and closings would decline, both increasing the opportunity for marine-based recreation and the perception by both permanent residents and visitors of the quality of recreational opportunities in the Keys, increasing recreational activity and the health of the local economy.

Without implementation of water quality improvement projects, continued water quality problems in Sanctuary nearshore waters would lead to additional beach advisories and closings and potentially further damage to coral reefs.

4.11.3 Alternative 3 (Alternative Funding Sources)

By improving nearshore water quality over time, Alternative 3 would reduce the incidence of beach health advisories and closings and improve recreational opportunities in the Florida Keys similar to Alternative 2. However because of the time necessary to secure optional sources of funding, the benefits of this alternative would be achieved over an extended period of time. The eventual beneficial effects would be significant because of the importance of the marine environment to recreation in the Keys.

4.12 Open Space and Aesthetic Resources

Visitors to the Florida Keys enjoy a unique sighting experience over the 100 miles of U.S. Hwy 1 linking the numerous islands consisting of natural habitats and open water. Water quality is important to the maintenance of healthy ecosystems and the open spaces of the Florida Keys. The effects of implementing project alternatives on open space and aesthetic resources in the Florida Keys and Sanctuary are discussed below.

With improvements in nearshore water quality, the incidence of beach advisories and closings would decline, both increasing the opportunity for marine-based recreation and the perception by both permanent residents and visitors of the quality of recreational opportunities in the Keys, increasing recreational activity and the health of the local economy.

4.12.1 Alternative 1 (No Action)

Under the *No Action* alternative, wastewater treatment in the keys would continue to primarily rely on individual treatment systems. There would be minimal impact to aesthetic resources, primarily nuisance odors and views associated with increased algal blooms and fish kills caused by continued nutrient loading from wastewater and stormwater discharges.

4.12.2 Alternative 2 (Proposed Action)

Federal funding assistance to local municipalities responsible for implementing the FKWQIP in the Florida Keys for the purpose of developing and implementing wastewater treatment and stormwater management improvements would occur under Alternative 2. The introduction of new WWTFs could result in impacts to aesthetic resources and open spaces near the site. Sites for WWTFs can range from two to five acres in size with a 50,000- to 100,000-square foot structure that is 25 to 30 feet tall (Furland 2003). Nuisance odors and sights due to algal blooms and fish kills would be reduced.

However, the *Monroe County Sanitary Wastewater Master Plan* (Monroe County 2000a) stated that WWTF sites would be directed toward industrial areas. Existing and future residential areas, as well as parks, conservation lands, resorts, restaurants, and other commercial areas would be avoided. Therefore, as plants similar to WWTFs are common in industrial areas, the impacts to aesthetic resources should be negligible. A visual resource assessment would be prepared as part of the project specific supplemental NEPA documentation, and would describe views and open spaces associated with that particular site.

4.12.3 Alternative 3 (Alternative Funding Sources)

Under Alternative 3, smaller, fewer, and less centralized WWTF systems would be constructed. As a result, aesthetic resource impacts would be less than Alternative 2. Nuisance odors and sights due to algal blooms and fish kills would be reduced over time.

4.13 Environmental Justice

As required by Executive Order 12898, this section focuses on potential impacts to minority and low-income residents as they relate to environmental justice (See Section 3.13 for a description of federal requirements). Primary impacts minority and low-income populations may experience as a result of the proposed alternatives include:

- Siting of wastewater and stormwater improvements, especially treatment facilities, in minority or low-income neighborhoods.

- Increased cost for wastewater and stormwater management services passed in the form of sewer charges and property taxes, having a disproportionate impact on low-income residents.

Under both state of Florida statutes and Monroe County ordinances, residents of the Florida Keys are required to replace existing cesspools and failing septic tanks with adequate wastewater treatment facilities. The financial impact to residents for these improvements would be uniformly applied in accordance with Monroe County Codes and Tax Structure.

Alternative 2, because it would result in accelerated installation of central wastewater treatment facilities, would reduce the need for many residents to install costly interim improved treatment facilities, instead allowing these residents to connect directly to a central sewer system. The potential to partially reduce, or address, the financial impact on all residents required to replace cesspits and any other substandard wastewater management system could yield a significant benefit to low- income residents as well as higher-income residents.

While the costs incurred to residents and business operators to replace inadequate treatment facilities are not directly related to the *Proposed Action*, the cumulative impact on low-income residents resulting from increased costs of facility operation in addition to the cost of replacing inadequate wastewater facilities should be considered in the evaluation of any project alternative.

Alternative 2, because it would result in accelerated installation of central wastewater treatment facilities, would reduce the need for many residents to install costly interim improved treatment facilities, instead allowing these residents to connect directly to a central sewer system.

4.13.1 Alternative 1 (No Action)

Under Alternative 1, the primary wastewater and stormwater improvements would be the replacement of inadequate residential and small business sewage systems with adequate on-site systems. Such improvements would be costly, with capital costs ranging from $2,500 to as much as $8,200, and monthly costs from $63 to $118 (FEMA 2002). Due to a lack of discretionary income, low-income and fixed income residents would be adversely impacted by the financial requirements of these improvements.

4.13.2 Alternative 2 (Proposed Action)

As noted above, Alternative 2 could result in adverse economic impacts to low-income residents of the Florida Keys. Wastewater treatment facilities, like most infrastructures, are often sited on the least costly property available that meets development requirements. Suitable property is often located in low-income areas, which may have a concentration of minority population. Under Alternative 2, a number of wastewater treatment plants would be sited in the Florida Keys. The principal design factors affecting plant siting are proximity to collection and transmission systems and disposal site for treated effluent, geologic stability, and access to utilities. A facility site chosen for this alternative must also meet land use and zoning requirements.

Land use information for the Florida Keys shows that about one-third of all developable property remains vacant, and the vacant land occurs throughout the Keys. Most of this property is zoned for residential development, although converting a parcel or parcels to government use for utilities is a common practice. In seeking land for installation of wastewater treatment plants, there is likely to be some latitude in selecting and purchasing property, the principal constraints being ensuring compatibility with adjacent and nearby land uses and avoiding disproportionate use of lands adjacent to or near concentrations of minority or low-income populations.

Until actual facility sitings are conducted, it is not possible to assess whether minority or low-income residents would be disproportionately impacted by implementation of project alternatives. During the process of locating potential sites for wastewater treatment facilities and collection systems, it would be necessary to monitor and assess the siting process to ensure that disproportionate impacts do not occur or are minimized to the extent possible.

Under Alternative 2, most residents and businesses in Monroe County would experience higher utility charges. While the wastewater improvements would initially affect only a portion of Keys residents and businesses, the stormwater improvements would affect many others. The effects of the wastewater improvements would be most felt by residents and businesses required to connect and pay the connection charge. The costs for connecting to the various systems have not been estimated, and there would likely be considerable differences in cost from one system to another. Nonetheless, based on the cost of connection to existing central sewer systems in the Florida Keys and elsewhere, the cost would be expected to exceed $3,000, and could be much higher.

In seeking land for installation of wastewater treatment plants, there is likely to be some latitude in selecting and purchasing property, the principal constraints being ensuring compatibility with adjacent and nearby land uses and avoiding disproportionate use of lands adjacent to or near concentrations of minority or low-income populations.

The connection charge could be an especially difficult financial burden for low-income residents previously required to replace a cesspool or other inadequate wastewater management system. The cumulative impact of having to fund a large central sewer system connection charge within a few years of paying for a qualifying on-site treatment system could be significant.

The monthly cost, and charge to residents, for operating and maintaining compliant central wastewater treatment facilities can be expected to reach $75 per month per residential unit. In many cases, residents are currently paying very little for wastewater management due to inadequate treatment facilities. Over 10 percent of Monroe County residents, about 8,000 people, are classified as living below the poverty level. Analyses conducted by Monroe County indicate that many more have little if any discretionary income at the present time. For this reason, any increase in wastewater charges, either for connection or operation and maintenance, would create an economic hardship for a large number of Keys residents.

The connection charge could be an especially difficult financial burden for low-income residents previously required to replace a cesspool or other inadequate wastewater management system.

There are several issues associated with resolving the potential impacts to low income segments of the population in the Keys under Alternative 2. These issues are described below.

- **Connection fee source of funding**. The principal issue associated with providing subsidies for low-income residents is the source of funding. If the subsidy is provided by the sewer utility, the utility would be compelled to recover the subsidy funding through collecting higher connection charges from other residents or diverting operating revenues. Operating revenues could be sourced for this purpose only if sewer rates were set sufficiently high to generate revenue in excess of the amount needed to recover operating expenses and meet any debt service coverage requirements. Other than the utility, the main potential sources of funding for the subsidy would be the lead federal agency, the local sponsor, or local government property tax revenues. In each case the potential for funding would have to be evaluated.

- **Service fee source of funding**. Again, the principal issue associated with the recurring cost of sewer service would be the source of funding. A major difference between funding requirements for subsidizing connection charges and recurring charges is the continuing nature of the recurring charges. Potential funding sources would be similar to those for connection charges. An alternative that should be considered is to provide a subsidy to low-income residents on a phase-out basis, whereby each qualifying low-income resident would receive a subsidy for a fixed period of time, and which would decline over time.

- **Graduated rate structure**. A rate structure that provides a lifeline sewer bill would include a very low base charge and volume charge for the first, say, 3,000 gallons of water use per month, with a sharply increasing charge for more water use. Such a rate structure links sewer charges to metered water use, a common method for charging for sewer services. This type of rate structure has several drawbacks. First, it runs counter to the prevailing practice of charging on the basis of the cost of service. Under most conditions, the cost of providing sewer service is relatively fixed, especially in an older system with significant amounts of inflow and infiltration, so a cost of service-based rate normally has a high base charge and flat volume charge. Second, a low base charge and low charge for the first two or three thousand gallons of water use places the sewer utility at financial risk because its revenue is tied to water use by larger customers. Any significant reduction in water use has a magnified effect on sewer utility revenues and, equally important, the very factors that lead to a decline in water use often cause increased wastewater management expenses. Third, higher rates for larger water users are arbitrary and discriminatory, with no basis other than providing a subsidy for low volume customers. Finally, such a rate structure subsidizes all low volume water customers, regardless of ability to pay.

Any increase in wastewater charges, either for connection or operation and maintenance, may create an economic hardship for a large number of Keys residents.

4.13.3 Alternative 3 (Alternative Funding Sources)

With slower implementation of central wastewater systems, Alternative 3 would result in many of the same impacts described for Alternative 2, only at a slower rate. However, similar to the *No Action* alternative, any such impacts would not be related to the proposed federal action. Therefore, no mitigation would be required under Executive Order 12898.

4.14 Land Use and Planning

The construction and upgrade of new WWTF are not expected to result in significant changes to existing land uses. New wastewater treatment systems would likely be located on vacant land and occupy one to five sacres depending on the size and capacity of the treatment system. Depending on the specific location, construction of a new WWTF may have the effect of establishing a precedent for more industrial or non-residential land uses within the project area. Because the environmental consequences on land use is both project and site specific, impacts would be further evaluated in supplemental NEPA documentation prepared for each project

4.14.1 Alternative 1 (No Action)

The absence of improved wastewater treatment and stormwater management infrastructure under Alternative 1 would be expected to have no significant impact on existing land use. However, future land use development would be limited to those areas and developments providing approved on-site wastewater treatment facilities, which could retard land development to a level below that which could be permitted with the availability of adequate wastewater infrastructure.

4.14.2 Alternative 2 (Proposed Action)

Alternative 2 is not anticipated to impact existing land use other than the use of vacant land for construction of wastewater treatment plants and stormwater management facilities. Less than 100 acres of land throughout the entire Keys would be converted to public utility use if the entire list of projects contained in the FKWQIP were implemented. This alternative would, however, lead to some increase in the rate of land development, due to the availability of wastewater and stormwater facilities for meeting land development requirements mandated in the Monroe County Comprehensive Plan.

4.14.3 Alternative 3 (Alternative Funding Sources)

The impacts of Alternative 3 on land use would be similar to those of Alternative 2. However, potential impacts would occur at a slower pace and possibly to a lesser extent.

4.15 Infrastructure

The effects of the *Proposed Action* and other alternatives on traffic, circulation and utilities and services in the Florida Keys are discussed in this section.

4.15.1 Alternative 1 (No Action)

Transportation. No changes to existing transportation use patterns would occur under the *No Action* alternative.

Utilities and Services. No changes to existing utility services would occur under the *No Action* alternative.

4.15.2 Alternative 2 (Proposed Action)

Transportation. Under the *Proposed Action*, federal funding assistance would be provided to local municipalities responsible for implementing the FKWQIP for the purpose of developing and implementing wastewater treatment and storm water management improvements. The construction of new WWTFs would result in minor, temporary impacts to traffic in the vicinity of new facility construction sites due to heavy equipment and trucks accessing the construction site.

In addition, the construction of wastewater collection systems throughout each community would affect traffic patterns. Depending on available right-of-way, sewer lines that transport the sewage to the WWTF are often constructed under roadways, and it would be necessary to temporarily close road segments during construction.

It is anticipated that maintenance of traffic (MOT) plans would be prepared to accommodate residential and business traffic during construction of wastewater treatment facilities, pump stations and associated sewer lines. The schedule for construction activity could range from one year for smaller plants to two years for larger plants.

The operation of the WWTF would result in additional work trips going to the plant site. It is estimated that four to 7 workers would be employed at a WWTF (Furland 2003), resulting in less than 30 trips per day. At larger plants, some of these workers would be traveling to and from work during off-peak hours. The impact on the area roadway system of the trips produced by the WWTFs would be insignificant.

Utilities and Services. The construction of large centralized wastewater treatment plants and collection systems would result in minor, temporary impacts to utilities at various locations and times throughout the Keys. Depending on the availability of rights-of-way, sewer lines are often constructed under roadways or in roadway rights-of-way. Consequently, it may be necessary to relocate buried water lines or electrical lines during construction. Impacts should be localized and short in duration.

The electrical requirement for a five-million gpd wastewater treatment facility is approximately 4,800-kilowatt hours per day. Discussions would be held with Keys Energy Services and Florida Keys Electric Cooperative during preparation of the supplemental NEPA documentation for each individual project to determine provision of adequate power for plant operation.

4.15.3 Alternative 3 (Alternative Funding Sources)

Transportation. Under Alternative 3, impacts would be similar to Alternative 2 although smaller construction sites would be utilized and construction of the entire FKWQIP would be extended over a longer period of time (potentially two to three years).

Utilities and Services. Under Alternative 3, impacts would be similar to Alternative 2 although smaller construction sites would be utilized and construction of the entire FKWQIP would be extended over a longer period of time (potentially two to three years)

4.16 Hazardous and Toxic Materials

This section discusses the potential environmental consequences of siting new wastewater treatment facilities, construction of sewer collection systems, or stormwater management improvements within the Florida Keys and the studies needed to avoid known areas of hazardous contamination and mitigative measures that would be necessary should hazardous contamination be encountered.

4.16.1 Alternative 1 (No Action)

No disturbance of contaminated lands would occur under this alternative.

4.16.2 Alternative 2 (Proposed Action)

Generally, it can be concluded that the extent of any potential hazardous contamination that would be encountered in the Keys on available vacant parcels of land would largely be associated with unregulated activities (abandoned automobiles and boats, waste piles, outhouses etc.) and confined to small, localized areas, and not considered a significant issue of concern. For individual infrastructure improvement projects the non-federal sponsor would be responsible for investigating the potential presence of hazardous substances as determined necessary by the government to identify the existence and extent of a hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on lands being acquired by the government for the construction operation and maintenance of the *Proposed Action* as funded by the government. Phase 1 Environmental Site Assessments would be conducted to determine if there were potential hazardous materials or waste concerns on properties or rights-of-way proposed for development or placement of collection systems. The results of these assessments and a more site-specific evaluation of the remedial actions or mitigation measures, if required, would be included in supplemental NEPA documentation.

The construction of the treatment facilities and the infrastructure would not generate hazardous wastes under normal circumstances. Accidental spills of petroleum products can occur during construction, but contractors would be required to provide pollution prevention plans and contain any spills.

The normal operation and maintenance of the treatment facilities would not typically generate hazardous wastes and materials. If hazardous wastes should enter the system, a monitoring system typically identifies it and corrective actions are taken to prevent a non-compliant discharge. Technological advances and strict regulations have resulted in a relatively benign

treatment process. Effluent disposal would likely be accomplished through shallow well injection. This disposal option would not generate hazardous wastes during the operation of the systems, nor would it result in the discharge of hazardous wastes into the ground water. As stated previously, the treated effluent would be monitored for hazardous material contamination.

4.16.3 Alternative 3 (Alternative Funding Sources)

Under Alternative 3, Monroe County would rely on local governments for the implementation of infrastructure improvements. Construction delays and reliance upon smaller projects would also result. The smaller projects would have similar impacts on the environment with respect to potential hazardous contamination as the large projects, and would also require Phase 1 Environmental Site Assessments prior to the purchase of potential sites or obtainment of easements. Many of the small systems would be constructed on private property but would still require compliance with state and federal regulations regarding the handling and disposal of hazardous materials.

4.17 Predicted Attainment of the Program Objectives

The primary goal of FKWQIP is to provide federal funding for local municipalities to implement wastewater and stormwater treatment projects that would result in commensurate water quality improvements in the Florida Keys National Marine Sanctuary.

4.18 Predicted Cumulative Impacts

Cumulative impacts are those impacts that result from project alternatives, in combination with other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal), business or individual undertakes other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

In order to adequately address the cumulative effects of a specific wastewater or stormwater improvement project, it is necessary to examine project-specific details. This PEIS, however, focuses the cumulative impact discussion at the programmatic level. Due to the wide array of projects addressing water quality improvement in the Keys and south Florida, the following sections focus on potential cumulative impacts of regionally important projects as they relate to the FKWQIP.

Water Quality. In combination with other ongoing wastewater and stormwater management improvement activities in the south Florida region, improvements to the water quality of the nearshore waters of the Sanctuary are anticipated to occur as a result of the *Proposed Action*. As discussed in Section 4.4, the conversion of cesspits and septic tanks to systems meeting Florida Statutory Treatment Standards are expected to result in approximately 92 percent reduction in total nitrogen (TN) input to ground water and 86 percent reduction in total phosphorus (TP) input to ground water attributed to wastewater sources in the Keys. Reduced groundwater nutrient loading would also reduce nearshore nutrient loading because of groundwater movement. Wastewater has been estimated to account for as much as 80 percent of the TN and 60 percent of the TP loading to nearshore waters. Similarly, it is estimated untreated stormwater runoff accounts for 20 percent of the TN and 45 percent of the TP loads to nearshore waters (EPA 1996, Kruczynski 1999). Accordingly, successful implementation of the entire master list of projects

(Appendix C) compiled for the FKWQIP should substantially reduce nutrient loading, resulting in a cumulative nearshore water quality benefit.

Ecological Habitats. The overall cumulative effects to ecological habitats as a result of the ongoing efforts to improve water quality in the Florida Keys are anticipated to be extremely beneficial. As described in Sections 4.4 and 4.5, positive effects to nearshore marine habitats, including seagrass meadows, and coral reefs, would likely occur due to the reduction of total suspended solids (TSS), nutrients, and pathogens released to the nearshore wasters that would be expected as a result of wastewater and stormwater improvement activities. Direct benefits of decreased TSS and nutrient release may include increased growth of seagrasses due to increased light penetration. Algal blooms may also become less frequent, pervasive and damaging as a result of the reduced TP and TN concentrations.

The specific project activities associated with the wastewater and stormwater programs in the Keys have the potential to result in loss of habitat. However, most activities would occur in developed and previously disturbed areas with low habitat value. Appropriate site selection and mitigation measures would minimize cumulative impact.

Accordingly, successful implementation of the entire master list of projects (Appendix C) compiled for the FKWQIP should substantially reduce nutrient loading, resulting in a cumulative nearshore water quality benefit.

Local Economy. The implementation of improved wastewater and stormwater treatment projects would result in cumulative improvements to ground water and nearshore water quality and reductions or eliminations of the number of health advisories in beaches and canals in the Keys. The cumulative impact would be an increase in the number of visitors to beaches that formerly posted advisories or reduction in the number of visitors at beaches that have historically not been subject to closure. Water quality benefits would also benefit commercial fisheries to the extent they are currently being adversely impacted by nutrient pollution. Generally, it may be predicted that harvested species that occur in nearshore waters such as spiny lobster, white mullet, gray snapper, various flounder, shrimp, and stonecrab would benefit from improved water quality.

When combined with the high cost of living in the Keys, the cumulative impact of implementing the wastewater and stormwater infrastructure improvements may result in a disproportionate adverse economic impact on low-income households.

Environmental Justice. Implementation of the FKWQIP master project list would generally increase wastewater treatment and stormwater management costs for residents of the Keys. Based on the information contained in Section 4.10 and 4.13, it was determined that low-income populations could not afford an increase in wastewater or stormwater management costs over present expenditures. When combined with the high cost of living in the Keys, the cumulative impact of implementing the wastewater and stormwater infrastructure improvements may result in a disproportionate adverse economic impact on low-income households. The severity of these impacts would depend on the specific project, financial options related to the capital costs of

proposed improvements, and the availability of funding from assistance program targeted to low-income service recipients.

4.19 Irreversible & Irretrievable Commitment of Natural & Depletable Resources

Construction of individual projects associated with FKWQIP may irreversibly impact a few permanent features located in the Keys. These impacts may occur as a result of constructing construction of centralized sewer systems, regional wastewater treatment facilities, and structures for stormwater management improvements. These facilities are all necessary to address nutrient and other pollutant loading to the nearshore waters of the Keys and improve water quality in the Sanctuary.

Resources committed as a result of the proposed projects would include local, state, and federal funding to purchase lands and labor as well as energy and project materials to build, operate, and maintain each individual wastewater or stormwater improvement project. Small parcels of land (i.e. two to five acres) required for some of the projects would be permanently converted to public utility use.

4.20 Unavoidable Adverse Environmental Effects

A limited number of acres of land would be permanently altered for use by public utilities in the Florida Keys as a result of the proposed project, whether for wastewater treatment or stormwater management improvements. The total land area required to implement FKWQIP projects is estimated to be less than 100 acres. Temporary increases in turbidity of local waters are expected due to construction of stormwater and wastewater treatment improvement projects. Fugitive dust from vehicle traffic and earth moving would be unavoidable but temporary and short-term in nature. Temporary disruption of soils is expected from the construction of sewer systems and clearing and grubbing of new wastewater treatment facility sites. An unknown number of historic and archeological sites may be affected; however studies would identify any significant sites and necessary mitigation would be developed, on a project-specific basis.

4.21 Indirect Effects

Beneficial results are anticipated as a result of the indirect effects of the proposed project on physical, human, and biological environments, primarily due to improved water quality in nearshore waters of the Sanctuary. The only identified negative indirect consequence of program implementation is increased urban growth as a result of constructing centralized sewer and wastewater treatment systems. However, a number of local ordinances regulate growth, both for private residences and new businesses. Advocates for property rights are very active in the Keys and support continued growth and development of private property. Changes to the rate of growth and building permit allocation system are at the discretion of the Monroe County Board of County Commissioners and the Florida Department of Community Affairs.

4.22 Compatibility with Federal, State, and Local Objectives

As a result of declining nearshore water quality in the Keys, a number of federal, state, and local laws and regulations have been implemented to improve wastewater and stormwater management, monitor water quality, assist in financing water quality improvements, and

establish new water quality monitoring standards. In particular, the Monroe County 2010 Comprehensive Plan, as well as Florida Executive Order 98-309 and F.A.C. 99-395, mandate that nutrient loading levels be reduced in the marine ecosystem of the Keys by the year 2010. Specific actions include eliminating cesspits, failing septic systems, and other substandard on-site sewage systems as well as requiring all wastewater discharge be treated to Florida Statuary Treatment Standards of 2010. In response to the mandated water quality improvements, a number of master plans have been prepared by Monroe County and municipalities within Monroe County and these have been compiled into the Master List of Projects contained in Appendix C.

The FKWQIP directly supports federal, state, and local objectives for improvement of water quality in the Keys. The program is a direct result of the Florida Keys Water Quality Improvements Act of 2001 that directed the EPA and the state of Florida to develop a water quality protection plan for the Sanctuary.

4.23 Conflicts and Controversy

Controversial issues associated with FKWQIP are the cost of program implementation, the means of recovering initial capital investment, and the means of generating revenues to support maintenance and operational activities. New urban development in the Keys is limited by the ROGO, consequently the number of new users would increase too slowly to share the cost of new and improved wastewater infrastructure. A significant portion of the population in the Keys is classified as low-income and/or on fixed income. Many of the typical measures of affordability are based on median family income which does not adequately reflect the abilities of those least able to afford the capital costs associated with the installation of new treatment systems or connecting to a new public sewer system.

Some users may be subject to the cost of immediate replacement of individual systems as well as future sewer connections. Users with cesspools or septic tanks may be required to replace their existing systems with an OWNRS before a public sewer system can be made available to their neighborhood. However, once a public sewer system is available, the user would be required to connect to the public system, adding additional costs to the user. Under this scenario, the user would have to pay for both an OWNRS and for connection to the sewer system.

Another prevailing issue, primarily within the scientific community, is whether the improvement of wastewater treatment and the installation of centralized sewers would improve the health of the coral reef within the Florida Keys National Marine Sanctuary. Conflicting scientific evidence would seem to indicate that improving nearshore water quality would, at a minimum, have a positive, albeit indirect, impact on the coral reef. Excessive nutrient loading in nearshore waters of the Sanctuary can only exacerbate historic problems, such as hurricane damage and African dust depositon, related to coral reef health. Implementing wastewater and stormwater treatment projects will alleviate the excessive nutrient loading to estuarine and marine habitats in the Sanctuary to the greatest extent feasible.

4.24 Uncertain, Unique, or Unknown Risks

The Florida Keys Water Quality Improvements Act of 2001 was passed with an authorization of up to $100 million to implement the program. However, to date limited funding have been

appropriated for program implementation. Without Congressional appropriation or identification of other funding sources, water quality degradation would continue within the Sanctuary and the Florida Keys would not meet state mandated statutory effluent standards for wastewater treatment systems. Without program implementation, the number or health advisories in beaches and canals in the Keys can be expected to increase. Local municipalities must also identify how they plan to raise the necessary funding to meet the cost requirements (i.e. the 35 percent match required for the non-federal sponsor).

4.25 Energy Commitments and Conservation Potential

Implementation of the proposed alternative would result in the expenditure of energy resources to construct treatment facilities, pump stations, and central sewers. These energy resources would include fuel for construction vehicles and equipment. Once the facilities are built and placed into operation, there would be an increase in energy demands to operate the treatment and pump stations. Energy available within the service area is adequate to accommodate the minimal increase in energy demand required for the *Proposed Action*. Conservation potential for any of the alternatives would be minimal.

4.26 Relationship between Short-Term Uses and Long-Term Productivity

While water quality improvements in the Sanctuary are anticipated as a result of the proposed project, short-term, or localized, adverse impacts, would undoubtedly occur. For example, the construction of centralized sewer systems throughout the Keys would disrupt local traffic conditions. These construction activities would be sequenced to minimize traffic congestion.

4.27 Environmental Commitments

During preparation of supplemental NEPA documentation, the Corps would obtain a Biological Opinion from the FWS for each specific wastewater or stormwater project to be constructed to determine potential impacts to sensitive ecological habitat and protected species. Appropriate mitigation measures would be developed and implemented to minimize adverse effects.

4.28 Compliance with Environmental Requirements

This section of the PEIS addresses compliance with applicable laws and regulations under the *Proposed Action*. Due to the programmatic nature of this EIS, individual project plans are not available for review by regulatory agencies. Coordination would be conducted during preparation of supplemental NEPA documentation prepared for individual projects. As appropriate, a process has been established with agencies for the review of projects receiving federal funds under the FKWQIP.

Archaeological and Historic Preservation Act and National Historic Preservation Act. Due to the programmatic nature of this PEIS, no specific consultation with the State Historic Preservation Officer (SHPO) has occurred. However, as funding is approved and supplemental NEPA documentation is prepared, archival research and consultation would occur with the SHPO in accordance with:

- Historic Preservation Act, as amended
- Archaeological and Historic Preservation Act, as amended

- Executive Order 11593

Clean Air Act. The study area is in a Clean Air Act compliance area. No air permits would be required under this program. In order to be in full compliance with Section 309 of the Act, the PEIS would be coordinated with concerned agencies, including the EPA, other stakeholder agencies, and the public.

Clean Water Act (CWA). As required, the non-federal sponsor would apply for permits with the Corps for projects that require work and/or placement of structures in waters of the United States. Compliance with the Clean Water Act would be determined on a case-by-case basis during preparation of supplemental NEPA documentation for each project. EPA reviewed the draft PEIS under the authority of CWA, and issued a rating of LO - Lack of Objection for the document.

Endangered Species Act (ESA). Because of the programmatic nature of this document, formal Section 7 consultation was not conducted. However, each specific project would be fully coordinated with the USFWS and NMFS under the Act prior to initiating construction.

Fish and Wildlife Coordination Act. The FKWQIP has been coordinated with the FWS and coordination procedures established. A review of federally funded projects will be conducted to ensure protection of sensitive ecological resources, federal land resources, protected species and critical habitat. Full coordination under the FWCA will be conducted for each specific project developed under the FKWQIP.

Farmland Protection Policy Act. Implementation of the FKWQIP would not impact existing farmlands in the Florida Keys. However, this issue would be coordinated with the Natural Resources Conservation Service during preparation of supplemental NEPA documentation for individual projects, as appropriate.

National Environmental Policy Act. The Corps has prepared this PEIS to address a coordinated program of wastewater treatment and stormwater management projects proposed for federal funding to improve water quality of the Sanctuary. The experience of the Corps has demonstrated the majority of recurring actions proposed for funding for which an EIS is required can be grouped by type of action or location. These groups of actions can be evaluated in a PEIS to comply with NEPA and its implementing regulations without having to produce a stand-alone NEPA assessment for each specific project. However, because actions proposed for funding under this PEIS can vary based on location, type of project, alternatives, and other site-specific criteria, supplemental NEPA documentation would be prepared for each individual project covered by this PEIS in accordance with 40 CFR Part 1508.28. Individual EISs would be prepared for those projects that are determined to have potentially significant adverse impacts.

Coastal Zone Management Act. The PEIS would be coordinated with the Florida Department of Environmental Protection (FDEP), the state clearinghouse for Coastal Zone Management Consistency Plan review. The state of Florida undertakes consistency review of both draft and final EISs. Coastal Zone Management Consistency Plans are limited to statements describing how the plans would be prepared for individual projects.

Resource Conservation and Recovery Act and Toxic Substances Management Act. A preliminary records search completed for the study area during preparation of the EIS found limited potential for hazardous, toxic, or radioactive waste substances to be encountered during implementation of the FKWQIP. However, compliance with applicable federal and state laws would be ensured during preparation of supplemental NEPA documentation for individual projects.

Executive Order 11988. Floodplain Management. This Order directs federal agencies to avoid siting projects in floodplains and inducing further development of flood-prone areas. One component of the FKWQIP, stormwater management improvements, is directed to reducing flooding conditions in urban areas of the Keys. However, in this PEIS, no specific information is available. This PEIS includes a commitment to avoid siting of wastewater treatment or collection facilities in floodplains as part of the FKWQIP. Compliance with this Order would be achieved during review of plans for individual projects while preparing supplemental NEPA documentation.

Executive Order 11990. Protection of Wetlands. This Order directs federal agencies to avoid developing or siting projects in wetlands. This PEIS includes a commitment to avoid siting wastewater treatment or collection facilities in wetlands as part of the FKWQIP. However, compliance with this Order would be achieved during review of plans for individual projects while preparing supplemental NEPA documentation.

Executive Order 12898. Environmental Justice. This Order directs federal agencies to provide for participation by minorities and low-income populations in the federal decision making process. It further directs agencies to fully disclose any adverse affects of plans and proposals on minority and low-income populations. Due to the fact that nearly 25 percent of the Keys population consists of low-income individuals or individuals over the age of 65 on fixed incomes, the potential for disproportionate impacts to these population segments exists regarding displacement due to facilities locations. Benefits and costs of FKWQIP are, however, equally shared among residents.

5.0 Public Involvement

The topics of wastewater degradation in the Florida Key National Marine Sanctuary (Sanctuary) and the need to reduce nutrient loading in the nearshore waters of the Florida Keys are of particular interest to regulatory agencies and citizens alike. For this reason, public participation throughout the Programmatic Environmental Impact Statement (PEIS) preparation process has been undertaken to ensure that the following occur:

- Compliance with the intent of NEPA and other applicable statutes are complied with
- Corps solicits and addresses public and agency opinions during this process
- Process is well-documented and characterizes the project accurately

5.1 Public Involvement for Master Plans

As stated in *Chapter 1*, the Corps did not undertake planning activities to delineate alternatives in this PEIS, but rather relied upon results of planning initiatives of Monroe County municipalities. Thus, it is important to recognize the extensive public outreach and involvement associated with these efforts.

Public involvement was an integral component of the Monroe County wastewater planning process and the development of the Monroe County Sanitary Wastewater Master Plan. Public involvement activities conducted as part of this master plan included over 30 meetings with key stakeholders and the public, hosted by the FKAA and the County between 1998 and 2000. Public forums in the Upper, Middle, and Lower Keys were held to allow key stakeholders and interested citizens of Monroe County the opportunity to participate in, and influence, the outcome of the Master Plan. Interaction with the public throughout the development process significantly assisted in the development of the contents of the Master Plan. Numerous public involvement efforts were implemented as part of the Master Plan development process and are outlined below.

- Public forums and workshops
- Meetings with civic, business, and environmental groups throughout the Florida Keys
- Preparation and distribution of project fact sheets and brochures
- Media coordination
- Production of two videos
- Development of a project web site

Interested citizens and key stakeholders directly influenced the development of the decision and evaluation processes, identified key issues to be addressed, and defined the elements of the wastewater master plan guiding Monroe County to achieve compliance with the Florida Statutory Treatment Standards of 2010. Comments provided by participants generally expressed concerns regarding:

- Implementation costs
- Extent of improved water quality
- Implementation approaches
- Alternative wastewater conveyance/treatment technologies
- Measure of project performance
- County responsiveness to public input

5.2 Public Involvement for PEIS

Applicable regulatory agencies, affected stakeholders, and interested members of the Florida Keys community have been provided opportunities to participate in the decision making process during the development of this PEIS. The Notice of Intent (NOI) to prepare a PEIS for the FKWQIP was published in the *Federal Register* on September 10, 2002 (67 FR 57413). A Scoping Letter was issued to various stakeholders and interested parties on February 11, 2003 and comments were received through April 15, 2002. The NOI, scoping letter and the responses to the scoping process can be found in Appendix G. A public meeting was held in Marathon, Florida, on February 27, 2003 to solicit comments and input on issues to be addressed during the NEPA documentation process. Issues raised at this public meeting included:

- Need for federal funding to support wastewater infrastructure development in the Keys
- Engineering and environmental issues associated with specific projects
- Cost of implementing wastewater improvements to residents of the Keys

In accordance with Corps procedures and NEPA public notification requirements, the draft PEIS was advertised in local newspapers and made available at local repositories for a 45-day comment period (April 30-June 14, 2004). Public comments submitted to the Corps during this time were reviewed and addressed, as appropriate, in the final PEIS. Copies of comment letters received are provided in Appendix G. A comment response matrix has been prepared listing public comments and the response prepared by the Corps. This matrix appears at the front of the Public Comment Letters contained in Appendix G. Please note all text changes to the EIS resulting from public comment are shaded throughout the final PEIS.

6.0 Conclusion

This Programmatic Environmental Impact Statement (PEIS) provides the basis for examining and evaluating potential environmental impacts of the proposed Florida Keys Water Quality Improvements Program (FKWQIP) on the physical, biological, and human environment in the Florida Keys National Marine Sanctuary (Sanctuary). Three project alternatives were evaluated as part of this PEIS, premised on the need to implement water quality improvement projects that will reduce nutrient loadings to nearshore waters and result in commensurate improvements in water quality in the Sanctuary. The three alternatives are listed below.

- ***Alternative 1: No Action.*** Withhold federal funding for programs designed to address state mandates to improve water quality in the Sanctuary.
- ***Alternative 2: Proposed Action.*** Provide federal funding to implement projects designed to address state mandates and improve water quality in the Sanctuary.
- ***Alternative 3: Pursue other Sources of Funding for Project Implementation.*** Identify and use other sources of funding to implement programs designed to address state mandates to improve water quality in the Sanctuary.

The preferred alternative, based on an analysis of potential environmental impacts associated with each alternative discussed in detail in *Chapter 4*, is the *Proposed Action* (Alternative 2) to implement projects designed to reduce nutrient loading to nearshore waters and subsequently improve water quality in the Sanctuary. The use of federal funds to assist local municipalities in developing and implementing wastewater and stormwater improvements is the best means to reduce this nutrient source and protect the Sanctuary.

Most residents and businesses in the Keys are connected to septic tanks and outdated on-site package plants that, if not properly operated, result in harmful bacteria and nutrient inputs to nearshore waters due to less stringent treatment standards when compared with centralized advanced wastewater treatment systems. Under the *No Action* alternative, wastewater and stormwater inputs and water quality degradation in the Sanctuary would continue. As a result, businesses, property owners, and local municipalities may risk non-compliance with federal and state regulatory water quality standards. Under Alternative 3 federal funding will be unavailable and local municipalities will pursue other funding for water quality improvements and implementation will occur as funding becomes available, likely resulting in fewer, smaller, and less integrated systems.

Under the *Proposed Action*, priority projects would be implemented as an integrated, area-wide water quality improvement program and are anticipated to accomplish the following:

- Meet goals of the Florida Keys Water Quality Improvements Act.
- Address regional water quality issues, based on need, design constraints, available technology, and funding.
- Reduce nutrient loadings to nearshore waters with commensurate increases in water quality in the Sanctuary.
- Attain federal and state regulatory water quality standards in a timely manner.

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8.0 List of Preparers

The people primarily responsible for the preparation of this Programmatic Environmental Impact Statement are listed below:

U.S. Army Corps of Engineers			
Barbara Cintron, Environmental Planning Branch Chief	35 years Biology	M.A. Botany	Senior NEPA Specialist for Jacksonville District, USACE
Shelley Trulock, Project Manager	10 years Water Resources	B.S. Architectural Design and Construction	Project Manager Jacksonville District, USACE
South Florida Water Management District			
Cecelia Weaver, Environmental Scientist	12 years Biologist	B.S. Biology	Project Manager, SFWMD
Everglades Partners Joint Venture			
Roger Anderson, Senior Environmental Planner	30 years Environmental Planning	M.A. Environmental Planning, AICP	Environmental Planning and NEPA
Adam Gelber, Environmental Scientist	8 years Ecology	B.S. Environmental Sciences	Wildlife Ecology Marine Biology
Isabel Gonzalez-Jettinghoff, Senior Environmental Planner	19 years Finance, Planning	MBA International Business	Economic Analysis
W. Mark Henry, Environmental Scientist	6 years Ecology	B.S. Geology and Biology	Ecology Water Resources
Bill Hutchinson, Senior Environmental Planner	30 years Environmental Planning	M.A. Economics	Environmental Planning Economic Analysis
Kathryn E. Kuhlman, Senior Environmental Scientist	15 years Ecology	M.S. Botany	Protected Species Botany and NEPA
Pam Latham, Senior Scientist	15 years Ecology	Ph.D. Systems Ecology	Protected Species Water Resources and NEPA

Everglades Partners Joint Venture			
John C. Martin, Principal Planner	28 years Environmental Planning	M.A. Enviornmental Planning, AICP	Environmental Planning and NEPA
William F. Precht, Senior Scientist	21 years Ecology	M.A. Marine Geology	Ecological Sciences
Martha Robbart, Environmental Scientist	3 years Ecology	M.A. Biology	Environmental Sciences
Tom St. Clair, Senior Project Manager	25 years Environmental Planning	Ph.D. Environmental Policy	Environmental Project Management and NEPA
Diana Umpierre, Senior Information Solutions Developer	8 years GIS and Planning	B.S. Geological Science	GIS and Environmental Planning

9.0 List of Recipients

The following agencies, groups, and individuals were sent copies of the draft FKWQIP Draft Programmatic Environmental Impact Statement:

Native American Tribes
Miccosukee Tribe of Indians of Florida
Seminole Tribe of Florida

Federal Agencies
Advisory Council on Historic Preservation
Bureau of Indian Affairs
Council on Environmental Quality
Federal Emergency Management Agency
Florida Keys National Marine Sanctuary
General Accounting Office
Gulf of Mexico Fishery Management Council
Natural Resources Conservation Service
National Park Service
Office of Environmental Policy and Compliance
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Environmental Protection Agency
U.S. Department of Justice
U.S. Department of Transportation
- Coast Guard
- Federal Highway Administration

U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. Public Health Service

State Agencies
The Governor
The Florida Legislature
Florida State Clearinghouse – Office of the Governor
Florida Department of Agriculture and Consumer Services
Florida Department of Community Affairs
Florida Department of Environmental Protection
Florida Fish and Wildlife Conservation Commission
Florida Department of Transportation
Florida Division of Historical Resources – SHPO
Florida Key Aqueduct Authority
Governors Commission for Sustainable South Florida
South Florida Water Management District

County Governments
Monroe County

Municipal Governments
Key West
City of Layton
City of Marathon
City of Islamorada
City of Key Colony Beach
City of Key Largo

Libraries
Monroe County Library System

Groups
Audubon Society of the Everglades
Biodiversity Legal Foundation
Conservancy of Southwest Florida
Environmental Defense Fund
Everglades Coordinating Council
Everglades Foundation
Florida Audubon Society
Florida Biodiversity Project
Florida Wetlands
Florida Wildlife Federation
Friends of the Everglades
Izaak Walton League of America, Inc.
National Audubon Society
National Parks and Conservation Association
National Park Trust
National Resources Defense Council
National Wildlife Federation
The Nature Conservancy
The Wilderness Society
Tropical Audubon Society
Trust for Public Lands
World Wildlife Fund

10.0 Glossary of Terms

Adsorption – Adhesion of molecules of gases or of ions or molecules to the surfaces of solid bodies with which they are in contact.

Advanced Wastewater Treatment (AWT) – Also known as **tertiary treatment**, AWT follows Secondary Treatment. Removal of soluble nitrogen and phosphorus compounds is a common application of AWT. AWT may involve chemical addition, filtration, or activated carbon processes. As referred to in the MCSWMP, effluent treated to AWT standards meets 5 mg/L BOD, 5 mg/L TSS, 3 mg/L TN, and 1 mg/L TP.

Anthropogenic – Relating to humans and their impact on the natural environment.

Benthic Algae – Algae relating to the bottom of a water body.

Best Available Technology (BAT) – The level to which wastewater treatment systems are designed. As referred to in the MCSWMP effluent treated to BAT standards that 10 mg/L BOD, 10 mg/L TSS, 10 mg/L TN, and 1 mg/L TP.

Best Management Practices (BMP) – A set of minimum practices developed and implemented to improve the physical, chemical, and biological integrity of the nation's waters. Examples include installation of silt fencing at a construction site to prevent eroded soils from entering a nearby waterway.

Biochemical Oxygen Demand/Biological Oxygen Demand (BOD) – The oxygen that is needed and used by aerobic organisms living in water that is rich in organic material (such as waters polluted by sewage).

Boulder Zone – A very permeable, cavernous zone in the lower Floridian Aquifer System that is about 2800 to 3300 feet below ground surface.

Calcareous – Containing calcium carbonate. As applied to rock, the predominant percentage of the rock is calcium carbonate.

Cesspool/Cesspit – An unregulated and unpermitted effluent disposal method that consists of an excavated area (100 to 1000 cubic feet, 4 to 8 feet deep) into the ground surface. The area is covered with a slab of concrete, and untreated sewage is then deposited into the pit. Liquid wastes are discharged through the porous limestone formations and ultimately to the nearshore areas. Solid wastes are retained in the pit, which is often abandoned after it becomes full.

Class B Lime Stabilization – The process used to reduce harmful bacteria and odors in sludge or biosolids. Lime is added to untreated sludge in sufficient quantity to raise the pH to 12 or higher. The high pH creates an environment that is not conducive to the survival of microorganisms. Class B Lime Stabilization refers to the EPA classification for the safe treatment, beneficial use, and disposal of biosolids that contain pathogen concentrations levels low enough for some beneficial uses, such as land application with restrictions.

Class I Injection Well – The first of five well classifications developed by the U.S. Environmental Protection Agency under their underground disposal control program to categorize the injection of various types of liquid wastes. Class I wells are typically used by hazardous waste generators and operators, as well as industrial and municipal disposal systems, to inject fluids into a geologic formation that is beneath the lower-most formation containing an underground source of drinking water within ¼ mile of the well bore. A Class I Well must meet siting, construction, operation, and maintenance criteria specific to this well class, as established by the U.S. Environmental Protection Agency and the Florida State regulating agency.

Class V Injection Well – Similar to a Class I Injection Well, the U.S. Environmental Protection Agency established this well category for a broad range of specialty applications to dispose liquid wastes, which are not categorized under the other four injection well classes. For example, a Class V well could be used to drain stormwater runoff into an aquifer.

Cluster System (of OWNRS) – An OWNRS that serves multiple homes. Clusters can be composed of small groups (such as 2 homes), which share one treatment system, or of large groups (50 homes), which use low-pressure sewers to connect the cluster to a centralized OWNRS.

Effluent – The waste stream from a wastewater treatment system collection unit.

Enteric – Relating to the intestines. Over 100 different human enteric pathogens, including viruses, parasites, and bacteria may be found in municipal wastewater and surface runoff.

Enterococci – A bacterium whose presence indicates Fecal Coliform.

Environmental Impact Statement (EIS) – A public document prepared pursuant to NEPA containing a detailed analysis and evaluation of all the impacts of a proposed major federal action and all its reasonable alternatives that has the potential to significantly affect the quality of the human environment. This is a more rigorous analysis than an Environmental Assessment and provides for formal public involvement.

Epiphyte – A plant growing on another plant but getting little nutrition from its host.

Equivalent Dwelling Unit (EDU) – A household of 2.3 persons generating about 168 gallons of effluent per day.

Eutrophication – The process by which a body of water becomes nutrient-rich and oxygen-deficient.

Executive Order (EO) – A Presidential mandate that directs a federal agency to consider certain issues as an agency plans their actions. For example, former President Jimmy Carter directed all agencies to "minimize the destruction and loss or degradation of wetlands" under EO 11990, "Protection of Wetlands."

FKAA - Florida Keys Aqueduct Authority**.**

Facility Siting - The process of determining the best location for a treatment facility. The siting decision model resembles an organization chart, and is broken into three levels. At the top level is the principal project objective of maximizing facility siting benefits. The second level lists a series of key issues that were identified by the stakeholder groups and the third level presents a series of performance criteria that measure how well a specific alternative will accomplish program objectives.

Fecal Coliform – A bacterium used as an indicator of total sewage biological contamination.

Florida Statutory Treatment Standards – Quality standards for discharged wastewater effluent as promulgated in F.A.C. 99-395. Treated effluent generated by sewage facilities with design capacities greater than 100,000 gpd must meet 5 mg/L TP. Sewage facilities with design capacities less than 100,000 gpd must meet 10 mg/L BOD, 10 mg/L TSS, 10 mg/L TN, and 1 mg/L TP. On-site sewage treatment and disposal systems must meet 10 mg/L BOD, 10 mg/L TSS, 10 mg/L TN, and 1 mg/L TP.

Gravity Sewers - Gravity sewers are sewer lines that "run with the lay of the land" and may be variable-grade effluent sewers (VGES), minimum grade effluent sewers (MGES), or septic tank effluent pump (STEP) sewers. The pipe system works like a sink trap through the low sections. VGES is designed to assure that the hydraulic grade line is below all septic tank outlets by increasing pipe sizes as required to lower the hydraulic grade line. MGES sewer lines generally run constantly downhill, but with no solids to transport, no set minimum velocity must be maintained and the line is much easier to lay than conventional gravity sewers. Septic tank outlets must be above the hydraulic grade line for both VGES and MGES. STEP sewers have septic tank outlets below the hydraulic grade line, so a pump is required to move effluent through the sewers. Since wastewater is pumped, line grade is irrelevant, making STEP sewers very easy to lay. The system may be designed with a pump tank at the outlet of each septic tank, or flow from several septic tanks may be routed through effluent gravity sewers to a collective pump tank.

Hydraulic Communication – Water movement from one area to another (such as from the Boulder Zone to the ocean).

Hydraulic Conductivity – An aquifer's water transmission rate; similar to transmissivity.

Hydraulic Head – The driving force influencing groundwater movement, water's total energy at a given location.

Injection Well (shallow and deep) – An underground well designed to pump treated effluent (or other materials) into shallow (e.g. 90 feet) or deep (e.g., 2,100 feet) geologic locations. Injection wells are designed to account for physical and chemical characteristics of the injection matrix, and require monitoring to ensure mechanical integrity of the well.

Lithologic – A rock's descriptive characteristics, including color, structure, mineral composition, and grain size.

Median Family Income (MFI) – as defined by the U.S. Census Bureau, refers to the income of a family where a family is defined as two or more people (one of whom is the householder) related by birth, marriage, or adoption residing in the same housing unit.

Median Household Income (MHI) – as defined by the U.S. Census Bureau, refers to the income of a household where a household is defined as all people who occupy a housing unit regardless of relationship. A household may consist of a person living alone or multiple unrelated individuals or families living together.

Microkarst – Karst features on the scale of millimeters. Karst is a type of landform developed over limestone, dolomite, or gypsum through solution of the rock, typified by closed depressions, caves, and underground drainages.

National Environmental Policy Act (NEPA) – A congressional act established in 1969 that directs all federal agencies to consider the environmental effects of their programs, projects, and funding decisions. NEPA considers the effects on all resources of natural and built environments and includes compliance requirements with all other applicable federal laws, such as the Endangered Species Act and the Environmental Justice Executive Order.

Nearshore Waters - Techncially, nearshore waters include the area between mean low tide and the seaward extent of the longshore bar and trough topography; it is approximately equal to the maximum width of the breaker zone. However, in the Florida Keys and most of Florida, nearshore waters are the narrow band of waters that form the mixing zone of freshwater terrestrial runoff and saline ocean waters. The Carrying Capacity Model uses a width of 500 meters, others have defined nearshore as < 1 km from shore.

Norwalk Virus - Norwalk viruses (and related caliciviruses) are important causes of sporadic and epidemic gastrointestinal disease in the United States, and have typically been associated with eating contaminated shellfish. Water and ice are other sources of infection. Symptoms of Norwalk virus infection include nausea, vomiting, diarrhea, headache, low-grade fever, and abdominal cramps. Persons with this infection usually recover within 2-3 days without serious or long-term health effects.

Offshore Waters - Offshore waters include the generally flat area extending from the seaward edge of the breaker zone to the edge of the continental shelf (Davis 1972). However, in the Florida Keys, offshore waters extend beyond the nearshore waters where mixing of freshwater and saline waters is not significant.

Oligotrophic – A body of water that is nutrient-poor.

OWNRS (On-Site Wastewater Nutrient Reduction System) – An on-site wastewater treatment system that meets a minimum level of BAT treatment, or 10 mg/L BOD, 10 mg/L TSS, 10 mg/L TN, and 1 mg/L TP.

OWTS (On-Site Wastewater Treatment System) – Any of several wastewater treatments located on the property they serve. Examples include septic systems, cesspools, aerobic treatment units (ATU), and OWNRS.

Oolites – Rocks consisting mostly of small, spherical calcium carbonate grains.

Operation and maintenance (O&M) costs – These include the monthly or annual costs incurred by service recipients for long-term operation and maintenance of the wastewater management system.

Permeability – The capacity of porous material to transmit water or other fluid. In bedded sediments, horizontal permeability is measured parallel to the bedding direction, and vertical permeability is measured transverse to the bedding.

Phytoplankton - Plant plankton, which float or weakly swim, are often microscopic (e.g., many algae species), and are the primary food source in most aquatic and marine ecosystems.

Primary Treatment – The first level of wastewater treatment that removes solids, greases, oils and other floatable solids from the waste stream, partially clarifying the effluent. Suspended solids, dissolved organic materials, and other pollutants are not removed from the effluent.

Programmatic Environmental Impact Statement (PEIS) – A concise public document prepared pursuant to NEPA. It contains sufficient analysis to determine the likely significance of a group of similar proposed actions (projects) and alternatives' impacts, to aid decision making. A project- and site-specific effects evaluation document supplements the PEIS, generically called a Supplemental NEPA documentation.

Protected Species - In this document, protected species refers to any plant or animal that has been designated as threatened or endangered, species of special concern, or who's designation as threatened or endangered is encouraged, by the federal government (under the Endangered Species Act) or the state of Florida. The purposes of the Endangered Species Act is to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve (these purposes).

Readiness to Proceed Criteria - These criteria were prepared to "define when a recipient is eligible to receive a percentage of their share of any federal or state appropriation for wastewater and stormwater improvements authorized under the Florida Keys Water Quality Improvements Act of 2001." Readiness to proceed occurs when all planning (including the selection of sites and wastewater/stormwater systems to be implemented, reclaimed water evaluation, and financing) are complete. This means that sites are established as available for the intended purposes, public participation is documented, and construction (design/build/operate or design/build) or a construction contract is either executed or authorized for execution by the project sponsor's governing body.

Scoping Issues - "Scope" consists of the range of actions, alternatives, and impacts to be considered in an EIS. To determine the scope of an EIS, agencies shall consider 3 types of

actions (connected, cumulative, and similar), 3 types of alternatives (no action, other reasonable courses of action, and mitigation measures), and 3 types of impacts (direct, indirect, and cumulative).

Secondary Treatment – Used in concert with Primary Treatment. This second level of treatment removes dissolved organic materials and more suspended solids, however nutrients such as nitrogen and phosphorus remain in the effluent.

Septic Tank – An OWTS using a tank and drainfield to capture waste, separate solids from liquids, and drain liquid to adjacent soils.

Significantly – In the NEPA context, this term is used to describe both the context and intensity (severity) of impacts. For a detailed description of this term, see Section 1508.27 of the President's Council on Environmental Quality's regulations implementing NEPA.

Slurry – Mixture of coarsely ground solids and liquid.

Specific Gravity – Ratio of a given mass to the mass of an equal volume of water at a specified temperature.

Stakeholder - The stakeholder on any issue represents the parties or individuals that the expert source or sources believe are trying to shape the resolution of the issue(s) in question.

Supplemental NEPA Documentation – A generic phrase used herein for referencing the site- and project-specific NEPA document that would be prepared following issuance of a final PEIS. This document would be either an environmental assessment or environmental impact statement depending on the significance of the specific project impacts.

System capital costs – These include expenses associated with planning, designing, engineering, purchasing, building, and installing a wastewater treatment system, and its wastewater conveyance piping in public right-of-ways and selected effluent disposal method (e.g., injection wells, SDI, reuse).

Tiering - "Tiering" refers to the coverage of general matters in broader EISs with subsequent narrower statements or environmental analyses incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. Tiering is appropriate when it helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe.

Total Nitrogen/Nitrogen (TN/N) – Nitrogen is a common element found in nature and in wastewater. Nitrogen is an essential nutrient for plants, but contributes to water body eutrophication when more abundant. "Total nitrogen" describes nitrogen in four oxidation states: organic nitrogen, ammonia nitrogen, nitrite nitrogen, and nitrate nitrogen. Removal or reduction of TN from wastewater effluent involves nitrification (where organic N and ammonia N are converted to nitrite N, which easily converts to nitrate N) and denitrification (where nitrate N is converted to nitrogen gas).

Total Phosphorus/Phosphorus (TP/P) – Phosphorus is a natural element, however most phosphorus enters waterways via human activities (i.e., untreated wastewater or fertilizer runoff). Similar to nitrogen, phosphorus is an essential nutrient for plants, but eutrophication occurs when phosphorus is more abundant. "Total phosphorus" is in organic and inorganic forms and can occur in solution, particles, or micro-organisms (such as polyphosphates, which account for 70% of wastewater phosphorus). TP removal or reduction from wastewater effluent typically involves biological treatment (to convert P to the orthophosphate forms), which are then removed via chemical processes.

Total Suspended Solids (TSS) – TSS are solids in water, such as silt, decaying plant and animal matter, and sewage, that can be trapped by a filter. High concentrations of suspended solids can cause many problems for water body health and aquatic life. For example, high TSS can block light from reaching submerged vegetation.

Turbidity – A measure of the water clearness as a function of suspended sediment.

Vacuum Sewer - Sewage flows by gravity from homes into a collection sump. When 10 gallons (40 liters) accumulates in the sump, the vacuum interface valve located above the sump automatically opens and differential air pressure propels the sewage through the valve and into the vacuum main. Sewage flows through the vacuum lines and into the collection tank at the vacuum station. Sewage pumps transfer the sewage from the collection tank to the wastewater treatment facility or nearby gravity manhole. There are no electrical connections required at the home. Power is necessary only at the vacuum station.

Wastewater Treatment Facility (WWTF) – An effluent collection, treatment, and disposal system that collects waste from homes and businesses, and transports collected waste through a series of sewers to a centralized treatment plant. Physical, chemical, and biological processes clarify the effluent at the WWTP so that the treated water can be safely released into the environment via water reuse, deep or shallow well injection, or other permitted methods.

Water Quality Cold Spots - Defined as areas where on-site systems will continue to operate. Cold Spots fall into two categories: 1) properties with unknown systems that must replace or upgrade their systems immediately with an on-site wastewater nutrient reducing system (OWNRS) by July 12, 2003 and 2) properties that currently have permits for their on-site systems and will not be required to upgrade or replace them until 2010, when all on-site systems must be upgraded or replaced with nutrient reduction OWNRS to meet the regulatory effluent limits.

Water Quality Hot Spots - These areas have been identified as sites of known or suspected water quality degradation, based upon workshops and discussion groups. The list was increased to 88 hot spots in 1996, primarily as a result of water quality issues and wastewater influences. Hot spot locations correspond with higher-density urban areas, representing neighborhoods and subdivisions with the poorest sewage treatment and strongest need for central sewage facilities.

Water Reuse (or reclamation) - Treatment and management of municipal, industrial or agricultural wastewater to produce water of suitable quality for additional beneficial uses.

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