1994 REPORT

INTERAGENCY WORKING GROUP
ECOSYSTEM RESTORATION AND MAINTENANCE

December 2, 1994

On September 23, 1993, a five-year Interagency Agreement on South Florida Ecosystem Restoration was signed by the Departments of Interior, Commerce, Army, Justice, and Agriculture, and the Environmental Protection Agency. The task force resulting from this agreement coordinates "the development of consistent policies, strategies, plans, programs and priorities for addressing the concerns of the South Florida ecosystem." It has tasked an I 1-member working group with responsibility annually to formulate and recommend to the task force management policies, strategies, plans, programs, and priorities for ecosystem restoration and maintenance. The first annual report follows.

CONTENTS

APPENDICES

EXECUTIVE SUMMARY:
FROM THE INTERAGENCY WORKING GROUP

On September 23, 1993, a five-year Interagency Agreement on South Florida Ecosystem Restoration was signed by the Departments of Interior, Commerce, Army, Justice, and Agriculture, as well as the Environmental Protection Agency. This agreement was a first--a federal effort formally establishing the South Florida Ecosystem Restoration Task Force made up of assistant secretaries and taking on responsibility for coordinating the development of "consistent policies, strategies, plans, programs and priorities for addressing the concerns of the south Florida ecosystem."

To help accomplish this, the Task Force established a management and coordination team, known as the Interagency Working Group, comprised of 11 agency managers with management and/or regulatory responsibilities in south Florida. This group was charged with developing and submitting a south Florida ecosystem restoration report to the Task Force within a year.

To accomplish this task, the Interagency Working Group appointed three sub-groups: on science, on infrastructure, and on management. These sub-groups were responsible for reporting back to the Working Group, as well as contributing to the development of federal ecosystem strategies and coordination in south Florida. The Working Group also met regularly as its members began the complex and intensive process required to produce the following report.

As you read, keep in mind the nature of this report. Fulfilling the requirements of the Federal Advisory Committees Act (FACA) has been an important obligation for the Interagency Working Group, which has gone to great lengths to meet FACA's spirit and intent. As far as possible under FACA, it has incorporated the resources and experience of all levels of government currently involved in south Florida land and natural resource management issues. Numerous state and local groups have been working for years on land and water issues linked to Florida's agricultural, ecological and recreational interests. For years individual federal agencies have been involved with them on various projects. However, until recently, these projects have not been carried out within the framework of an ecosystem management strategy. Such a framework is only now beginning to evolve. The federal Task Force is one avenue through which ecosystem management is being approached. The Governor's Commission for a Sustainable South Florida, the Man and the Biosphere program, the ecosystem management by the Florida Department of Environmental Protection, and the work of the South Florida Water Management District are other prominent efforts.

The Working Group is committed to more fully integrating the work of these important partners in the coming year. This document is the first of five annual reports to be developed under the initial Memorandum of Agreement establishing the Interagency Task Force. It starts the process, providing recommendations for coordinated action that guides the federal role in south Florida. A more developed plan, addressing priorities and

schedules, will come in successive reports as the nature of a sustainable ecosystem for south Florida is identified and achieves broad consensus. Meanwhile, this document reflects the commitment that exists and the effort that has begun on the part of 11 agencies and the departments for which they work. It has drawn on the teamwork, the dedication, the technical expertise and the professionalism of numerous individuals whose work on the Task Force has crossed agency lines.

We are enormously proud of the tasks accomplished in the past year. Although every member of the group has had other full-time jobs to carry out, they have juggled schedules and doubled up on other deadlines in order to carry out the responsibilities of the Working Group along with the responsibilities of their full-time jobs. Special acknowledgement is due to the many agency staff who made substantial contributions to this report, and especially, Editors Dolores Mescher and Mary Maruca.

In preparing the first annual report of the Working Group to the Task Force, an initial draft was widely circulated to interested organizations and individuals throughout south Florida and beyond. Four public meetings were also held at various locations in the area. Comments received as a result of this process were important in shaping the final report. This is the beginning of an exciting planning process for all of us. As we complete this first of five reports on south Florida ecosystem restoration, we recognize the importance of our partners in this significant effort and intend to achieve their full integration into this planning endeavor.

Considered and adopted by resolution of the Working Group on December 2, 1994.

Richard G. Ring, Chairman, 1993-94
National Park Service

Billy Causey, Vice Chairman
National Ocean Service/NOAA

Col. Terrance Salt, through 7/94
U.S. Army Corps of Engineers

Col. Terry L. Rice, from 8/94
U.S. Army Corps of Engineers

Suzanne Ponzoli, through 4/94
U.S. Attorney's Office, Southern District

Peter Outerbridge, from 5/94
U.S. Attorney's Office, Southern District

Dr. Brad Brown
National Marine Fisheries Service/NOAA

Mike McGhee
U.S. Environmental Protection Agency

Bill Ott
Bureau of Indian Affairs

Ron Smola
Natural Resources Conservation Service

John Vecchioli
U.S. Geological Survey

James Weaver
National Biological Service

David Wesley
US. Fish and Wildlife Service

The Everglades is a geographical location. It is a place on a map. More than that, however, it is an idea. As an idea, it is outside of time--eternal--changing only as our views change. As a location, it is bound by time as humans keep it, "not in ages and in centuries" as Marjory Stoneman Douglas writes, "but...in hours and days, the small events of [a human] lifetime." In this dichotomy lies the roots of change--human ability to regard an area as changeless throughout a lifetime while all around significant changes are taking shape.

South Florida is much the same, subject to time and to timelessness, depending on whether we are discussing physical location or idea. Yet if the Everglades-as-idea suggests quiet, subtle forces that have remained much the same for centuries, south Florida suggests a different context. Here is a canvas for change, with colors and textures fluctuating according to trends in architecture, politics, and human history.

South Florida and the Everglades--two seemingly separate worlds with separate lexicons--actually share the same natural and cultural roots. They also share responsibility for resolving an issue as large as the territory they occupy: the question of whether it is possible for human and natural cycles to become compatible in a way that sustains human use. From the perspective of the federal interagency task force charged with responsibility for south Florida ecosystem restoration and the preparation of this report, the answer is a qualified "yes"--a "yes" based on the growing number of partners at the federal, state, local and private levels coming together to work toward ecosystem restoration in south Florida

CREATING CONDITIONS FOR CHANGE

Once the Everglades was a river of grass, silent, miasmic, undisturbed except by the species of birds, bugs and other animal life that called it home. In that distant time, the Everglades--and much of south Florida--was a place to bypass--a "vast glittering openness as Marjory Stoneman Douglas wrote, "a rotting shallow, inland sea" that beckoned its own, breed of rivermen and scoundrels, conquerors and pioneers, scientists and, finally, the rest of us, some eager to be seen and others simply looking for a place to hide--a temperate climate, a spot of sun, a beach, an easier life.

How did a place so eminently real, so wholly abundantly tangible become an idea image in the mind? Primarily, it was the influx of humanity that created change. Increased human activity encouraged the split between cyclical patterns and those that required more resources than natural processes could provide. So human-directed processes came into play and, slowly, the south Florida ecosystem of wet prairies, marshes, coastal estuaries and hardwood hammocks with their scattered human occupants began to change. First settlements, then towns, then larger towns, and ultimately an intricate, interconnected system of urban, suburban, recreational and commercial development added complex layers of color and texture to the south Florida canvas. Slow-moving sloughs and marshland that

once changed according to the dictates of seasonal rainfall gave way to more regularized water management dictated by human use. Some areas that had been wet dried up. Others that once alternated cyclically between wet and dry became predictably one way or the other.

Still, the image in the mind remained--a river of grass, an impenetrable wetland where wading birds settled abundantly on the land like white and pink plumed clouds and ancient crocodiles flaunted their roughly textured skin, as commercially valuable as the gold once sought by early explorers. Animated by this image, south Florida and the Everglades were seen at their best--the way they still are in pockets of the ecosystem, but the way they are no longer throughout the original ecosystem that once stretched south of Orlando to include Kissimmee River, Lake Okeechobee, Big Cypress Swamp, the Everglades and Florida Bay.

Although this image once was considered accurate by the majority of expectant visitors, more and more details simply did not fit: toxic mercury accumulations in fish pulled from the Everglades, algal blooms and sea grass die-offs, fewer and fewer wading birds, and rapidly diminishing numbers of big cats--Florida panthers--all challenging south Florida's image of abundance. Too much change was coming too fast to be ignored in a state where commercial success required a healthy natural environment.

Today, change has made south Florida something other than it was. And it is changing again. What is happening in south Florida is the result not of one step but of many, of growing awareness based on a number of factors: on media attention, on political support, and on just plain necessity. In an area with a population of slightly more than six million, there no longer are sufficient resources for the present water management system to meet human and wildlife needs equally. So change is evident in south Florida where diverse constituencies are sometimes at odds, but where, at every level, challenging new approaches to the issue of ecosystem restoration are taking shape.

Particularly impressive has been the State of Florida's more than 10-year commitment to its "Save Our Everglades" program, launched by then-Governor Bob Graham in 1983. The goal of the program--to make the Everglades look and function more like it did in 1900 than in 1983 by the year 2000--was reinforced by six objectives:

- Re-establish the values of the Kissimmee River;
- Protect Lake Okeechobee;
- Protect the Water Conservation Areas;
- Protect the Big Cypress Swamp;
- Restore Everglades National Park and Florida Bay; and
- Protect endangered wildlife.

This has resulted in cooperation among government agencies, Congress, conservation organizations and the public to produce the following accomplishments:

- Beginning of Kissimmee River restoration in full partnership with the U.S. Army Corps of Engineers;

- Improvement of overland water flow through the Everglades, protection of the Florida panther and other wildlife species against highway mortality, and expansion of the Big Cypress National Preserve boundary by 146,000 acres as part of the conversion of Alligator Alley (State Road 84) to intersect Highway 75 across the Everglades;

- Creation of Florida Panther and Ten Thousand Islands National Wildlife Refuges, two new refuges;

- Enactment of the "Florida Everglades Forever Act," which provides for long-term restoration of the Everglades and will help bring an end to 36 legal challenges to cleanup plans; the Act authorized an "agricultural privilege tax" to help finance the construction of Stormwater Treatment Areas on more than 40,000 acres of land in the Everglades Agricultural Area;

- Removal of more than 14,000 cows from Lake Okeechobee tributary basins and required construction of Best Management Practices on 18 dairies remaining in those basins;

- Beginning of a comprehensive program to restore fresh water flow to Everglades National Park and Florida Bay;

- Completion of plans and execution of a federal/state agreement to restore the C-111 basin;

- Implementation of programs to conserve Florida panther habitat and restore panther genetic health; and

- Enactment by Congress of the Everglades National Park Expansion Act to expand the park by some 108,000 acres; in October 1991, Florida transferred 42,959 acres in the expansion area to the National Park Service.

In addition to these efforts, the South Florida Water Management District, in conjunction with other public and private organizations, has established a trust to protect the Corkscrew Regional Ecosystem Watershed, a 54,000 acre mixture of uplands and wetlands supporting such publicly-owned down-stream natural areas as Florida Panther National Wildlife Refuge and Big Cypress National Preserve. At Loxahatchee National Wildlife Refuge, the Corps of Engineers now floods marshlands year round to encourage nesting of wading birds. In addition, the Corps' Central & South Florida Restudy project stands as an important conceptual rethinking of water management in south Florida. While such land use planning is generally a responsibility of state and local agencies, the federal government recognizes its influence on land use through its programs and policies, and is committed to

interacting with state and local governments to protect regional ecosystems containing valuable national parklands. Congressional establishment of Florida Keys National Marine Sanctuary in 1990 is a strong example of federal/state partnership in the service of south Florida ecosystem management.

For years, state and local groups have worked with such land and water issues linked to Florida's agricultural, ecological and recreational interests. Also for years, individual federal agencies have been partners with them on various projects. However, these projects have not been carried out within the framework of an ecosystem management strategy. Such a framework is now evolving. The Governor's Commission for a Sustainable South Florida, the Man and the Biosphere program, the ecosystem management carried out by the Florida Department of Environmental Protection, and the work of the South Florida Water Management District represent prominent efforts through which an ecosystem management strategy is being developed. The federal agencies represent another.

FEDERAL ACTIONS

At the federal level, the Departments of Interior, Commerce, Army, Justice, and Agriculture, and the Environmental Protection Agency have been charged with responsibility for developing consistent policies, strategies, plans and priorities with which to restore the south Florida ecosystem. The role of these federal groups was defined in the September 23, 1993, Interagency Agreement on South Florida Ecosystem Restoration. The task force, established by this five-year agreement, created an 11-member management and coordination team, known as the Interagency Working Group, whose goal was to develop and submit a south Florida ecosystem restoration report to the task force within a year.

Fulfilling the requirements of the Federal Advisory Committees Act (FACA) has been an important obligation for the Interagency Working Group, which has gone to great lengths to meet FACA's spirit and intent. As far as possible under FACA, it has incorporated the resources and experience of everyone involved in south Florida land and natural resource management issues. Cross-fertilization through public meetings has brought groups involved with south Florida ecosystem issues closer together. The Interagency Working Group continues to seek opportunities to increase consensus by reaching out to south Florida interests through the public comment process. In this way clearer understanding of which groups are responsible for which restoration actions is being achieved, and the federal side of the restoration effort more firmly integrated with state and local activities. This first annual report to the Task Force by the Working Group is the result of these efforts and of strong cooperation among agency staffs.

Indeed, each federal, state, local and private group as well as every resident of south Florida has a stake in ecosystem restoration. Water storage and delivery, agricultural run off, and water quality contaminants issues are among those with potentially mammoth impact on this population of more than six million. On the one hand, the area's commercial and industrial health depends on a healthy ecosystem, while, on the other, increasing population and the demands of further infrastructure development strain the very elements comprising ecosystem health.

The region faces major environmental issues. Population growth is expected to triple in 50 years, making advanced planning critical to managing dramatic change. Increasing population growth also means increasing competition for a finite water supply, as well as increasing byproducts of growth: contaminants, introduced species, and resource overuse associated with growing commercial development.

How does one accommodate continued growth in south Florida while simultaneously reducing symptoms of ecosystem decline? Although the need to grow in order to maintain economic health may seem a necessity at first, managers are recognizing the need for potential trade-offs to maintain environmental integrity. Industrial growth that once transformed apparently "useless" swamps and flatwoods into developed land is being reevaluated as beneficial wetlands functions become better understood. In south Florida now, the public places increased importance on preserving undeveloped lands and regaining lost wetland benefits by restoring such areas as the Kissimmee River.

The public has expressed its support for change, and many voices have spoken out in support of ecosystem conservation and its importance to south Florida's future. However, a system as complex as the south Florida ecosystem and one on which so many demands have been placed does not lend itself to a quick fix. Exactly what constitutes a viable system for the south Florida area has yet to be determined.

No maker what ultimately is attempted, no one anticipates re-creating the south Florida ecosystem the way it used to be. Too much has changed; too much of the original ecosystem has been set aside for other purposes. It can never return to that vast, glittering openness characteristic of its original condition. Whatever evolves from the current hard-won ecosystem emphasis will have to be managed, because community needs for flood control and water supply still must be accommodated. As a result, south Florida ecosystem restoration emphasizes sustainability--balance between environmental needs and the needs of human communities. This is the criteria against which any ecosystem management projects will be measured, one that will be considered in all evaluations of proposed policy, planning and design alternatives. Essentially, sustainability will be the criteria against which any ecosystem management proposal is evaluated before it is approved to be carried out, as well as the criteria against which it will be tested to measure its continuing success.

SUMMARY OF FINDINGS

The Interagency Working Group studied the character of the south Florida ecosystem as it existed prior to drainage. With that, it compared the character of the system as it presently exists. The differences between them were many, as might be expected after years of intensive human intervention. The 990 miles of levees, 978 miles of canals, and 30 pumping stations that, in part, comprise the water management system of south Florida suggest the degree to which water flow has changed since the natural pattern of rainfall and evaporation, wet and dry cycles, first were established.

The natural balance between land and water also has changed. Excessive drainage for agricultural and other purposes has caused organic, porous soil to oxidize. Oxidation has meant diminished soil thickness--significant in south Florida because, at its deepest, only 12

to 14 feet originally existed. By 1984, 5 or more feet at these locations had been lost. Though the amount of loss has slowed, it has had a far-reaching impact.

Soil loss has meant loss of elevation--the degree of incline that, prior to drainage, shifted water south, supplying it to the farthest reaches of the ecosystem, feeding down through sawgrass, soil and limestone to supply the system's two aquifers, the Biscayne and Florida aquifers. Now, the movement that water makes is handled mechanically through an extensive system of levees and canals.

Soil loss also has meant diminished water quality. The more soil oxidation that occurs, the less the remaining soil is able to retain minerals and other components. These wash downstream in the company of pesticides and assorted other run-off, with predictable adverse impacts on native plants and animals. Increasingly, invasive non-native species such as Brazilian pepper, Australian pine, and Melaleuca have found growth conditions more favorable for them than for native species.

Ecosystem fragmentation has further contributed to current changes. Fire, once an ally in habitat diversity, has been curtailed to a predictable schedule of use, leading to over drying of wetlands and a diminished mosaic of burned and unburned areas necessary for habitat diversity.

Perhaps the most astounding byproduct of this report is simple recognition of how much has changed--and how much will have to be undone in order sufficiently to approach restoration of the ecosystem's natural components so as to achieve sustainability. Not only has the entire integrated system of water flow been rearranged but soil composition, habitat, the identity and numbers of land and water species, and the relationship between fresh and salt water have all changed. In the face of such dramatic differences, how can restoration proceed?

The report begins with hydrologic restoration. Without it, nothing else can happen effectively. However, hydrologic restoration does not occur in a vacuum. With it comes efforts to curb the invasion of exotic non-native species, eliminate the production of contaminants, and stop soil erosion and oxidation. It also depends, in part, on the linkages developed between computer-generated models of current hydrology and those of future water quality, ecology and plant and animal populations. These scientific models should enable researchers to determine relationships between water and plant and animal communities at the ecosystem level.

SUCCESS INDICATORS

What will a restored ecosystem look like? Much of that is difficult to determine now, during the earliest stages of the process. However, certain benchmarks do exist with which we may start to determine ecosystem restoration success. Three characteristics that gave the south Florida ecosystem resiliency and sustainability were dynamic storage and sheet flow; large spatial extent; and habitat heterogeneity. These characteristics certainly will serve as future indicators of restoration success. Increased native plant and animal diversity would suggest habitat heterogeneity, an especially important element considering that

estimated benefits from simply removing the black and white Australian melaleuca tree from the landscape would amount to approximately $168 million. Also, considering that mercury contamination indicates ecosystem disruption, its opposite--mercury reduction in large-mouth bass, alligators, and panthers--would suggest another important health indicator.

The re-establishment of pre-drainage wading bird nesting colonies, another indicator, is already underway in such areas as the Loxahatchee National Wildlife Refuge where year-round water provided through the Corps of Engineers is bringing back Florida kites and endangered hawks. Moreover, a Corps of Engineers test project along a 1,000-foot section of the Kissimmee River (Canal 38) installed a new series of structures to return water to the Kissimmee's former channels and reestablish 300 acres of marshes on previously drained flood plains. The success of this pilot project has encouraged the Corps to move forward with plans to restore 56 miles of the Kissimmee, thus contributing to the goal of increasing restored wetland acres--another important indicator.

There are other indicators also: reduced numbers of deformed fish in estuaries, increased seagrass cover, no further wetland losses, increased abundance of fish and species recovery. Indeed, as the restoration process gains momentum, further indicators are sure to present themselves.

With ecosystem restoration still in its formative stages no one can fully predict the configuration it will take once complete. Certainly the size and complexity of the south Florida system, plus the amount of change it has undergone leave scientists, engineers, and managers with numerous challenges and unknowns. As a starting point for restoration, however, Interagency Working Group members in conjunction with agency staffs have outlined the major issues, and proposed recommendations they regard as critical to change, explained in full in the document that follows.

Already, changes are underway. Indeed, the manner in which federal agencies do business in south Florida has been revamped. The actions underway in the federal sector represented on the Interagency Working Group represent a new wind of change. Agencies that, prior to the Interagency Working Group configuration, operated more or less on their own have become aware of what their colleagues are doing, and now are working to avoid overlapping tasks. Increased communication is taking place across agency lines, making it possible for restoration to proceed within an environment of mutual support.

SUMMARY OF TASK FORCE PRIORITIES

The Interagency Task Force, through its Interagency Working Group, is not yet in a position to propose a comprehensive, fully integrated restoration plan for the south Florida ecosystem until it has fully integrated the approach with state, local and tribal interests. It is able, however, to outline and recommend a restoration vision for south Florida as well as management objectives to support this vision, as seen from the perspective of the federal community. It is also in a position to recommend steps the federal community can take to reinforce existing restoration efforts and to initiate new efforts. These items are incorporated in the following report.

In 1993, the Task Force adopted nine priorities, tasking the Working Group to carry these out, as well as evaluate other priorities. Under each priority, a number of actions have been accomplished and tasks projected for upcoming years.

1. Provide consolidated federal objectives on ecosystem restoration to the Corps' reconnaissance study for the redesign of the Central and South Florida Project and continue to provide timely support.

Accomplishments:

a. Produced Science Sub-Group Report on Ecosystem Restoration for C&SF Restudy.
b. Worked with Corps of Engineers in public scoping meetings.
c. Reviewed and recommended final study objectives.
d. Professional staff assigned to the restudy team by three federal and two state agencies (USF&WS, NPS, NMFS, SFWMD, FG&FWFC).

Recommended Critical Tasks:

a. Assign multi-agency staff to support next (feasibility) stage of C&SF Project.
b. Peer review River of Grass Environmental Model.
c. Develop detailed hydrological & ecological models to support next general design stage.

2. Establish research priorities and implement a process for coordinating research on the south Florida ecosystem, including Florida Bay, which includes development of a base line scientific condition assessment and indicator monitoring program, and appropriate biological and hydrological modeling to evaluate ecosystem restoration objectives and programs.

Accomplishments:

a. National Park Service completed a comprehensive interagency research plan for Florida Bay involving 15 federal, state, and local agencies and non governmental organizations; and began coordinating a program involving more than $5 million in research undertaken by 15 different federal, state, and local agencies along with private organizations.

b. Science Sub-group developed and released a draft comprehensive science needs assessment for the south Florida ecosystem for peer, agency and public review.

Recommended Critical Tasks:

a. Expand Florida Bay interagency research and provide periodic reports.
b. Finalize and distribute comprehensive ecosystem research plan addressing priorities and implementation process.
c. Coordinate the implementation of priority research and associated monitoring projects.

d. Target, review, and expand predictive hydrological and ecological models including:
   1. Natural System Model (hydrologic)
   2. Across Trophic Level Systems (ATLSS) models
   3. Florida Bay circulation dynamics model
e. Expand Systematic Reconnaissance Flights monitoring program.
f. Initiate a program of socio-economic research necessary to assess the full range of ecosystem restoration management projects.

3. Establish partnerships with the state and local agencies to support land acquisition initiatives in the south Florida ecosystem.

Accomplishments:

a. Everglades National Park Expansion Act Amendment passed, authorizing 25% federal cost share partnership for acquisition of eastern transition lands.
b. National Park Service expanded East Everglades addition land acquisition program, which includes a 20% state cost share.
c. National Park Service acquired Reefcomber property in Key Largo to support expanded interagency science effort in Florida Bay.
d. Corps of Engineers supported state land acquisition in the Kissimmee River basin.
e. Supported South Florida Water Management District (SFWMD) in obtaining acquisition approval from the state trustees for the Internal Improvement Fund for the western three sections (1,920 acres) of the Frog Pond.

Recommended Critical Tasks:

a. Support state & local efforts to acquire and protect coastal Everglades, including Model Lands.
b. Support state and SFWMD efforts to acquire sufficient interest in remaining areas of Frog Pond and Rocky Glades to implement approved C-111 General Reevaluation Report.
c. Support an accelerated program to preserve undeveloped lands, particularly lands contiguous to natural areas, through quick land acquisition that may require the development of a south Florida Restoration Land Trust.

4. Support development of an effort to integrate actions essential for the recovery threatened and endangered species, and undertake a multi-species recovery plan with the south Florida ecosystem restoration program.

Accomplishments:

Fish & Wildlife Service proposed and outlined a recovery strategy for threatened an endangered species in south Florida, for which partial funding was obtained.

Recommended Critical Tasks:

Fish & Wildlife Service will initiate a multi-species management strategy in FY 95 and seek remaining funding in FY 96.

5. Support expedited implementation of Corps projects in the Everglades ecosystem including Shark Slough, C-111, and Kissimmee River.

Accomplishments - Shark Slough:

a. Modified Water Deliveries Program
   l. Several feature design memoranda developed.
   2. L-67 gap experiment undertaken.
   3. Project Cooperative Agreement (PCA) signed with SFWMD.

Recommended Critical Tasks:

a. Continue completion of feature design memoranda.
b. Support Governor's Commission on the 8.5 square mile area, and develop alternative recommendations regarding the proposed mitigation seepage canal surrounding the area.
c. Begin actual construction of approved project features.

Accomplishments - C-lll Project - Restoration of Taylor Slough:

a. C-111 project accelerated, approved and funded by Congress as a new construction start.
b. Implemented Taylor Slough demonstration project under experimental water deliveries program.

Recommended Critical Tasks:

a. Finalize C-lll project cooperative agreement.
b. Support land acquisition and begin actual construction.
c. Develop and implement new version of experimental water deliveries program.
d. Begin environmental impact statement for operation of modified water deliveries and C-111 systems.

Accomplishments - Kissimmee:

a. PCA agreement executed with SFWMD.
b. Groundbreaking ceremony.
c. Test fill constructed and monitoring initiated.

Recommended Critical Tasks:

a. Complete Upper Basin project modification report.
b. Continue detailed design for Kissimmee restoration.

6. Support development of a comprehensive wetlands permit mitigation strategy for south Florida that furthers ecosystem restoration.

Accomplishments:

EPA and the Corps initiated the planning proposal.

Recommended Critical Tasks:

a. Finalize interagency scope of work.
b. Initiate plan and coordinate with state and SFWMD.
c. Seek broad interagency commitments for participation.

7. Develop an integrated, long-term proposal and budget for ecosystem restoration, maintenance, and protection detailing current activities, achievements, and projected accomplishments.

Accomplishments:

a. Working Group prepared a draft first annual report to the Task Force and circulated it for public comment.
b. Task Force and Working Group coordinated support for FY 95 budget requests.
c. Task Force reviewed and reprioritized FY 95 funding to support and coordinate critical ecosystem projects.
d. Working Group and Task Force prepared and submitted a cross-cut agency budget proposal for FY 96.

Recommended Critical Tasks:

a. Develop more detailed funding priorities and requirements for FY 97.
b. Develop cross-cut FY 96 budget briefing and presentations on Task Force accomplishments/funding needs.

8. Implement a continuing process that identifies and integrates immediate management goals, priority projects, and funding needs for the south Florida ecosystem.

Accomplishments:

a. Working Group organized and established three sub-groups: 1) Science, 2) Management, and 3) Projects/Infrastructure.

b. Task Force established and filled the executive director position, and staff level steering committee positions.

Recommended Critical Tasks:

a. Establish fourth sub-group on Information & Education.
b. Obtain funding for field level agency staff support.
c. Develop and assign specific coordination, evaluation and goal setting tasks to sub-groups.

9. Fully integrate the state and South Florida Water Management District into the ask force and build partnerships with appropriate local and tribal governments.

Accomplishments:

a. Scheduled Working Group meetings to coincide with those of Governor's Commission on a Sustainable South Florida.
b. Task Force met concurrently with Governor's Commission and SFWMD governing board.
c. Sponsored joint spatial data workshop with SFWMD and Florida Department of Environmental Protection.
d. Task Force initiated review of options to formally integrate tribal, state, regional, and local government with the federal task force.

Recommended Critical Tasks:

a. Select and implement formal action to accomplish integration.
b. Whenever possible, continue scheduling overlapping Task Force, Working Group, and Steering Group meetings with Governor's Commission and other ecosystem efforts.
c. Establish office for executive director to support task force and working group in Miami, near offices of Governor's Commission.
d. Create a C&SF project management/advisory team with federal and non-federal participation in compliance with the Federal Advisory Committees Act (FACA).

In addition to the previous nine priorities, the Working Group is recommending two new priorities to address federal involvement with the south Florida ecosystem restoration.

1. Facilitate implementation of the Everglades Forever Act.

Accomplishments:

a. Supported negotiations leading to passage of the Everglades Forever Act by the Florida legislature, which provides for water quality cleanup of the Everglades Agricultural Area and related ecosystem restoration projects.

b. EPA issued National Pollution Discharge Elimination System (NPDES) permit for the Everglades Nutrient Removal Project, the first of several stormwater treatment areas to be built.

Recommended Critical Tasks:

a. Finalize, adopt, and begin implementation of a federal Everglades Forever Act program management plan (draft completed 12/94).
b. Complete federal programmatic EIS.
c. Specifically begin work on C-51/STA IE.
d. Continue threshold/nutrient dosing research to provide basis for setting final water quality standard.
e. Continue NPDES permitting for additional stormwater treatment area discharges.
f. Support development and implementation of emergency interim plan for Florida Bay.
g. Establish an Everglades Agricultural Area (EAA) office of the Natural Resources Conservation Service and provide technical assistance to private landowners in the EAA and C-139 Basin, encouraging implementation of management practices to reduce phosphorus loadings from farm runoff.
h. Continue mercury research and monitoring.

2. Support program to eradicate invasive exotics, particularly Melaleuca (Australian Paperbark), Casurina (Australian Pine), and Schinus (Brazilian Pepper).

Accomplishments:

a. Obtained funds to build Ft. Lauderdale quarantine research facility.
b. Partnership agreement executed to restore 5,000 acres of Brazilian pepper infested land in Everglades National Park.

Recommended Critical Tasks:

a. Seek expanded eradication funding.
b. Develop a comprehensive control plan.

CONCLUSION

Although much remains to be done, much already is underway, and there are many willing hands to complete the tasks that lie ahead. Marjory Stoneman Douglas concludes *The Everglades: River of Grass* with the following words:

Perhaps even in this last hour, in a new relation of usefulness and beauty, the vast magnificent, subtle and unique region of the Everglades may not be utterly lost.

Substitute "south Florida" for "Everglades," and we are given the promise of restoration--of a region, vast, magnificent, subtle and unique, not fragmented into its natural

and cultural identities but integrated in such a way that the restored south Florida ecosystem becomes the bedrock from which an integrated, sustainable future springs.

Short of this, what remains of the natural system will be more than compromised. Short of this, the ecosystem on which continued human occupation depends will lose entirely its ability to replenish itself. Investing now in the south Florida ecosystem--determining necessary changes to current practices and the best ways to carry them out--helps to ensure that this region of sawgrass and sloughs, wading birds and open sky will retain its regional character while providing more equally for the plants, animals, and humans living within its boundaries.

1. FROM KISSIMMEE THROUGH THE KEYS: INTRODUCTION TO THE PROBLEM

INTRODUCTION

Water is life in south Florida--from the head waters of the Kissimmee to the end of the Florida Keys, which define the ecosystem. For the area's animal and plant populations, as well as its human community, clean, abundant water has been fundamental to prosperity and growth. Yet urban development of south Florida during the past 100 years has altered natural processes, and shifted the centuries-old relationship between land and water.

Channelization of water flow and drainage, as well as the filling of wetlands--long accepted means for land development--have gradually altered natural communities and the hydrologic regime. Over the past years, the south Florida ecosystem has shown increasing signs of stress, with a severe loss of its wading birds, and 56 plant and animal species either threatened with, or endangered by, extinction. Wetlands loss, organic soils subsidence, exotic plant and animal invasions, and such catastrophic events as algal blooms, seagrass and mangrove die-offs, and coral diseases manifest ecosystem stress in south Florida at a time when protection of the drinking water supply, as well as its diverse plant and animal communities, depend on a stable, healthy system.

Many regard the catastrophic changes in Florida Bay as harbingers of south Florida's future, failing corrective action. From estuary to marine lagoon, the Bay now contains areas in which salinities exceed sea water strength, a condition that many feel has led to the loss of thousands of acres of seagrass, continuing algal blooms, and fish kills.

Before human intervention in the south Florida area, a stable, predictable hydrologic system sustained fish and wildlife populations and their habitat. Changes occurred when human populations required increased acreage of dependable dry land. Few realized the impact that lowering the water table could have on the overall system, only one of which was allowing sea water to flow into the estuaries and infiltrate parts of the fresh-water aquifer.

Although resource managers now better understand the interconnectedness of the south Florida ecosystem, this understanding comes at a time when the area's human population has grown to slightly more than six million--about half Florida's total population. Attracted by the mild climate, they have contributed to South Florida's two most significant industries, agriculture and tourism. South Florida's mild temperatures provide an extended growing season which, in conjunction with effective water drainage, has made agriculture a year-round endeavor. Citrus, cattle, sugarcane and vegetable farming dominate, while commercial fishing for fin fish, shrimp, lobster and crab lead the marine industries.

Tourism, the largest industry in south Florida, attracts international travelers to the eastern and western seaboards, as well as to the Florida Keys. They come for diving,

snorkeling, and recreational fishing, to relax in the sun and enjoy the climate. They contribute approximately $77 million to the economy from recreational fishing. The resulting economic growth, which has impacted population growth, has focused attention on infrastructure, flood control, and drinking water supply issues.

Tourism and agriculture, as well as the quality of human life depend on environmental quality. But if human populations have altered the natural system, how can commerce and environmental quality coexist? Some have translated this dilemma into a debate between the economy and the environment. In reality, the two are so closely linked that the economy may not be sustainable if the ecosystem supporting it fails.

The challenge of the Task Force on South Florida Ecosystem Restoration is to help propel the community of south Florida with its varied array of stake holders to a state of balance where human activities and a healthy environment coexist.

PARTNERS IN THE SOLUTION

The September 1993 signing of the Interagency Agreement on the South Florida Ecosystem led to the creation of the Task Force, as well as its Working Group, whose membership comprises various federal agencies. As a federal entity, the Interagency Working Group (IWO) conducts itself in accordance with the Federal Advisory Committee Act, which makes it difficult for the group to comprehensively incorporate the resources and experience of non-federal organizations currently involved in south Florida land management issues. Given the legislative limits within which it has been necessary to operate, the IWG still has attempted to encourage communication by keeping its meetings public. Formal partnership with the state of Florida, the South Florida Water Management District, the Florida Department of Environmental Protection, other state and regional agencies, and local and tribal governments, as well as the public does not exist at the present time. However, federal IWG members recognize that full restoration of the south Florida ecosystem cannot be accomplished until local, state, scientific, and federal efforts are combined, and they are working toward that end. Indeed, public involvement in this restoration effort is critical, if change is to occur successfully at the grassroots level.

In a very broad sense each resident of south Florida holds a stake in the process. The two dominant industries, agriculture and tourism, depend on ecosystem health. So does the quality of urban life. Adequate drinking water not only impacts the way Floridians live but also affects other components of the ecosystem. Certainly local, regional, state, and federal agencies with trustee responsibilities for south Florida's natural resources are vested in this effort. Working with the public for productive change, the following federal agencies play important roles as Working Group members:

U. S. Department of Interior

The National Park Service administers three national parks (Everglades, Biscayne and Dry Tortugas), and one national preserve (Big Cypress) in south Florida. It assists with state and local conservation and recreation planning.

The Fish and Wildlife Service administers 10 national wildlife refuges, manages all actions under the Endangered Species Act, provides comments on comprehensive wetland programs including permitting, carries out authorities of the Fish and Wildlife Coordination Act and enforces federal wildlife laws.

National Biological Service, a newly formed agency, is responsible for inventorying, monitoring, and conducting research on biological resources.

United States Geological Survey provides geologic, topographic, and hydrologic information.

Bureau of Indian Affairs has trust responsibility for south Florida's federally recognized Miccosukee and Seminole Indian Tribes.

U. S. Department of Commerce

National Oceanic and Atmospheric Administration (NOAA) has the trusteeship responsibilities for U. S. marine resources, and extensive research capabilities in marine a atmospheric research, some of which address south Florida issues. The agency has the following main line components:

O *National Marine Fisheries Service (NMFS)* reconciles conflicts between water resource projects and marine resources; handles review and permit processes pertaining to marine resources; consults, evaluates, and reports on marine species; protects cetaceans; ar manages marine fishery resources.

O National Ocean Service (NOS) administers the Florida Keys National Marine Sanctuary and administers the Coastal Zone Management Program which provides assistance to states for planning.

O OOAR

U. S. Department of Agriculture

Natural Resources Conservation Service (formerly Soil Conservation Service) provides technical assistance to farmers and ranchers; maps the nation's soils, and develops erosion-resistant plants; delineates wetlands on agricultural lands for all federal programs; provides flood prevention and water conservation assistance for irrigation, recreation, wildlife habitat and other uses; and through local water resources research, enables local governments and citizen groups to plan water-related needs.

Agricultural Research Service (ARS) is the primary in-house research arm of the Department of Agriculture, carrying out research in categories ranging from soil, water and air to systems integration.

U. S. Department of the Army

U. S Army Corps of Engineers (Corps) has flood control authority in central and south Florida; and is responsible for water deliveries to Everglades National Park; for restoration of the Kissimmee River; and for studying the effects of modifying the Central and Southern Florida Flood Control Project on environmental quality, aquifer protection, and urban water conservation. Under the Clean Water Act the Corps issues all federal permits for dredge or fill of wetlands.

U. S. Department of Justice

U. S Attorney's Office for the Southern District of Florida represents federal agencies in judicial actions involving the United States in south Florida.

U. S. Environmental Protection Agency

The Environmental Protection Agency is charged with restoring and maintaining the chemical, physical and biological integrity of the nation's water, as well as permitting discharges. In addition, EPA is required to develop a water quality protection program for the Florida Keys National Marine Sanctuary, and to recommend priority corrective actions and compliance schedules addressing point and nonpoint pollution.

11. MOSAIC OF WATER, LAND AND PEOPLE: UNDERSTANDING THE PROBLEM

THE NATURAL SYSTEM

The south Florida ecosystem encompasses approximately 28,000 square kilometers with at least 11 major physiographic provinces: Everglades, Big Cypress, Lake Okeechobee, Florida Bay, Biscayne Bay, Florida Reef Tract, nearshore coastal waters, Atlantic coastal ridge, Florida Keys, Immokalee Rise, and Kissimmee River Valley. Kissimmee River, Lake Okeechobee, and the Everglades form the watershed that connect a mosaic of wetlands, uplands, coastal areas, and marine areas.

Prior to drainage, which began in the late 1800s, wetlands covered most of central and southern Florida. The Everglades region, nearly flat and sloping slightly from east to west, was nevertheless heterogenous in landscape, sculpted by 5,000 years of hydrologic and biological evolution on a Pleistocene limestone platform. A circa 1850 military map (Ives 1856) provides the best template for determining pre-drainage conditions.

The pre-drainage landscape was characterized by swamp forest; sawgrass plains; mosaics of sawgrass, tree islands, and ponds; marl-forming prairies dominated by periphyton; wet prairies dominated by *Eleocharis* and *Nymphaea*, cypress strands, pine flatwoods, pine rocklands, tropical hardwood hammocks, and xeric hammocks chiefly of oak. The estuarine-coastal system had its own identity: shallow seagrass beds, riverine and fringe mangrove forests, intertidal flats, coral reefs, hard bottom communities, mud banks, and shallow, open inshore waters. Land and water interconnected on a topographic gradient ranging from about 20 feet above mean sea level at Lake Okeechobee to below sea level at Florida Bay. Sustaining these communities was a hydrologic system that stored and released water on a large scale over a vast territory of diverse habitats, home to innumerable plants and animals.

HISTORY OF CHANGE

The first haphazard efforts in the late 1800s to drain portions of south Florida were followed in the early 1900s by the creation of the Everglades Drainage District, established to encourage Everglades drainage for agricultural and urban use, especially south of Lake Okeechobee in what is now the Everglades Agricultural Area (EAA). By 1929, 440 miles of canals and levees had been constructed, including four major canals draining southeastward from Lake Okeechobee to the Atlantic Ocean.

In 1926 a hurricane swept water from Lake Okeechobee southward killing 400 to 500 people. In 1928 another hurricane killed 2,400 people living in farming communities within the EAA and the city of Okeechobee. Consequently, the federal government built Hoover Dike around a portion of Lake Okeechobee in the 1930s. Drought and subsequent fires prevailed until 1947, when two hurricanes inundated the region, causing about $60 million of property damage.

Congress declared the need for a regional master plan balancing flood control and water supply protection. In 1948, the Army Corps of Engineers assumed responsibility for a comprehensive state-federal water control program known as the Central and Southern Florida Flood Control Project (C&SF) that would cover 15,000 square miles. Congress authorized $208 million.

Designed and built by the Corps, the C&SF is maintained and operated both by the Corps and by the South Florida Water Management District, the local sponsor. It includes:

- 990 miles of levees;
- 978 miles of canals;
- 30 pumping stations;
- 212 flood control or water diversion structures; and
- Secondary water management systems constructed by local interests.

Costing approximately $1 billion, with much of the work completed during the 1950s and 1960s, C&SF work included:

- Channelization of the Kissimmee River into a 56-mile canal with control structures;
- A levee surrounding Lake Okeechobee (730 square miles) with control structures, hurricane gates and pumping stations;
- Encirclement of the 1000 square mile Everglades Agricultural Area by canals and levees, with 7 pumping stations to provide forced drainage;
- An east coast protective levee for urban flood control extending from the eastern shore of Lake Okeechobee 130 miles southward to Homestead;
- Local protective works along the developed lower east coast; and
- Three multi-purpose Water Conservation Area -- one the Loxahatchee National Wildlife Refuge -- (totaling 1137 square miles) in the Everglades west of the east coast levee with control structures to effect water transfer, including transfer to Everglades National Park.

Authorized project purposes include flood control, water supply, drainage, fish and wildlife preservation, Everglades National Park water supply, recreation, navigation, and saltwater intrusion prevention. The C&SF Project was designed to accommodate the high evapotranspiration rates, sign)ficant overland flow, subsurface flow in highly transmissive aquifers, pronounced wet and dry seasons, drought, intense rainfall, tropical storms, low coastal elevations and other hydrologic characteristics. Complex water quality demands and

growing environmental awareness made resolving conflicting priorities within the multi-purpose C&SF Project more and more difficult.

OTHER FORCES THAT CHANGED THE SYSTEM

Population Growth: In the 1800s Seminoles and Miccosukees chiefly populated south Florida because floods and hurricanes discouraged the region's urban and agricultural development. Growth occurred only in such naturally well-drained areas as the Atlantic Coastal Ridge. In 1890 the population of the area presently encompassed by Dade, Broward and Palm Beach Counties was 861, while nearly all of the lower west coast population of 20,200 was located in Key West--in contrast to the current population of south Florida that numbers more than 6 million. The population of what became the South Florida Water Management District (SFWMD) was 32,000.

Comprehensive flood control has helped to transform the area, expanding developable acreage, which resulted in increased population and appraised property value.

- The lower east coast population was about 215,000 in 1930, 694,000 in 1950, 2.2 million in 1970 and 4.0 million in 1990.
- The population of the 18 counties within SFWMD boundaries was 727,097 in 1945, and 6.3 million in 1990.
- Population projections show south Florida tripling within 50 years.
- The appraised property value was $1.2 billion in 1950, $240 billion in 1991.

Land Use Conversions: Highly fragmented, the south Florida ecosystem contains four wetland landscapes now reduced to remnants: the cypress strands fringing the western side of the Atlantic coastal ridge, the pond apple forest/swamp on the southem shore of Lake Okeechobee, the tall sawgrass plain of what is now the Everglades Agricultural Area (EAA), and the biologically important peripheral wet prairies (Davis et al. 1994).

- On the east coast ridge, only 10% of the former rockland pinelands and 10% of the tropical hardwood hammocks persist; stressed by a lowered water table and introduced exotics, they are more vulnerable to natural disasters.
- Compartmentalizing the Everglades further fragmented the system by creating a series of poorly connected wetlands.
- Urbanization fragmented the upland systems and placed stress on the ecosystem's water supply and water storage capacity.
- Roughly 50% of the pre-drainage wetlands have been lost to agricultural, industrial, and residential development, especially the peripheral (short hydroperiod) wetlands on the eastern side of the Everglades, and continue to be incrementally diminished by wetland permitting programs.

- Wetland loss has reduced landscape heterogeneity and long-term population survival for vertebrate species requiring extensive territory, among them wading birds, snail kites, and panthers.

- Decreasing the extent of south Florida's wetlands has reduced the solar collector area feeding aquatic productivity.

By any measure of species richness, there has been a drastic erosion of south Florida's biodiversity.

In their natural condition, the Everglades and other wetlands were naturally flowing systems that not only covered a greater area but also exhibited longer inundations and more sustained outflows to estuaries than exist in their current managed state. With decreased wetlands has come a decrease in the function, sheet flow, and base flow of wetlands. Water management significantly changed the volume and timing of water flow, as well as overland flow patterns across wetlands and into estuaries.

Central & Southern Florida Project: The 1948 cost-benefit analysis that justified the Central & Southern Florida (C&SF) Project projected the greatest benefit to be the increased land use. Since the project's initiation in the late 1940s, rapid growth has increased the demand for flood control and water supply to meet municipal, industrial, agricultural, and environmental needs. Although millions of acres of south Florida have been placed in public ownership, the ecological condition of the Everglades watershed ecosystem continues to deteriorate. Increased concern and often conflicting expectations regarding flood control, environmental restoration, and competition for water resources have led to the need for an in-depth comprehensive study of the multi-purpose C&SF Project.

THE ECOSYSTEM TODAY

Though altered considerably from its pre-drainage condition, the south Florida ecosystem is vitally important to both the economy and the ecology of the nation. It is:

- The predominant source of fresh water for Florida's most populous region.

- Home to 56 federally-listed threatened or endangered species and 29 candidate species.

- The principal nursery area (Florida Bay and adjacent estuaries) for the largest commercial and sport fisheries in Florida: this area is important to bottlenosed dolphin and is an important developmental and nesting habitat for nesting sea turtles.

- The home of the largest wilderness east of the Mississippi River.

- The location of the only living continuous coral reef system adjacent to the continental United States (the third largest barrier reef community in the world).

- The site of the two federally-recognized nations of the Seminole Tribe of Indians and the Miccosukee Tribe of Indians of Florida.
- An international commercial and tourist center.
- The primary domestic producer of the nation's sugar and winter vegetables.
- The home of an expanding population exceeding 6 million people.
- The location of Lake Okeechobee and other world class sport fishing areas.
- The most significant breeding ground for wading birds in North America, wintering grounds for more than half the nation's wood stork population and more than 100,000 white ibises; staging area for glossy ibises, peregrine falcons, and swallow-tailed kites migrating between breeding and wintering grounds.
- The home of 3 national parks, 1 national preserve, 10 national wildlife refuges, 1 national marine sanctuary, and numerous areas protected under state or local ownership.
- Home of the Everglades, designated by the United Nations as a World Heritage Site and an International Biosphere Reserve, and by the International Union for the Conservation of Nature as a Wetland of International Significance.
- The world's largest organic soil deposit.

RESTORATION ISSUES

Although vast areas of south Florida have been set aside as protected public areas, symptoms of ecological decline continue to increase. The region faces major environmental issues:

- Planning for regional population growth (expected to triple within 50 years);
- Competition for a finite water supply among an expanding urban population and agricultural interests and remnant natural resources;
- Identification and implementation of the structural and operational modifications to the C&SF Project needed to restore the ecosystem;
- Nutrient enrichment of the Everglades and coastal marine ecosystem by agricultural drainage or urban drainage and waste waters;
- Declining health of the coral reef system;
- Permitting and mitigation programs ineffective in preventing loss of remaining natural uplands and wetlands;

- Purchase and public ownership of critical unprotected lands in south Florida's watershed;
- Extensive mercury contamination of freshwater fish and other biota;
- Increase in introduced (exotic) plants and animals and decline in native species;
- Incomplete understanding of what constitutes a functioning system for the area, as well as conflicting views on restoring the water system;
- Lack of public understanding of ecosystem values and the human environment;
- Natural resource compatible recreational access;
- Lack of consensus on the causes of and solutions for ecosystem degradation;
- Adequate financial commitment to ecosystem restoration;
- Organic soil subsidence;
- Minimization of water quality degradation and maximization of water conservation through structural and agronomic management practices in urban and agricultural areas;
- Sustainable economic development; and
- Ecological degradation of Florida Bay including extensive algal blooms and seagrass die-off.

A VISION FOR THE ECOSYSTEM

When the Interagency Working Group met in 1993, it began to consider what it regarded as its collective "future vision" for the south Florida ecosystem. The document produced as a result of the 1993 Management Objectives Workshop stated that "the purpose of the Everglades Restoration program is to restore and maintain the elements of this ecosystem to most resemble the natural functions of a healthy, balanced, and functioning estuarine, and marine environment. [This should be a] system where human activities and actions occur in such a manner so as to support healthy natural conditions and lead to diversity and abundance of natural biological systems over the entire general area, and specifically in the public lands set aside for their natural values."

ECOSYSTEM MANAGEMENT OBJECTIVES

This vision was to be obtained through the following objectives:

Florida Bay, Estuaries, and Near Coastal Waters

- Restore and sustain healthy ecosystem conditions in these waters, which allow natural processes, functions, and cycles to continue or be re-established.

- Manage use of natural resources (commercial, sport fisheries, and others) to maintain sustainable populations.

- Maintain the health and biodiversity of the coral reef ecosystem component.

Fresh Water

- Manage the hydrological conditions in the remaining undeveloped and potentially restorable lands in a way that maximizes natural processes characteristic of the historic south Florida ecosystem (including water quality, quantity, distribution, timing, and biological integrity). Restoration of the natural system will be evaluate~ and implemented to maximize benefits to the overall ecosystem.

- Develop and manage the total hydrologic system to maximize ecosystem restoration while providing appropriate consideration to meet the needs of urban, agricultural, . man-made components. The Working Group recognizes that future management of the system will require shared adversity where the full range of hydrologic needs cannot be fully met.

Development

- Ensure that any development plans or permits for development are fully coordinated among affected governmental agencies and are compatible with restoration of the south Florida ecosystem.

- Ensure that existing development that has an adverse impact reduces or eliminates degradation and that new development does not contribute to degradation.

- Develop and use a system-wide integrated mitigation plan, coordinating all levels of government, which contributes to overall restoration.

- Ensure that regardless of any future development there is a sufficient land, water, resource base to conduct the required natural resource restoration efforts.

Research

- Implement a coordinated research program to develop an understanding of the physical, chemical, and biological processes essential to achieving restoration of the south Florida ecosystem.

Plants and Animals

- Restore and maintain the biodiversity of native plants and animals in the upland, wetland, marine, and estuarine communities of the south Florida ecosystem.

- Eradicate or control invasive exotic plants and animals.

- Provide for adequate natural habitats for native plants and animals.

- Recover species that are threatened or endangered.

Education

- Coordinate a multi-cultural information and education program to ensure that the public is informed of the unique values of the south Florida ecosystem and that they are regularly apprised of the environmental, social, and economic benefits of restoration.

Indian Nations

- Provide for the implementation of Tribal resource development consistent with sound water management and environmental principles, and as compatible as possible with restoration.

- Provide protection of the reservations from adverse water quality and quantity impacts, either through upstream controls for other use impacts or funded on reservation mitigation for impacts.

- Provide for timely restoration of the ecosystem in WCA-3A to protect tribal rights.

III. BUILDING BLOCKS OF RESTORATION: DEFINING ECOSYSTEM RESTORATION, PROTECTION AND MAINTENANCE

Water created the south Florida ecosystem, and water management practices have critically altered it. This makes hydrologic restoration--the natural distribution of quality water in space and time--a necessary starting point for ecological restoration. How the hydrologic system is managed affects land use, a critical factor in planning for restoration. In recognition of the role supportive land use planning and permitting can play in restoration success, the Interagency Task Force follows three objectives:

- Support development of a comprehensive wetland permit mitigation strategy for south Florida that furthers ecosystem restoration.

- Reduce constraints on economic expansion by increasing the overall water supply and improving quality of life.

- Address south Florida's water quality and supply, as well as subsidence of organic soils so as to provide for more sustainable economic opportunities while improving natural ecosystem sustainability, recognizing that current urban, economic, and agricultural growth rates are not sustainable.

THE ALTERED ECOSYSTEM

Changes in the hydrologic structure of south Florida, which began before the turn of the century when Hamilton Disston connected the Caloosahatchee River with Lake Okeechobee in 1883 and culminated with the 1948 implementation of the Central and

Southern Florida Project, created an intricate network of levees, canals, and pumping stations for flood control, drainage, and water supply. Flood control made possible massive land-use changes that decreased the availability of land for water storage and recharge. The current hydrology of south Florida functions not at all as it did prior to the 1800s.

Soil Subsidence: Extensive drainage for agricultural purposes south of Lake Okeechobee caused tremendous organic soil losses. Without water, the soil became denser and drier--one of the first environmentally destructive effects of drainage--resulting in losses of 5 or more feet of soil by 1984 (Stephens 1984) and now calculated at 3 cm per year, a substantial loss when the maximum thickness was only 12 to 14 feet initially. Although soil loss still continues, the process has been slowed by re-flooding fallow fields and maintaining a high water table.

Soil loss of such magnitude has heavily impacted Everglades hydrology and ecology, especially the elevation gradient from the upper to the central Everglades. Soil loss has meant elevation loss, which has meant loss of the hydraulic head that once naturally drove water south. Moving water from north to south now requires pumping, an effort that grows more extensive as soils continue to subside. In addition to impacting elevation, soil loss

has also meant reduction in water storage capacity--the area's ability to absorb water, thus balancing seasonal and long-term variations in rainfall.

Add to the problems associated with soil loss the enormous spatial extent over which the loss has occurred and the restoration issues are magnified. In fact, the loss extends beyond the Everglades Agricultural Area (EAA) into the Everglades.

Water Quality Implications of Soil Loss: The combination of 1) soil loss in EAA, 2) routing water around EAA, 3) EAA's water demands, and 4) materials leaching out of the area have caused significant downstream impacts. Soil loss may have concentrated compounds and minerals such as phosphorus in the remaining soil. As soil loss continues, the binding capacity of remaining soil is likely to become so saturated it will be unable to retain minerals, which will be released into downstream waters. The problem also is magnified by pesticides and other chemical applications accumulating in the environment for at least 50 years:

- High mercury concentrations found in large-mouth bass, alligators, panthers, and other top predators demonstrate the existence of contaminants in aquatic food chains, even though the sources and movement through the ecosystem remain uncertain.

- Water discoloration indicates dissolved organic carbons, precursors to trihalomethanes (a known cancer causing agent) formed as a result of the chlorination treatment process for drinking water; drinking water supplied by Lake Okeechobee and the Everglades to east coast cities first passes through major canals traversing the EAA; an EPA study found the Miami Preston-Hialeah well field to contain one of the highest concentrations of trihalomethanes in drinking water supplies; Dade County water treatment plants have switched to a chloramine-based purifying process, though public health concerns may exist with this product also.

- Organic soils oxidizing due to drainage in the EAA and elsewhere appear to be the source of the dissolved compounds, which decrease in canal water with distance south from the EAA (EPA, provisional data).

Nutrient Enrichment and Contamination: Eutrophication and water quality degradation are growing concerns in south Florida. Nutrient-laden agricultural runoff has altered marsh macrophyte and algal communities, diminishing their supporting role as food chain bases and habitats. Extensive eutrophic zones have been found in the public Everglades marshes. Elevated concentrations of chlorinated hydrocarbon pesticides or their derivatives have been found in great egrets and other wading birds from Water Conservation Area 1 (Winger 1987).

Mercury Contamination: A human health fish consumption advisory due to mercury contamination either bans or restricts the consumption of freshwater fish from two million acres encompassing the Everglades and Big Cypress National Preserve, and there is extensive mercury contamination of other biota associated with aquatic food webs. Since 1989 mercury has been found at elevated concentration in varied Everglades biota, including freshwater fish, raccoons, wading birds, and alligators. A Florida panther (an

endangered species) found dead in Everglades NP in 1989 had a liver mercury concentration of 110 ppm. The maximum concentrations found in bass (4.4 ppm) and bowfin (over 7 ppm) collected from a WCA-3A canal are the highest concentrations found in the state of Florida, and are higher than concentrations found at Superfund sites in the Southeast that are contaminated with mercury. The source(s) of mercury, and the mechanism(s) and environmental conditions resulting in the bioaccumulation of toxic methyl mercury in the Everglades remain unknown.

Uncoupling Wetlands/Estuaries From Rainfall: Water impoundment in the Water Conservation Areas and surface water diversion to the Atlantic coast, as well as ground water and levee seepage losses eastward in the modified system have reduced flows to the southern Everglades, shortening hydroperiods. Not only have these changes meant larger intra-annual flow variations but also large volumes of rainwater drained to sea annually that did not occur historically. This eastward water diversion occasions a several hundred thousand-acre-foot loss per year to the sea.

Reduction in flow from upstream also has reduced flood duration as well as the maximum area annually inundated. Peak flows are higher after major rains and flow rates drop off more abruptly at the end of the wet season than they would have in pre-drainage days. Channelization and impoundment also have disrupted the annual pattern of rising and falling water depths in remnant wetlands.

Altered Hydroperiods: The accelerated runoff rates that have accompanied increased development have meant increased wetland drying over vaster areas. Land is saturated with water for shorter periods of time, resulting in lower aquatic production at all levels of the food chain. Surface water refugia supporting aquatic fauna and their predators during drought are smaller and fewer in number, having been relocated and subdivided as part of the currently-managed system.

In a few areas, such as the southern parts of the Water Conservation Areas, channelization, coupled with impoundment, have increased depth and hydroperiods. Resulting regulation water releases have caused unseasonable flooding of alligator nesting sites in Everglades National Park and disrupted wading bird nesting, which depends on concentrated food supplies.

Invasive Introduced Species: The canal networks have provided a kind of deep water refugia for introduced (exotic) plants and animals, encouraging communities substantially different than the natural ones, particularly where predatory fish are concerned. Furthermore, the water conveyance system may be a conduit for the dispersal of invasive species. It also may foster introduced species by creating conditions favoring exotics above natives.

Loss of Hydraulic Head and Recharge: Artificial drainage drastically lowered the water table and increased water table recession rates on the east coast ridge. This impacted water flow to both interior wetlands and estuaries. It also affected ridge plant communities, the salt/fresh interface, and water supply.

Fire Regime Changes: Fragmentation has interfered with the ability of fire to maintain natural mosaics. In the natural system, fire increased habitat diversity; in the current managed system, it reduces diversity due to altered seasonal burning accompanied by over drying of wetlands. Human tendency to replace natural variations and extremes in disturbances like fire with regular schedules can lead to the loss of biological diversity because species tend to adapt to natural variations in environmental conditions. Regularizing physical driving forces may favor some species over others and affect species composition.

Lost Wetland Function Greater Than Lost Wetland Area: South Florida wetlands have been reduced by half, but breeding wading bird populations have been reduced to less than 10% of their former number. This suggests either: (1) that the particular wetlands that were lost played an especially critical role in wading bird feeding and nesting success, and/or (2) that the remaining wetlands are so degraded that their carrying capacity for wading birds is only 20% of the former capacity. The estuarine system serves as a foraging ground for wading birds, and loss of estuarine feeding opportunities may also have decreased the wading bird carrying capacity of the ecosystem.

Estuarine Impacts: Water management has resulted in:

- More short duration, high volume water flow to estuaries and less base flow;
- Regulatory releases to control lake and ground water levels according to prescribed flood-preventive formulae, which have produced pulses of fresh water entering estuaries, causing rapid, drastic decreases in salinity that stress estuarine organisms;
- Water flows diverted from one receiving basin to another, changing long-term salinity regimes;
- Water diversion and increased runoff rate, providing Florida Bay with less water flow than it received historically and creating salinities exceeding oceanic concentrations (Florida Bay salinities have reached 70 ppt during severe drought; Biscayne Bay may exhibit abnormal negative or reverse salinity gradients, with hypersaline conditions inshore; and salinities in Manatee Bay have dropped from 36 ppt to 0 ppt in a matter of hours due to abrupt regulatory releases from the South Dade Conveyance System-especially disruptive to Manatee Bay, which ordinarily experiences extremely high salinities due to natural freshwater inflow loss);
- Long-term changes in freshwater inflow rates to estuaries, which have shifted salinity zones upstream or downstream, resulting in areas within species' optimum salinity ranges that no longer coincide with the estuary features supporting species' growth and survival;
- Spatially compressed (steeper) salinity gradients providing less overall area within some salinity zones and less opportunity to overlap with favorable structural habitat-estuary salinity zone shifts and area changes within various salinity ranges may have

reduced species optimum habitat and even eliminated some species habitat all together.

Estuarine and Reef Resources Declines: Fisheries productivity depends on habitat quality and quantity. One measure of habitat carrying capacity is the abundance of f~sh age 0 to 1 (known as recruitment). Decreased fisheries productivity may be reflected in catch rate declines. Landings in the valuable Tortugas pink shrimp fishery, dependent upon Florida Bay nursery grounds, have declined sharply since the mid 1980s. Long-term catch rates, standardized for vessel power increases, declined from the 1960s through the 1970s. Unstandardized catch rates declined precipitously beginning in the mid 1980s (Browder 1985).

In addition to declining catches, fish displaying abnormal dorsal fins and misaligned scales are common in North Biscayne Bay (Browder et al. 1993), and present in the St. Lucie Inlet and the lower Indian River (Kandrashoff pers. comm.). The same abnormalities have been seen in at least 10 species, suggesting a cause common to the environment of these species. On the reef tract, a declining community is also evident, exemplified by coral bleaching, coral diseases (including black band disease), and a decline in coral cover and recruitment. Recently, DDE and other chlorinated hydrocarbons have been found in coral reef tissue (Skinner and Japp 1986). Extensive seagrass loss has occurred due to poor water quality (increased nutrients and turbidity, decreased light penetration), alteration of the natural freshwater inflow pattern, dredge and fill activities, and boating activities (Kenworthy and Haunert 1990).

THE PROCESS OF RESTORATION

What Restoration Means: In the context of south Florida, restoration means a return to pre-existing ecological conditions. The conceptual target for south Florida's wetlands and estuaries is pre-drainage topography and hydrology evidenced by the 1858 military map, and for vegetative cover the 1943 natural vegetation map prepared by Davis, expanded to include southwest Florida and the Kissimmee River Valley. In reality, the irreversible loss of significant wetland areas (the large spatial scale was key to long-term ecosystem maintenance), as well as the almost complete urbanization of the east coast ridge (a major ground water recharge area) and the need to accommodate agriculture make the restoration target only approachable. What we can hope to recapture are the essential hydrologic and landscape characteristics critical to a sustained, healthy south Florida ecosystem.

Rationale For Hydrologic Restoration: Hydrologic restoration is a necessary beginning to ecological restoration. However, encouraging habitat heterogeneity may require additional restoration efforts, among them:

- Reduction in water and airborne nutrients and contaminants;
- Ending soil subsidence;
- Control of invasive exotics; and

- Re-establishment of natural corridors in uplands and wetlands for native biotic dispersal and diversity.

The restoration approach has three overlapping components, discussed in terms of alternative minimum, incremental, and maximum (unconstrained) restoration areas:

- Restore the areal extent of the system, as well as its hydrological integrity to recover sustainable biotic populations;

- Adjust hydrological restoration plans to maximize ecological restoration; and

- Establish a comprehensive, regional monitoring program to measure hydrological and ecological responses (referred to as success criteria) to the hydrologic restoration programs.

Certainly, the identity of the resulting landscape will emerge from the identity of the re-established system. Management's challenge is understanding these new system trajectories and guiding them toward ecosystem health and sustainability, possibly supporting the design of enhancement projects.

Models, Rain-driven Formulae, and Adaptive Management: Linking current hydrologic models and future models of water quality, ecology, and plant and animal populations should help determine differences between pre-drainage and present-day conditions. Developed at scales ranging from regional landscapes to constituent communities (Appendix M), these models must have scientific credibility to guide restoration.

Since quantitative measures of hydrological and ecological changes from pre-drainage times to the present are lacking, the best guide is the family of natural system models (NSMs), coupled with spatially explicit simulation models of species at the landscape level. Existent models of natural system hydrology have been calibrated based on present system hydrologic models, but with canals, levees, and control structures removed.

Assuming identical rainfall, comparisons of NSM with present model results allow changes in flood stages, duration of flooding, spatial extent of flooding, and other related information to be assessed. For instance, they show the spatial distribution of hydroperiods under pre-drainage and present conditions, indicating that hydroperiods in pre-drainage times were longer. How to translate NSM output into a water delivery schedule adjusted for rainfall at various landscape locations has yet to be determined. However, a rain-driven formula (based on a regression of water flow rates on rainfall, paced to reflect natural system delays from storage) currently is being used by SFWMD to schedule more natural volume and timing for Everglades water deliveries from the upstream Water Conservation Area. Similar formulas based on NSM (Fennema et al. 1994) output could provide improved water deliveries system wide. Also the NSMs can provide perspective on how to restore more natural water flow volume and timing to estuaries.

To understand the role of water among biotic communities, ecosystem-level modeling needs to be coupled with NSMs and the various hydrological alternatives. Currently, several ecological models are being developed, among them an innovative approach to be used by the Park Service, Biological Survey and the University of Tennessee/Oak Ridge National Laboratory. Designed to accept calibrated input, suggest monitoring strategies, and evaluate management alternatives, this approach uses integrated simulation models of major trophic groups along with monitoring programs that include broad-scale landscape characterization, water quality and quantity measures, and natural resources (e.g., wading bird populations, fisheries, snail kites, vegetation communities, and contaminants in air, water, sediments, and biota).

Modeling and monitoring, along with research, are part of the adaptive management process--the repeated use of models, research, and monitoring to revise, improve, and fine tune management procedures.

Structures V. No Structures: Potential hydrologic solutions to south Florida's water control structures, including canals and levees, or 2) add more structures/modify existing structures to approximate natural hydrologic conditions despite constraints imposed by wetland and upland losses.

Removing structures would reestablish natural patterns of wetland continuity, sheet flow, and animal movements, as well as reduce conduits for introduced species and pollutants. However, current reduced water storage capacity and recharge may make restoration to pre-drainage flow rates, timing, and spatial patterns impossible.

Option 2--modifying and/or adding to existing water control structures--provides the flexibility with which to adjust water management operations in response to system needs (adaptive management). However, adding structures also may have undesirable effects, unless innovative designs reduce negative long-term impacts on the restoration process. Determining the most appropriate approach will have to be on a case-by-case basis, taking into account ecological costs and benefits.

ESTABLISHING A RESTORATION DIRECTION

As previously stated, the over-arching intent is restoration of pre-drainage, landscape scale hydrology and ecology re-establishing ecosystem integrity and sustainable biodiversity: a healthy, sustainable ecosystem that has room for human activities.

ACHIEVING RESTORATION

- Maximize the system's spatial extent and landscape heterogeneity to recover ecological structure and function. Prevent further wetland loss, recover undeveloped degraded wetlands, and restore landscape elements lost to development.

- Re-establish natural hydrologic structure and function through the restoration of: 1) sheet flow; 2) strong hydrologic linkages between areas; 3) natural dynamic water

storage capacity; 4) natural relationship of ground and surface water levels, as well as water flow with rainfall; 5) natural quantity, timing, location, and quality of freshwater flow throughout the system and into estuaries.

- Gradually decompartmentalize the Water Conservation Areas (WCA) to reinstate sheet flow from WCA1 through WCA3, perhaps making water movement from Lake Okeechobee to the WCAs easier.

- Recover threatened and endangered species.

- Restore natural biological diversity.

- Re-establish natural vegetation and periphyton communities spatially and compositionally.

- Strive to evolve an EAA agriculture allowing EAA to function hydrologically as the area did in the pre-drainage system, providing delayed release of wet season rainfall from Lake Okeechobee to downstream natural areas.

- Promote water conservation and water reuse in urban and agricultural areas.

- Restore natural rates of ecosystem productivity.

- Re-establish sustainable breeding wading bird populations and colonies.

- Halt and reverse the invasion of exotic plants and animals.

- Prevent point and non-point airborne or waterborne pollution (contaminants, excessive nutrients, and thermal pollutants).

- Re-establish the corridors for movement, dispersion, and interactions among vegetation and animals.

- Increase the hard coral cover on Florida Keys reefs.

- Restore natural estuarine and coastal productivity and fisheries, and natural seagrass communities.

- Link agricultural and urban growth management with ecosystem management.

- Restore a natural system that is self-maintaining with little human intervention.

- Implement best urban and agricultural management to improve water quality and reduce water consumption.

- Restore the sustainability of human and natural systems supporting cities, farms, and industries in an environment characterized by clean air, clean water and abundant natural resources.

CONCEPTUAL FOUNDATION OF RESTORATION

The conceptual foundation of the restoration effort should be as follows:

- The fact that spatial extent is a critical aspect of the south Florida ecosystem indicates the need to reverse the trend toward incremental loss of natural areas and compartmentalization of the remaining systems. Fragmentation results in erosion of biodiversity and must be corrected by restoring connections between biotic communities.

- Water is life. Without it, the ecosystem fails to function. The importance of hydrology to the annual pulse of wet and dry cycles as well as to random disturbances of those cycles mandates the development of rainfall-based water delivery plans with built-in dynamic storage and delays. The plans should provide formulas derived from present and future NSMs that will: 1) restore pre-drainage sheet flow volumes and distributions in time and space; 2) restore pre-drainage depth patterns, and 3) mimic pre-drainage hydroperiods, including extended periods of flooding.

- The role of drought and fire in maintaining ecosystem heterogeneity suggests the importance of allowing environmental fluctuations and extremes to occur as they would have naturally.

- Recognition of the damage caused by nutrients, contaminants, and other materials introduced into this fragile ecosystem demands their significant reduction or elimination from the airsheds and watersheds of the ecosystem to below-detrimental levels.

- The role of spatial salinity gradients in sustaining nursery and other supportive habitat in coastal wetlands and estuaries requires creation of more natural volume, timing, and locations of freshwater inflows to restore the historic salinity structure.

- Altered water depths and hydroperiods, as well as water quality have given the edge to introduced species; natural hydroperiods and water depths need to be reestablished and water quality improved to control such species.

- The relationship between ground and surface water necessitates that water table levels be raised to restore more natural flows to wetlands and estuaries.

- The pre-drainage role of sheet flows in structuring and integrating the physical and biotic landscape makes it imperative to reestablish sheet flow conveyance on the system's historic north-south gradient. This must emanate from the top down and be massive enough to restore historic water volume transport in time and space.

- Soil subsidence has diminished the natural hydrologic system, including the dynamic storage and hydraulic head provided by the former soils and their associated marshes. This function needs to be engineered in the short term, but in the long term may be reinstated as conditions are created to promote the accretion of organic soils.

- Agriculture in the Everglades Agriculture Area (EAA) is not sustainable as currently practiced due to organic soil oxidation (Snyder and Davidson 1994). However, urban development would be a poor alternative land use, as well as a poor use of resources required to maintain drainage in what is, in effect, the middle of the basin. Restoration efforts must strive to develop a productive EAA agriculture that halts soil subsidence and contributes to ecological restoration.

- Agricultural practices decreasing airborne and waterborne export of nutrients and contaminants need to be encouraged (e.g., use of native rangeland instead of improved pasture, water tolerant strains of sugar cane, organic farming, and sterile cultivars of ornamental non-native species).

- Urban water consumption and contamination of ground and surface waters diminishes available clean water. Water conservation and improved techniques for treating and reusing urban waste water and storm water runoff need to be encouraged.

- Areas serving the ecosystem need to be retained in setting boundaries influencing restoration. Rather than degrade functioning systems, degraded ones need to be improved.

REGIONAL RESTORATION SUCCESS CRITERIA

Sustainability--balance between environmental needs and the needs of human communities--is the criteria against which projects associated with ecosystem restoration will be measured. It is a criteria that will be considered in all evaluations of proposed policy, planning and design alternatives. Essentially, sustainability will be the criteria against which any ecosystem management proposal is evaluated before it is approved to be carried out, as well as the criteria against which it will be tested to measure its continuing success.

Basically, the criteria of sustainability has two components: workability and longevity. If a proposal is sustainable, it will: a) work according to the best scientific, social, engineering and budgetary definitions, as well as b) demonstrate the flexibility necessary to accommodate predicted and unknown demands. Its workability and longevity will be measured by a range of indicators, among them:

- Scientific analysis
- Engineering analysis
- Cost benefit analysis
- Analysis of system's capacity to accommodate changing demands
- Lifecycle costs

The great challenge of achieving sustainability for the natural components of the ecosystem is the reestablishment of a healthy, functioning natural system overall, rather than the reestablishment of any one species at its level of sustainability. However, certain fish and wading bird species are used here to measure ecosystem restoration success because holistic indices are more difficult to acquire. I]sing indicators such as these, south Florida ecosystem management partners are examining the actions needed to restore a sustainable natural environment.

- Reinstatement of natural hydroperiods and sheet flow, as approximated by natural system models.
- Re-establishment of pre-drainage wading bird nesting colony locations and timing of~ nesting.
- No further wetland losses.
- Restoration of degraded wetlands.
- Wetland use permits require enhanced hydrologic connectivity, water quality, and water storage.
- Improved recruitment of fishery and non-fishery species in estuaries.
- Increased fish abundance and species recovery in pre-disturbance locations.
- Reduction in body burdens of mercury large-mouth bass, alligators, panthers, and other top carnivores.
- Elimination of organic soils subsidence.
- Contaminant reduction in canal surface sediments at locations monitored by SFWMD.
- Increased native landscape diversity and faunal diversity.
- Reestablishment of lost vegetative landscapes.
- Reduced numbers of deformed fish in estuaries.
- Nutrient-tolerant plants reduced or eliminated.
- Exotic plants or animals reduced or eliminated.
- Periphyton community taxonomic composition characteristic of oligotrophic, natural hydroperiods.
- Increased populations of threatened and endangered species.

- Increased seagrass cover.

An equal number of factors must be outlined to achieve desired objectives for the developed human environment in South Florida, and much of the work of the Governor's Commission and the Interagency Task Force will involve defining these criteria further in the coming year. Attention to both the natural and human components of ecosystem management are critical if we are once again to integrate the human and natural environment, a delicate balance that history, culture and other factors have altered, thus necessitating present efforts. Indeed, all proposals for human and natural environments have to be evaluated against workability and longevity to see if any are sustainable.

GOALS OF EVALUATION PROCESS FOR SUCCESSFUL RESTORATION

Restoring south Florida's ecosystem depends on agencies' ability to sustain long-term, effective, coordinated actions. Success needs to be evaluated in terms of the entire ecosystem. The evaluation process needs to:

- Assess Task Force effectiveness and individual agency actions in restoring the south Florida ecosystem;

- Provide information that is suitable and sufficient for making management decisions about future actions; and

- Provide information that enables the public to judge ecosystem restoration success.

REQUIREMENTS FOR ANNUAL EVALUATION PROCESS

To meet these objectives, the Task Force will establish an annual evaluation process:

- Providing a reliable basis for federal managers to assess accomplishments and prepare, revise, and execute management plans;

- Having consistent format and standards;

- Addressing the Regional Restoration Success Criteria in the November 15, 1993, Science Subgroup Report;

- Addressing agency-appropriate Sub-Region Success Criteria identified in the Science Subgroup Report;

- Coinciding with annual agency budget preparation;

- Resulting in agency reports to the Task Force that precisely identify the extent of success and describe planned corrective actions coordinated among Task Force agencies; and

- Resulting in an annual report, with executive summary, at the Task Force level, describing agency efforts, accomplishments, and adjustments in management actions necessary to restore and maintain the south Florida ecosystem.

IV. WORKING GROUP ACTIVITIES

During the past year, the Interagency Working Group has been actively engaged in identifying, coordinating, and accelerating implementation of south Florida ecosystem related projects that were already in progress at the inception of the group. It has accomplished this through numerous public meetings bringing people together both formally and informally. Working Group members have been tasked with and have accomplished activities ranging from research to report writing. Among the projects the group has helped expedite are:

- The Army Corps of Engineers Central and South Florida Restudy, which defines problems and opportunities connected with south Florida's interconnected water system.

- The C-111 Project, which addresses mod)fications of the South Dade County Conveyance Canal System intended to restore more natural hydrologic conditions in Taylor Slough.

- The Kissimmee ground breaking that should lead to restoration of natural wetland habitat in a large part of the floodplain.

- L-67 de-grading, intended to restore more natural hydrologic conditions in Shark River Slough.

- The Florida Bay Science Plan, a comprehensive state-federal research and monitoring strategy for Florida Bay.

V. WORKING GROUP RECOMMENDATIONS

The Working Group has completed this report it was assigned to provide to the Task Force. Expanding on the priorities approved by the Task Force at its inception in September 1993, the Working Group makes the following individual recommendations that it strongly feels must be addressed in order to approach ecosystem restoration for south Florida. We intend to proceed with those the Working Group has appointed itself to carry out. We are recommending the Interagency Task Force follow through with those it is responsible for and establish priorities among them. Also, we are recommending similar action with those recommendations assigned to specific agencies. (Note: The letters [A.] do not correlate to the lettering of the appendices since many recommendations are referenced in more that one appendix, as noted in each recommendation.)

SUSTAINABILITY

The following recommendations focus on sustainability, which is the primary criteria against which successful ecosystem management is measured--the establishment of a sustainable system that balances biodiversity and human activities. To accomplish sustainability, the Working Group recommends actions that will draw together the major participants in united action. For additional background on these issues, see Appendices B and M.

1. Establish 1) a multi-agency federal initiative to assist and complement state or regional sustainable development studies; and 2) an IWG federal advisory group composed of industry, municipalities, agencies, environmental organizations, and others. (Lead--Office of Coastal Zone Management, NOAA; ITF Executive Director)

To encourage a basis for common understanding among federal, state and local policy makers, the initiative would include:

- Projections of future land, water and resource bases, as well as land uses (urban, residential, and agricultural) as these pertain to population growth projected for 2010, 2030, and 2050;

- A comprehensive inventory of economic development (residential and industrial) in south Florida, resulting in a list of industries, with their financial contribution, their environmental impacts, and their societal importance;

- A method whereby federal, tribal, state and local agencies may assess the economic, social, and environmental consequences of proposals to restore the Everglades, as well as the consequences of not adopting them; and

- Identification of possible policy or legislative options (e.g., tax incentives, regulatory program changes) encouraging sustainability.

To carry out the second part of this recommendation, the establishment of the IWG advisory group; the Interagency Task Force executive director would need to acquire the necessary approvals pursuant to the Federal Advisory Committee Act (FACA).

2. Engage state agencies (FG&FWFC, SFWMD, FDEP) in restoration efforts. (Lead--ITF)

An enormous base of expertise exists within institutions engaged in south Florida research modeling and monitoring, expertise that needs to be recognized, coordinated, and integrated into federal efforts. The Task Force should embark immediately upon engaging these agencies as partners in south Florida's ecosystem restoration.

AGENCY COORDINATION

To implement ecosystem restoration, federal agencies not only have to work together with partners but also to direct their united efforts beyond their own boundaries to keep the public fully informed of developments as they occur. This group of recommendations aims to increase communication among federal and non-federal groups as well as the public. For additional background on these issues see Appendices C, E and L.

1. Assign responsibility for interagency coordination to several groups, including Management, Science, and Projects sub-groups, also adding an information/education sub-group. (Lead--IWG)

IWG members will work together to resolve communication, coordination, or differing agency positions at their level, bringing issues that require higher level policy review to the attention of agency superiors.

2. Actively participate with the Governor's Commission on a Sustainable South Florida to ensure compatibility of water supply issues with development and growth management; and coordinate with the South Florida Water Management District (SFWMD) to ensure compatibility of Lower East Coast Water Supply Plan with restoration efforts, as well as to adopt more efficient municipal and industrial water use. (Lead--IWG, Corps)

3. Establish a public information and education sub-group, which would: 1)establish a mechanism to provide timely information via media and others to south Florida cultural groups; 2) inventory and coordinate existing educational activities and sponsor new outreach efforts; and 3) adopt standard operating procedures for public meetings. (Lead--IWG, Public Information and Education Sub-group)

The Public Information and Education Sub-group, comprised of member agencies' public information specialists, would meet periodically with their counterparts in other agencies to coordinate activities on specific restoration endeavors. The mechanism they develop to provide the public with information would include:

- A list of interested parties and media through which to communicate, such as publicnotices, special mailings, newsletters, and electronic bulletin boards with access to documents under consideration by IWG;

- Information presented in various languages and disseminated in various ways (speeches, exhibits, brochures); and

- Research on public perceptions of restoration, environmental activities, and possible support of these activities.

Public education with an ecosystem focus includes information on ecosystem structure, wetlands, water quality, water supply conservation measures, and ground water protection. The IWG, through the Public Information and Education Sub-group, would 1) conduct and maintain an inventory of on-going federal, state and local educational activities; 2) help increase coordination in the content, presentation and distribution of educational efforts; 3) suggest modification of existing efforts to include restoration-related information; 4) identify and sponsor new educational efforts; and 5) help incorporate the education program into local efforts, which might require establishing a speakers bureau within the IWG.

Adopting standard operating procedures for public meetings and document publication would provide the public with a reliable process for their involvement. Such considerations might include: minimum amount of notice time prior to meetings; method of notice distribution; meeting agenda/format; publication of results; and provisions for reaching various cultural groups. The procedures would be drafted by representatives from federal, state and local agencies, various interest groups and the general public.

EXPEDITING RESTORATION

This category includes research and data collection approaches to expediting restoration. For additional background on these issues see Appendices D and M.

1. Implement a research program defining the correlation between water management and ecosystem health, and including a detailed description of the science required to support restoration. Workshops would be conducted to assess monitoring needs and capabilities; adopt quality control procedures; and coordinate efforts. (Lead--Science Sub-Group)

The South Florida Task Force, through its Science Sub-group, in conjunction with state and regional agencies, will oversee and coordinate the south Florida ecosystem's restoration research, avoiding duplication and identifying areas needing additional investigation.

2. Identify ongoing data collection efforts and gaps, and recommend data format and exchange methods. (Lead--Science Sub-group)

3. Establish interagency project teams for each of the major Corps environmental restoration projects. (Lead--Corps of Engineers)

Interagency project teams will provide the Corps with input regarding project objectives, alternative plan formulation and evaluation, and project design and construction. Periodic team meetings and updates should be held throughout project planning, design, and construction, with participation, when appropriate, of Department of Agriculture and Department of Transportation agencies.

WATER QUALITY AND SUPPLY

One of the keys to ecosystem restoration is water quality and supply. These recommendations focus on water management from this perspective, emphasizing new ways to re-use water, encourage its conservation, and move it effectively from one part of the system to another. For additional background on these issues, see Appendices E, F, and M.

1. Restore more historic volume, timing, and location of freshwater flow to Everglades, Florida Bay, Biscayne Bay, and other bodies. (Lead--Corps, with coordination and cooperation of all federal agencies and SFWMD)

2. Encourage water conservation and re-use. (Lead--EPA and SFWMD)

SFWMD, with the cooperation of all federal agencies, will encourage such approaches as use of nutrient-enriched waters for golf courses and agricultural lands; bricks or other devices in toilets; and more efficient, water-saving shower heads; plus establishment of water supply reserves.

3. Perform studies to reclaim waste water, and to redirect stormwater from western Dade, Broward, and Palm Beach Counties inland rather than toward the coast. (Lead--Corps, with USGS).

Using GIS and other tools, prepare countywide comprehensive plans for the reuse of treated wastewater in such areas as golf courses, county parks and the lands around public buildings. Conduct waste water reuse pilot studies on different substrate, including rock land of south Dade County, and examine the effects of waste water reuse on water quality in associated ground and surface waters. Also determine the economic and ecological impacts/costs of redirecting some stormwater runoff inland to proposed catchment areas.

4. Use hydrologic models to test various landscape scenarios on undeveloped lands for their effect on supply and management flexibility. (Lead--USGS)

5. Study feasibility of reducing trihalomethane formation in drinking water through water management to reduce organic carbon content of surface and seepage water recharging the Biscayne aquifer. (Lead--EPA and DEP)

6. Develop a water budget for south Florida. (Lead--Corps, with USGS and SFWMD)

Accomplish this through authorization for a feasibility study.

7. Determine water quality status throughout the system and use a monitoring program to determine constituent loads. (Lead--USGS, NBS, NPS, Corps, NOAA, EPA)

8. Seek authority under Clean Water Act to regulate all nonpoint sources of pollution in south Florida, and to provide up-front matching funds to local governments for nonpoint pollution abatement, including authority to recover costs from polluters. (Lead--EPA)

9. Determine critical pollutant numeric threshold levels adequate for native flora and fauna preservation. (Lead--NPS, NBS, USFWS, EPA)

10. Determine sources, mechanisms, and environmental conditions resulting in biological accumulation of mercury and take appropriate remedial action. (Lead--EPA, NPS, USGS, NBS, USFWS, NOAA, State of Florida)

11. Investigate the biological hazards posed by other contaminants routinely applied in south Florida and take remedial actions as warranted. (Lead--EPA)

Florida's sandy soils and highly permeable substrate make pesticide contamination a particular concern with regard to protection of aquatic life and drinking water quality. Several massive mortalities of fish and other aquatic life have been reported in association with heavy rains shortly after the application of Nemacur (active ingredient fenamiphos) to golf courses.

12. Identify and ensure numeric standards are in place for key pollutants in ecosystem waterbodies. (Lead--EPA)

WETLAND PERMITTING AND MITIGATION STRATEGY

The way wetland permitting and mitigation are carried out will have a significant impact on ecosystem restoration in south Florida. The following recommendations should help ensure wetland protection as part of the restoration effort. For additional background on this issue, see Appendix G.

1. Develop a South Florida Ecosystem Wetland Conservation Plan by September 1996, including completion of the 5 tasks identified under Appendix G.(Lead--Corps, EPA, FWS, NRCS)

2. Require an annual report to be submitted by the Interagency Working Group to the Task Force that summarizes the effect of the federal 404 wetland fill permitting program on the south Florida environment. This report will contain

information by county for the number of permit applications received (for individual and general permits, including nationwide permits), number of permits modified prior to approval, number of permits approved, number of permits denied, number of veto actions, wetland acreage filled in original application and in approved permit, and mitigation required. (Lead--Corps, FWS, EPA, NRCS)

3. **Develop and maintain a wetland permitting information database that facilitates completion of these reports as well as ongoing efforts to assess the cumulative effects of the wetland permitting program on the goal of south Florida ecosystem restoration and the region's remaining natural resource base. (Lead --Corps, EPA, FWS, NRCS)**

4. **Integrate the federal wetland permitting program with ongoing federal planning activities and ongoing county comprehensive planning programs. (Lead--Corps,EPA, FWS, NRCS)**

5. **Form a Wetland Interagency Coordination Group (WICG) that meets regularly to ensure that wetland regulatory, permitting and planning activities are proceeding on a timely basis; discuss and resolve emerging permitting and ecosystem restoration issues; and discuss pending permit applications. This would cut review time, reduce correspondence, and lead to increased uniformity and consensus. (Lead--Corps, EPA, FWS, NMFS, NRCS)**

6. **Identify wetlands of particular ecological significance (critical areas). Their functionality should be assessed in a manner that incorporates a holistic consideration of the functions that the particular wetland (and upland) provides to the greater ecosystem. These assessments and identification of critical areas must be performed in a coordinated manner by the federal agencies involved in permitting processes. (Lead--Corps, EPA, FWS, NRCS)**

7. **Increase emphasis on wetland enforcement and on permit compliance to ensure that the wetland regulatory program and mitigation requirements are providing projected benefits. Expand funding of contracts for monitoring and compliance to ensure that mitigation is providing projected benefits. (Lead--Corps, EPA, FWS, NRCS)**

8. **If appropriate, Corps may deny a permit or EPA initiate a 404(c) action to avoid wetland loss or irrevocable changes to a particular area so that restoration initiatives are not precluded. (Lead--Corps, EPA)**

9. **Invite local governments to evaluate any programs they have that match the current federal ones and invite them to submit delegation ideas. (Lead--Corps)**

10. **Increase the south Florida presence of agencies with limited or no local satellite offices by increasing travel funds, co-location of offices, or relocating personnel to south Florida. (Lead--IWG)**

11. **Develop a uniform wetland assessment approach that produces consistent assessments of wetland functions and filling impacts. (Lead--Wetlands Interagency Coordination Group (WICG])**

12. **Identify specific critical areas that require watershed management plans and recommend priorities. (Lead--WICG)**

13. **Prepare and update master map of activity along urban-natural edge, including permits, restoration projects, and planning efforts. (Lead--FWS)**

14. **Evaluate potential conflicts between proposed development projects and the recommended restoration projects contained within this plan. If appropriate, initiate an EIS if there is a conflict in an identified critical area. (Lead--WICG)**

15. **Expedite completion of Advanced Identification of Disposal Area projects (ADIDs). (Lead--EPA)**

16. **Invite state and local agencies to present their comprehensive plans to the group and provide a formal opportunity to comment (or provide information on federal efforts) on the plans. These comments would be coordinated with the other entities of the Interagency Working Group. (Lead--WICG)**

17. **Encourage establishment of mitigation banks through new legislative authority to provide seed money or loan guarantees and through expedited review of bank applications. (Lead--ITF, in coordination with the federal/state review process)**

18. **Seek legislative authority to return fines and fees collected during the regulatory process back to the restoration effort. Ensure that these funds are used to achieve wetland conservation or preservation goals. (Lead--ITF, Corps)**

HABITAT RESTORATION--EXOTIC PLANTS AND ANIMALS

The introduction of exotic flora and fauna have contributed to the decrease of native communities. The following recommendations are aimed at controlling exotics in the south Florida ecosystem. For additional background on this issue, see Appendices H and M.

1. **Assign a representative(s) of the Working Group or Science sub-Group to the Federal Interdepartmental Committee for the Management of Noxious Exotic Weeds; help organize a similar interagency group to coordinate and integrate research and management of nonindigenous animals. Integrate efforts with state, local and non-government entities.**

2. **Establish separate working groups for plants and animals to develop comprehensive multi-species management plans for control of invasive or otherwise harmful nonindigenous species. (Lead--Departments of Interior and Agriculture)**

Include state and county entities and assign responsibilities to specific agencies and individuals at all government levels. Adopt the Exotic Pest Plant Council's current list to identify invasive plant species recognized as problems. Determine the magnitude of infestation and the relative threat to natural areas to help prioritize critical target areas and species for eradication efforts. Encourage and assist the coordination of programs and management efforts, as well as the sharing of information on eradication techniques. Provide region-wide perspective for addressing issues. Assist with funding and incentive programs.

3. Provide funding for increased research to prevent, halt, or reverse invasions by nonnative species. (Lead--Corps, NBS, NPS)

With respect to plants, more work is needed on (1) biological control agents, (2) factors that affect the invasibility of natural areas, (3) environmental requirements and phenology of particular problem species as these relate to their vulnerability to specific controlled burning or water management regimes, and (4) habitat restoration strategies to control re-invasion by non-indigenous species after their removal. With respect to animals, research is needed on how nonindigenous species reproducing in the wild have impacted food webs, community structure, and populations of species in natural areas in which they have become established.

For both animals and plants, research is needed to develop methods of screening and risk assessment to prioritize efforts at all stages of control (importation, distribution, eradication). Developing effective criteria for identifying and screening potentially invasive exotics before they become well established will help to focus preventive efforts.

Coordinate through the Science Sub-group the use of research findings to support management and operational procedures.

4. Fully fund the Melaleuca Biological Control Quarantine Facility and biological control investigations and continued eradication efforts by federal, tribal, state, and local agencies for melaleuca, brazilian pepper, and other high priority problem species. (Lead--Corps, DOA/ARS)

Funds could be raised through user and recreational fees.

5. Promote development of organized, holistic control strategies to protect natural areas that emphasize prevention of invasions by nonindigenous species. (Lead--FWS, ARS)

Target the three stages of introduction: importation, propagation. and distribution. Preventive efforts might include import restrictions, local planting ordinances, and public education. Implement the recommendations in OTA (1993) that address the problem of potentially invasive new imports of both plants and animals. Consider proposing new legislation and/or lengthening the list of species prohibited from importation under the Lacey Act (Lead--FWS).

6. Require the use of native species for all landscaping of federal property, including federal buildings, prohibit the planting of invasive nonindigenous species on public lands, and institute vigorous control actions against existing stands. (Lead--ITF)

Adopt the Exotic Pest Plant Council's list for prohibition and eradication. Develop policy requirements prohibiting the use of invasive nonindigenous species for landscaping federally funded projects such as highways and greenbelts. Urge that state and local governments act similarly. Urge state, local, and non-government groups to use native vegetation, rather than drought- tolerant non-native species, in xeriscape programs.

7. Identify existing monitoring programs and ensure they are complementary, not duplicative. (Lead--FWS, NBS, NPS)

Ensure that basic variables are defined and measured the same way so that data can be analyzed across areas, not just locally. Support the activities of the COVER Group (Colloqui of Vegetation Everglades Research). Develop a computerized atlas of ongoing monitoring programs.

8. Reallocate existing funding or testify for appropriation of additional funding to support a multi-pronged approach to controlling harmful nonindigenous species. (Lead--FWS)

Emphasize non-aquatic species to close the gap in control efforts between aquatic and non-aquatic species.

9. Document the present nature and extent of invasion of south Florida's natural areas by non-native plant species and prepare a summary report. (Lead--NBS)

Quantify and map invasions of selected areas, prioritized according to representativeness, sensitivity, or special concerns. Use the resulting report to prepare brochures and to prioritize critical target areas. Coordinate with the Florida DEP effort and the COVER group.

10. Design and implement public education and training programs. (Lead--FWS)

Raising public awareness of the role of invasive nonindigenous species in south Florida's ecosystem degradation is integral to effective solutions. Certification training classes should be developed for workers involved with screening imports or enforcing ordinances. Landowners should be encouraged to remove exotic pest plants and replant with natives.

11. Establish a horticultural program to develop sterile cultivars of popular and widely used but invasive non-native ornamental plants, such as certain flowering trees and Ficus species. (Lead--Department of Agriculture)

12. Encourage and support the inclusion of nonindigenous species eradication efforts in mitigation and compensation plans. (Lead--USFWS)

HABITAT RESTORATION AND RECOVERY PLAN-- NATIVE FLORA AND FAUNA

Controlling or eradicating exotic plants and animals are not enough. Protection of native flora and fauna also requires strong directive actions. Many species within the region are declining: there are 56 federally listed threatened or endangered species and 29 candidate species. Because of the importance of habitat to survival, a major focus should be protection and enhancement. Emphasis on habitat dictates a multi-species approach, that will not only be more effective, but will provide better orientation toward whole ecosystem restoration than single-species management. For additional background on these issues, see Appendices I, J, and M.

1. Identify all federally listed threatened and endangered species; then refine the list to exclude those with limited distribution in south Florida. (Lead--FWS)

Review the project boundaries established by the Task Force and list threatened and endangered species within those boundaries.

2. Map species distribution and key habitat associations, as well as land use classification, master plan designations, and land ownerships. (Lead--FWS, NBS)

Compare species' spatial distribution with public land use maps, integrating species information with land use classification, master plan designations, and ownership. Identify gaps in habitat protected under public ownership or restricted land use categories. Develop strategies to protect poorly covered species.

3. Develop a team of individuals representing involved agencies and land managers to help develop a multi-species recovery report. (Lead--FWS)

4. Establish a south Florida ecosystem endangered species coordinator. (Lead--FWS)

The coordinator will serve as the central contact for endangered species recovery issues of the ecosystem.

5. Develop multi-species strategies and long-term goals, including analysis of ongoing recovery efforts. (Lead--FWS)

Review on-going actions to determine if they can be combined to benefit multiple species (e.g. combining snail kite and wood stork surveys with annual surveys for wading birds). Develop recovery goals that identify essential research and management actions, focusing on improving coordination among managers. Identify specific lands important to recovery efforts and take actions toward land protection and/or land management (e.g.,

prescribed burning or water management for improved hydroperiods or improved water quality).

6. Conduct research aimed at restoring the structure of native floral and faunal communities. (Lead--FWS, NBS)

Research must: 1) assess status and trends of wildlife populations and habitat resources such as vegetative communities, periphyton, and coral reefs, and 2) identify and understand effects on natural community structure and productivity of major influencing factors (e.g., nutrients, mercury, pesticides, habitat alteration, hydrologic alterations, and global change). Research on threatened and endangered species must: 1) identify species "on the brink" of listed species status; 2) determine the ecological requirements for species recovery, especially considering interaction with other native flora and fauna (using GIS based, integrated, multi-species approach); 3) assess status and trends of all threatened and endangered species, and ongoing interactions with other native flora and fauna (also using GIS-based, integrated, multi-species approach).

7. Initiate projects to improve habitat. (Lead--FWS)

These may include: 1) adding or removing water control structures; 2) changing hydrologic operational criteria; or 3) implementing management actions involving control of exotic plants, fire, or grazing, as well as establishment of sanctuary areas. Highest priority should be given to increasing spatial extent of wetlands or sheet flow, or returning the natural habitat heterogeneity of wetlands.

8. Predict and assess various water management alternatives using adaptive management processes. Develop models to assess restoration alternatives. (Lead--NBS)

9. Research and identify spatial thresholds that relate wildlife population dynamics to conditions of water and vegetation patterns. Determine the response of vegetative habitats to improved spatial and temporal water conditions. (Lead--NBS)

Support research: 1) relating forage fish and invertebrate population dynamics to conditions of water depth, timing, and duration over the habitat mosaics of south Florida's ecosystem; 2) relating habitat conditions (hydroperiods, hydropatterns, water depth, forage base dynamics, and vegetation patterns) to wading bird abundance, distribution, and reproductive success; and 3) relating spatial extent of the ecosystem to the sustainability of viable populations of wading birds and their forage base (including relationship of spatial thresholds and water condition constraints to sustained reproductive success of the wading birds and their associated prey).

10. Determine recovery potential of habitats impacted by excessive nutrients, and determine thresholds for undesirable conversions. (Lead--NBS)

11. Initiate and sustain routine system-wide monitoring of wading bird populations, as well as incorporate critical needs criteria for wading birds into permitting process. (Lead--FWS, NBS)

Integrate systematic reconnaissance flights (SRF) and SFWMD efforts and expand to cover entire ecosystem. (Lead--NBS)

12. Establish ecosystem-wide databases of contacts, jurisdiction and authorities, and GIS-based spatial data. (Lead--USGS)

These data bases will include: 1) a list of contact points, agencies, and organizations involved in habitat management throughout the ecosystem; 2) a summary of agency jurisdiction and authorities over large tracts of natural areas; and 3) a GIS-based system for compiling, organizing, and managing spatial data.

13. Restore the Richmond federal pineland and adjacent properties. (Lead--FWS)

Support the Dade County Park and Recreation Department in their FEMA funding request to restore the Richmond federal pineland properties, as well as adjacent county- and University of Miami-owned pineland and Navy Wells properties.

14. Restore natural fire regimes (including prescribed burns) and develop educational material on the role of fire. (Lead--NBS)

15. Use disturbed sites (levees, abandoned railroad right- of-ways, and power line right-of-ways) to develop wildlife corridors; and require use of native plant species in greenways. (Lead--FWS and NPS)

Encourage, plant, and maintain native vegetation appropriate to the soil, microclimate, hydrologic conditions, and nearby native plant communities. Also, require that projects qualify for federal funding only if landscaped with native plant species and/or if existing native vegetation is not destroyed.

16. Enforce laws and develop educational materials to prevent human disturbance of rookeries, nesting areas, and den sites. (Lead--FWS)

HABITAT RESTORATION--NEAR COASTAL WATERS

To be successful, habitat restoration and recovery must include provisions to restore the effectiveness of near coastal waters. These suggested provisions follow. For additional background on these issues, see Appendix K.

1. Identify gaps in existing programs consistent with objectives identified for ecosystem restoration. (Lead--NOAA)

The first step to habitat restoration and recovery is identifying federal, state and local programs consistent with south Florida's ecosystem restoration strategy. The next step is identifying the "gaps" as they apply to the following areas:

Habitat Restoration: The following projects will help restore and sustain healthy ecosystem conditions encouraging natural processes, functions, and cycles to continue or be re-established:

- Initiate the Central and Southern Florida (C&SF) Project Restudy feasibility phase to aid in long-term strategic identification of portions of the ecosystem where hydrological restoration can occur, taking into consideration potential adverse impacts to all coastal ecosystems from manipulating the flood control system;

- Initiate construction on the C-111 environmental restoration project to provide more freshwater into Taylor Slough;

- Purchase lands identified in the Everglades Forever Bill and expedite restoration necessary to prepare the land for hydrological use;

- Implement the Lower East Coast Water Supply Plan;

- Maximize restoration of water flow under US 1 along the 18 mile stretch proposed for widening, including mitigation projects proposed by the Florida Department of Transportation (e.g. filling in canals, restoring habitats, and installing culverts);

- Remove the old US 1 bridges in the Keys that impede water circulation between Florida Bay, the Gulf, and the Atlantic Ocean (the new replacement bridges, built after DOT widened US 1, are supported by smaller pilings that don't impede ebb and flood tidal cycles like the older bridges);

- Continue Coastal America projects such as those used to install mooring buoys to protect critical habitats;

- Implement NOAA's damage restoration plan for coral reefs impacted by ship and small vessel groundings;

- Expand NOAA's seagrass restoration project at a site damaged by prop-wash deflectors; and

- Remove old fill areas that impede water circulation along shorelines and between embayments.

Water Quality Management: At a minimum, several Keys projects addressing water quality must be implemented:

- The Water Quality Protection Program (WQPP) for the FKNMS, with implementation to address deterioration of water quality in Florida Bay, eutrophication of near-shore

waters, sources of nutrients entering the near-shore waters of the Keys, and stormwater run-off;

- Point source discharge permit programs;
- Identification of non-point discharge sources, along with implementation of management/grant programs;
- Stormwater treatment programs;
- Enforcement of septic tank regulations;
- Identification and removal of illegal cess pits;
- Installation of marina pump-out facilities;
- On-site Sewage Disposal System Demonstration projects;
- Alternative Waste Water Treatment demonstration projects;
- Study of the Key West Sewage outfall plume; and
- Local existing water quality management plans for specific water bodies.

Species/Habitat Management: Managing use of natural resources (commercial, sport fisheries, and others) to maintain sustainable populations depends on coordination among involved state and federal agencies, as well as increased focus on such permit programs as point source discharge and dredge/fill. What follows is a partial list of habitat management plans and actions for the Florida Keys and the coral reef-community that must be implemented to ensure management of natural resources for sustainable populations:

- Monroe County's land use plan;
- Proposed marine zoning plan (FKNMS);
- Protection of significant habitats (e.g., seagrasses, hard bottoms, coral reefs) from direct impacts (FKNMS DEIS/MP);
- Management action plans contained in the DEIS/MP for the FKNMS (e.g., channel marking plan, mooring buoy plan, regulatory plan, etc.
- USFWS Backcountry Management Plan and other refuge management plans;
- Dredge and fill permitting program(s);
- Endangered species recovery plans in Keys; and

- agencies' management plans.

Public Education: The education staff of the FKNMS has prepared a directory of the Florida Keys' environmental education programs. The programs that need support are:

- Florida Bay Watch Program, using citizens and various user-groups to monitor water quality in and around the Florida Bay;

- Coral Watch Program, using interested individuals to monitor Florida Keys corals;

- FKNMS' Education Action Plan;

- On-going NPS educational programs;

- On-going FWS education program used on refuges;

- Environmental education plans developed by grass roots, local, state, and federal organizations, using FKNMS' Education Action Plan as a mechanism for coordination; and

- Non-government organizations capable of getting information to the public.

2. Develop programs to expand existing programs and fill in the gaps. (Lead--NOAA)

After existing programs have been integrated and research ascertains specific impacts to the coastal areas, additional management measures will likely be necessary, among them:|

- Use acquired land in the proposed buffer zone for treating upland runoff;

- Identify and prioritize sites suitable for habitat restoration/improvement activities and pursue this under existing programs such as Coastal America or the dredge and fill permitting program (mitigation);

- Enhance enforcement of existing regulations (e.g. septic tank operation, dredge and fill, NPDES, bilge dumping, prop dredging); and

- Implement public education efforts through radio/tv public service announcements, brochures, school curriculum supplements, and speaker's bureau.

3. Identify sources of coastal system degradation through research efforts coordinated with the Science sub-group. (Lead--NOAA and NPS)

LAND-BASED PROTECTION

Restoring the mosaic of land and water also requires land acquisition. Since opportunities to restore special scale and habitat heterogeneity are diminishing as growth

continues, it is critical that south Florida re-examine land use planning and move to preserve critical wetlands that still exist and may be at risk. In many cases this may require the quick acquisition of land that is possible only through the establishment of a South Florida Restoration Land Trust. The federal government needs to work in partnership with state and local governments responsible for land use planning, especially because it influences land use through many of its programs and policies. The importance of land based protection is reflected in the following recommendations. For additional background on these issues, see Appendix L.

1. Establish an ad hoc interagency team. (Lead--NPS)

A land acquisition strategy would be developed by an ad hoc interagency team made up of agencies with land purchasing authority and those interested in preserving natural resources impacted by land use (e.g. Corps, NPS, FWS, SFWMD, NOAA, EPA, local county agencies).

2. Develop a land acquisition strategy (including the feasibility of a Restoration Land Trust) and prioritization criteria. (Lead--ad hoc interagency team)

Tentative elements of the land acquisition strategy include: 1) Addressing relevant issues identified above; 2) Exploring establishment of a South Florida Restoration Land Trust with the following capabilities and benefits:

- Obtaining and holding land acquisition funds;
- Anticipating opportunities and needs for specific land parcels; and
- Streamlining the land acquisition process using avenues available to private developers.

3) Developing criteria with which to establish priorities for:

- Natural resource value of the land;
- Regional water table sensitivity to land development (based on elevation, permeability, etc.);
- Potential usefulness of land to south Florida's overall restoration;
- A buffer between areas of differently managed water levels;
- A flowway for water conveyance;
- Along canals to create littoral zones (on gradual inclined banks);
- Predicting relevant land use changes;

- Mapping organic soil thickness|
- Analyzing master plan alterations/zoning changes; and
- Analyzing permit applications.

SCIENCE PROGRAM

A strong science program is integral to ecosystem restoration. Without it effective decisions could not be made on hydrology, flora and fauna, and all the other aspects critical to restoration that have been expressed in the previous recommendations. A strong science program is recommended here as a critical tool for carrying out all aspects of ecosystem restoration. For additional background on these issues, see Appendix M, as well as other related appendices indicated above.

1. Develop an assessment protocol that helps focus modeling and monitoring activities on predicting and measuring restoration success indicators. In workshop settings, in interaction with model and monitoring planning, define practical and sensitive indicators, starting with the restoration success criteria recommended in the Science Sub-group Report. (Lead--Science Sub-group)

First, select a set of indicators for which sufficient baseline information and understanding is available to support their immediate use. Then propose a second set of potential indicators for which baseline information should be developed to allow their eventual use.

2. Develop a monitoring plan, bringing together in workshop settings the major participants in present and proposed monitoring efforts. (Lead--Science Sub-group)

Conduct special topic workshops, as for instance, the geospatial workshop of September, 1994.

3. Establish groups to model the hydrologic, hydrodynamic, landscape, meteorologic, and ecologic processes of the south Florida restoration area, taking into account existing models. (Lead--Science Sub-group)

The first step will be development of a hydrologic model for the south Florida land base. Existing models will be upgraded and new ones developed for areas not yet covered by hydrologic models. Hydrologic models will provide input for hydro-dynamic models being developed to predict circulation, mixing, and salinity patterns in Florida Bay as a function of freshwater inflow and other variable factors. The set of models will consist of a 3-dimensional model for Florida Bay, quantified for operating in 2 dimensions until sufficient data to support 3-D runs can be obtained, and a regional numerical ocean circulation modeling system that can provide boundary conditions for the Florida Bay model. Ecological models that relate species, populations, communities, and landscapes to the simulation outputs of hydrologic or hydrodynamic models will provide an objective a

prior way to evaluate alternative water management strategies for their influence on the ecosystem.

4. Provide an institutional framework, including a home and consistent funding, for each of the major types of modeling. (Lead--ITF, with advice from Science Subgroup)

Support model development, maintenance, upgrading, and application to assessment and other restoration needs.

5. Upgrade the hydrologic monitoring network to improve present flow estimates and to cover areas presently not covered. (Lead--Science Sub-group, USGS, NPS)

An expansion of the hydrologic monitoring network is needed to provide more complete and accurate data on surface and groundwater flows to estuaries. This information is critical to hydrologic model testing and refinement and to restoration planning and assessment. It will enable more accurate water budgets to be constructed and will provide baseline data from which to evaluate operational changes that affect surface and groundwater flows to Biscayne Bay, Florida Bay, and west coast estuaries.

6. Develop the information base for application of the adaptive management approach, emphasizing the building of understanding and assessment capability. (Lead--Science Sub-group)

Promote research integrated with modeling and monitoring. Emphasize the acquisition of information that can be used in assessment to support the adaptive management strategy.

7. Encourage the developing landscape studies program consisting of modeling, retrospective paleontological studies, trend and gradient analyses, and monitoring. (Science Sub-group, NBS)

Landscape models are needed that simulate vegetation succession as a function of the hydrologic regime and aperiodic events, incorporate land shaping processes such as soil accretion and soil subsidence, can interact with hydrologic models to affect hydrologic processes, and can provide the explicit spatial framework necessary for models of species and communities that are influenced by landscape patterns.

A landscape studies program that includes landscape modeling is underway and needs further support and some reorientation to meet the modeling needs described above. Complementary projects are being carried out at the South Florida Water Management District (ELM) and in a cooperative project by ENP/NBS/ORNL (ATLSS).

Paleontological studies provide retrospective perspectives and complement models that hindcast previously existing conditions.

8. Perform research to develop technology for maintaining current agricultural harvest levels with zero soil subsidence in the Everglades Agricultural Area (EAA). (Lead--Department of Agriculture/ARS)

Such research would help determine: 1) required annual period for maintaining saturated soils; 2) required maximum water table depth during other times; and 3) most water tolerant cultivars of existing crops. Plant breeding and biotechnology would be used to encourage this trait.

Supporting work should evaluate the present C&SF Project for its capability to support on-farm water management for zero-subsidence agriculture, and design modifications to provide this support. Hydrologic models should be used to evaluate the effect of a summer-flooding-based, zero-subsidence agriculture in the EAA and a supportive redesigned C&SF Project on 1) the timing and volume of water released from the EAA to the Water Conservation Areas and 2) seasonal conveyance capacity from Lake Okeechobee through the EAA.

9. Use hydrologic models to test, for their effect on water supply and water management flexibility, various land use scenarios for the undeveloped lands in western Dade, Broward, and Palm Beach Counties east of the Water Conservation Area levees. (Lead--Corps, USGS)

Both local governments and permitting agencies have little perspective on the cumulative effects of land use decisions, particularly as they relate to water. Evaluations of cumulative effects of potential land use changes on water supplies and water management flexibility is needed.

10. Ensure agencies have the authority to address ecosystem-wide issues. (Lead--ITF)

11. Provide continuous funding as an integral part of restoration operations budgets for this multi-year adaptive management effort. (Lead--ITF)

Adaptive management for ecosystem restoration requires continual predictions and feedback from the interactive modeling, monitoring, and research efforts--and thus, continuous funding.

12. Ensure resources to support the planning, coordination, and oversight activities of the Science Sub-group. (Lead--ITF)

APPENDIX A:
INTERAGENCY TASK FORCE WORKING GROUP MEMBERS

David Wesley, State Supervisor
U.S. Fish and Wildlife Service
6620 Southpoint Drive South, Suite 310
Jacksonville, FL 32216
W: 904/232-2580
F: 904/232-2404

Billy Causey, Sanctuary Superintendent
Florida Keys National Marine Sanctuary
P. O. Box 500368
Marathon, FL 33050
W: 305/743-2437
F: 305/743-2357

Ralph Gonzales, Eastern Area Office
Bureau of Indian Affairs
3701 N. Fairfax Drive
Arlington, VA 22201
W: 703/235-2571
F: 703/235-5565

Peter Outerbridge,
Assistant U. S Attorney
U. S. Department of Justice
155 S. Miami Avenue, Suite 600
Miami, FL 33130-1693
W: 305/536-5477
F: 305/530-7139

Col. Terry L. Rice, District Engineer
U. S. Army Corps of Engineers
P. O. Box 4970
Jacksonville, FL 32232
W: 904/232-2241
F: 904/232-2237

John Vecchioli, District Chief
U. S. Geological Survey
227 North Bronough Street, Suite 3015
Tallahassee, FL 32301
W: 904/942-9500, ext. 3011
F: 904/942-9521

Dr. Brad Brown, Director
Southeast Fisheries Center
75 Virginia Beach Drive
Miami, FL 33149
W: 305/361-4284
F: 305/361-4219

Mike McGhee, Water Management Division
U.S. Environmental Protection Agency
345 Courtland St., NE
Atlanta, GA 30365
W: 404/347-4450
F: 404/347-5204

Col. Terrance Salt
Task Force Executive Director
U.S. Department of the Interior
6620 Southpoint Drive South, Suite 310
Jacksonville, FL 32216

Richard G. Ring, Superintendent
Everglades National Park
40001 State Road 9336
Homestead, FL 33034-6733
W: 305/242-7710
F: 305/242-7711

Ron Smola, Area Conservationist
Natural Resources Conservation Service
5700 Lake Worth Road
Lake Worth, FL 33466
W: 407/439-1770
F: 407/433-5233

James Weaver, Director
National Biological Survey
7920 N.W. 71st St.
Gainesville, FL 32606
W: 904/378-8181
F: 904/378-4956

APPENDIX B: SUSTAINABILITY

MAJOR ISSUE

Fundamental to ecosystem restoration and management is the concept of sustainability. It must be the criteria by which any successful restoration effort is measured. The concept recognizes that lasting solutions require a balance between resolving urgent environmental concerns while providing for the essential needs of development and industry--meeting the needs of the present without compromising the ability of future generations to meet their own needs. More specifically, development and economic activity in south Florida must be compatible with attainment of the over-arching goal of south Florida ecosystem restoration and maintenance and the ecosystem must support a healthy south Florida economy. Restoration must proceed within the context of a healthy economic setting.

BACKGROUND

People are attracted to south Florida for many reasons. Some are very conscious of the vast natural, undeveloped areas and routinely enjoy the recreational opportunities they afford. Others choose to live in south Florida because of the mild climate or for family or business interests. Many own undeveloped land which they plan to develop in the future as retirement homes. All are part of a regional economy that is fundamentally based on how the land is used or preserved. In general, economic growth in Florida is synonymous with conversion of undeveloped "useless" land to another use. There is a growing recognition that this "useless" land provides essential benefits to the general public. The challenge is to describe these benefits in relevant terms and then determine the value of those benefits to the general public.

In the past 90 years, the population of Florida has grown dramatically. The advent of the railroad, modern conveniences such as air conditioning, channelization of water flow, and subsequent drainage of wetlands have rendered once uninhabitable areas not only inhabitable but, in concert with the mild climate of south Florida, most desirable.

The setting established by modernization created the nearly ideal conditions for south Florida's two most significant industries, agriculture and tourism. A third key group of regional industries is residential and light commercial development. Many commercial enterprises and retirees are moving to Florida for its quality of life. Florida, particularly in the south, continues to experience rapid growth. In 1945 the population of the 18 counties that encompass the south Florida watershed was about 730,000. In 1990 the population in these same counties was 6.3 million. Concurrent with this population growth has been the conversion of natural lands (uplands and wetlands) within the region to urban, residential, and agricultural land uses. Present estimates of population growth indicate an additional tripling of the human population in south Florida within the next 50 years. The cycle of increasing population requiring increasing commercial development paving the way for new

population increases will repeat and will result in increased demands within the region for water supply, flood control, shelter, transportation, and service needs.

The pressures of this growth on the ecosystem is producing clear signs of severe stress. Loss of wetlands, invasions of non-native species, declines in water quality, increases in the occurrence of ecological events such as marine-based algal blooms, seagrass die-offs, mangrove decline, and coral diseases are a few of the manifestations of ecosystem stress and if not corrected, threaten the economic vitality of key regional economies. The ecosystem cannot sustain current pressures.

Recognition that humans are a part of the south Florida ecosystem is necessary to ecosystem restoration planning. The restored south Florida ecosystem cannot and should not be exactly the same as the system that existed prior to human intervention, because the basic needs of human communities for flood control and water supply must be accommodated.

Managers should not wait until scientific consensus is reached before taking action. Ludwig et al. (1993) cite the California sardine fishery as an example of this danger. The Pacific anchovy harvest plunged from 10 million metric tons per year to near zero following a decision allowing liberal fishing limits and a series of El Nino events. There is still scientific debate over the influence of exploitation versus El Nino events. Throughout south Florida, and particularly in Florida Bay, this same dilemma appears. There are conflicting opinions on the causes of the problems. Managers cannot wait for a complete scientific understanding before taking prudent action. They must instead use the best available information and be willing to accept reasonable risk in their actions.

In south Florida, the challenge is to restore the health and defining characteristics of the regional ecosystem within the context of a vibrant economy. A healthy ecosystem is an essential prerequisite to long-term sustainability of human communities and economic endeavors. Water purification, clean air, and safe edible natural resources such as fish and shellfish are provided by healthy ecosystems. We must develop and apply ecologically friendly methods in agriculture, industry, and other human pursuits so that the health and defining characteristics of the ecosystem are restored and its support functions for human communities are operational. The future growth in south Florida must facilitate the halting and eventual reversal of the varied and widespread symptoms of ecosystem decline. Public and industry officials must embrace a sustainable development approach if the economy and natural resources of south Florida are to thrive over the long term.

OBJECTIVES

The Interagency Working Group proposes four management objectives for sustainable development:

Ensure that any development plans or permits for development are fully coordinated

- among affected governmental agencies and are compatible with restoration of the south Florida ecosystem.

- Ensure that existing development which has an adverse impact reduces or eliminates degradation and that new development does not contribute to degradation.

- Develop and utilize a system-wide integrated mitigation plan, coordinating all levels li' of government, which contributes to overall restoration.

- Ensure that regardless of any future development there is a sufficient land, water and resource base to conduct the required natural resource restoration efforts.

Sustainability in south Florida will require an adaptive, multi-faceted approach focusing on assessments, creative business alternatives, incentives and education. Enduring solutions to economic and environmental problems are only as effective as the commitment of the citizens who are part of that economy and environment. Therefore, public officials should have a long-range view which provides the basis for the pragmatic, sequential actions necessary for success.

APPENDIX C:
COORDINATING AGENCY POSITIONS AND ACTIONS

MAJOR ISSUES

Ecosystem restoration activities are being undertaken by eleven agencies within six federal departments. Numerous other federal agencies are engaged in significant programs or projects in south Florida that have major effects on the success of restoration efforts including: the widening of U.S. Route 1 to the Florida Keys, funded by the Federal Highway Administration, and oil and gas permitting on federal lands and offshore waters by the Bureau of Land Management. In addition, tribal governments and a wide variety of state and local government agencies are actively involved in planning, regulatory activities, and projects that target restoration goals or significantly affect ecosystem conditions. There is a continuous need for the communication and coordination of strategies, plans, funding proposals, project schedules, permit requirements, and program/project evaluations among this~array of agencies' activities to assure a comprehensive effort, avoid duplication, maintain linkage of funding and schedules, resolve differing agency positions, and compare results against overall objectives.

BACKGROUND

There are numerous groups, committees, advisory councils and commissions at work in south Florida trying to address or coordinate some aspect of agency restoration effort. Agencies' personnel regularly coordinate, consult, and resolve differences on specific projects and programs.

While these extensive advisory and agency efforts accomplish a great deal, the total number and compartmented nature of the efforts have substantial drawbacks. Typically, these individual efforts can overlook some interested or affected party. Often they leave agency differences unresolved, or without necessary approvals or realistic commitments. This contributes to delays and misunderstandings until agency managers or higher authorities are consulted.

The public and agency officials are often confused over which agency or advisory/coordinating group is charged with, or can impact, a given restoration activity. Frustration resulting from these circumstances often lead to misunderstanding, confrontation, and/or unilateral action to obtain decisions or move a project forward. The Interagency Working Group (IWO) has the charge and the opportunity to integrate the federal side of the restoration effort and to create a strong link with state and local activities.

OBJECTIVE

Develop and implement a clear, unified process to: communicate status of restoration plans and activities; coordinate priorities, funding, and implementation schedules among all agencies; and quickly identify, confront, and resolve agency differences.

APPROACH

The Interagency Working Group will assign areas of coordination responsibility to several sub-groups, including the existing Management, Science, and Projects Sub-groups and add at least an information/education sub-group. Each will be required to routinely meet and review all federal agency activity in the assigned area. The IWG will identify, discuss, and work to informally coordinate and resolve matters of concern. It will provide periodic opportunities for state and local agency presentations and public comment to identify the full range of coordination issues and opportunities appropriate for consideration. (Sub-group membership would be altered as appropriate to include state and local government representatives and citizen advisors upon implementation of the recommendations in Appendix M.) Each Sub-group will immediately bring items to the attention of individual affected members, or to the full IWG if management action is needed to expedite an effort or resolve an issue.

Each participating agency manager will dedicate the necessary personal time and staff support to support this process on a continuing basis

APPENDIX D:
EXPEDITING CORPS RESTORATION PROJECTS

ISSUES/PROBLEMS

Congressional appropriations to the Corps for these projects have been adequate. Yet, the rate of actual progress has often been disappointing, creating important problems in expediting Corps restoration projects.

Environmental Evaluations: The single most difficult task in the design of any environmental restoration project is predicting the potential benefits. Environmental benefits must be described in a way that supports optimization of the project design and justification of federal expenditures. This requires prediction of environmental impacts in quantifiable terms. Unfortunately, in most cases, it is not possible to make quantifiable predictions that are scientifically valid. This has necessitated the use of expert opinion and has made documentation of project justification particularly difficult.

The lack of predictive ability has hampered design of restoration projects. For example, both the Modified Water Deliveries to ENP and the C-111 projects were designed without the benefit of a final operating plan. Necessary environmental data collection, evaluation, and model development for use in developing an operating plan have not been completed. This work will continue through construction of the project features. The structural systems were designed to provide maximum operational flexibility.

Plan Formulation: The development of environmental restoration objectives and the formulation of alternative plans to address those objectives have caused project delays. Criticism of the Corps' plan formulation by other federal agencies has typically occurred as a part of the final coordination of a plan formulation report and/or NEPA document. It is very inefficient to attempt to modify project objectives or reformulate alternatives at this stage of the process.

Environmental Monitoring: A lack of adequate environmental data has been a consistent problem in environmental restoration projects. There is a lack of data that relates ecologic and hydrologic parameters. Hydrologic data collection is generally adequate; however, the available processes for sharing and transferring data need improvement. There is generally a shortage of associated environmental data and a comprehensive program to coordinate environmental monitoring studies is needed.

BACKGROUND

The Central and Southern Florida (C&SF) Project was designed and constructed by the Corps of Engineers with the South Florida Water Management District (SFWMD) and the St. Johns River Water Management District (SJRWMD) acting as the local sponsors. The project serves the congressionally authorized purposes of flood control, urban and agricultural water supply, prevention of salt water intrusion, recreation, navigation,

protection of fish and wildlife resources, water supply for Everglades National Park (ENP), and environmental restoration. The project area includes the Upper St. Johns River Basin, the Kissimmee River, Lake Okeechobee, the Everglades Agricultural Area, the Water Conservation Areas (WCA), and the lower east coast. In recent years, the dominant theme of Corps studies and projects has been to develop and implement modifications to the water management system that restore and enhance the region's natural resources while still maintaining other authorized project purposes.

SCOPE

The Corps of Engineers is implementing a number of environmental restoration projects in south Florida within the boundaries of the South Florida Water Management District. The projects can be separated into four categories: operational modifications, . projects in the design and construction phase, plan formulation for authorized projects, and plan formulation for projects to be recommended for authorization. These categories encompass the full range of action from immediate improvements through operational changes limited by the capability of the existing water management system to long-term planning efforts addressing fundamental changes to the structural and operational system.

Operational Modifications: Operational modifications are changes to the operating criteria of various features of the C&SF Project to restore more natural water conditions. Operational modifications are constrained by the capabilities of the physical project features and the need to protect the authorized project purposes.

(1) Lake Okeechobee Regulation Schedule Review: At the request of the SFWMD, the regulation schedule is being reviewed to consider possible operational modifications. High water levels associated with the current Lake Okeechobee Regulation Schedule have altered the vegetative communities within the lake that developed during years of lower lake schedules. A review of the regulation schedule is being conducted to determine whether alterations should be made to correct this problem. All associated impacts are being evaluated including water supply, discharges to the estuaries, water quality, etc. Recommendations will be made in the summer of 1994.

(2) WCA No. 1 Regulation Schedule Review: At the request of the U.S. Fish and Wildlife Service (FWS), the regulation schedule for WCA No. l is being modified to restore more natural water conditions for the benefit of nesting wading birds and snail kites. The revised schedule will be implemented in the summer of 1994.

Design/Construction of Approved Projects: The basic designs of these projects have been approved and detailed design and construction are proceeding, although some modification of the design details may be appropriate as detailed design proceeds. NEPA documentation for these projects is complete.

(1) Kissimmee River Restoration: The project consists of the revitalization of the headwaters and restoration of the historic floodplain wetlands in the lower basin. In the upper basin, Lakes Kissimmee, Cypress, and Hatchineha will be operated to

achieve more natural water level fluctuations with respect to historic elevations and seasonality. This will revitalize the peripheral marshes around the three lakes and will reestablish historic flows to the lower basin. In the lower basin, about 25 miles of the existing flood control canal will be filled and flow will be restored to about 50 miles of the natural river channel. In so doing, about 29,000 acres of the historic wetland habitat will be restored. Land acquisition is required in both basins for areas that will be subjected to more flooding. The test fill construction contract has been awarded and a ground-breaking ceremony was held in April 1994. Construction is scheduled to take approximately 15 years.

(2) Modified Water Deliveries to ENP: The purpose of this project is to modify the C&SF Project to restore more natural hydrologic conditions in Shark River Slough, ENP's largest slough system. The project is being implemented in conjunction with Department of Interior's acquisition of about 107,600 acres in the East Everglades for incorporation into ENP. It includes the construction of water control structures, canals, and levees in WCA No. 3 and the removal of a 10-mile-long canal and levee to restore water flows through the historic flow-way. It also includes the construction of two pump stations, a seepage levee, and a seepage collection canal to avoid adverse impacts to adjacent developed areas. The first of five Feature Design Memorandums for the project was approved in December 1993. Construction is scheduled to be initiated in FY 1994.

(3) C-111: The purpose of the C-111 project is to modify the water management system to restore more natural hydrologic conditions in Taylor Slough in ENP while maintaining flood protection for the adjacent agricultural areas. The draft General Reevaluation Report (GRR) recommends the acquisition of agricultural lands that lie between the ENP boundary and L-31N and C-111. A system of canals, levees, and pumps will create a buffer zone and a floodwater detention/retention area between the park and agricultural lands. This will enable the restoration of large areas of short hydroperiod wetlands in the upper zone and headwaters of Taylor Slough. The recommended plan also includes a pump and spreader canal to restore overland sheet flow over an existing wetland north of the lower section of C-111. This project will produce more natural flows to Florida Bay and a reduction in damaging freshwater discharges to Manatee Bay/Barnes Sound. The GRR is undergoing final public and agency review. If approved in June 1994, as scheduled, detailed design will be initiated. Construction is scheduled to be initiated in FY 1996.

Plan Formulation of Authorized Projects: Only about 70 percent of the authorized C&SF Project features have been constructed. For some of the authorized but unconstructed projects, studies have been requested by SFWMD to determine whether construction is still justified. Plan formulation and NEPA documentation for projects in this category is under way.

(1) C-51 West: The original design for the C-51 project provided flood control benefits to the eastern and western C-51 basins. Project features for the eastern basin were completed in 1991. A Detailed Design Memorandum for the C-51 West project features was under review in 1991. The report was withdrawn when negotiations

related to the resolution of the Everglades litigation led to recommendations for implementation of a modified C-51 plan. It was included in the Technical Mediated Plan (TMP) that resulted from mediation discussions. Even though the mediation reached an impasse, the federal government is still committed to implementing the TMP, including the modified C-51 plan. The new plan would provide flood control benefits, but it would also provide water quality enhancement and water supply benefits. The physical features of the plan would be substantially altered. The original 1,600 acre flood detention area would be expanded to form a larger shallower Stormwater Treatment Area 1 East.

(2) Operational Studies for Shark Slough and Taylor Slough Water Deliveries: Preliminary operating plans were developed for Modified Water Deliveries to ENP and the C-111 Projects as a part of the general design phase. However, reports for both projects recognized the need for additional data collection and analysis and recommended additional studies to develop operational strategies to optimize environmental benefits. The Experimental Program of Modified Water Deliveries to ENP has been underway since 1985. The testing program allows restoration of more natural hydrologic conditions to the extent possible within the constraints of the existing structural system. It is also enabling the collection of hydrologic and ecologic data that can be used to develop an optimum operating plan. Although the testing program initially only addressed Shark River Slough, it was expanded in July 1993 to include Taylor Slough. The testing program will continue through completion of construction of the Modified Water Deliveries to ENP and C-111 Projects. An adaptive management strategy is being used to enable the evolution of the operational strategy as data is collected and analyzed, as the required hydrologic and ecologic models are improved, and as other modifications are made to the water management system (i.e., construction of Stormwater Treatment Areas, implementation of the Lower East Coast Regional Planning Project recommendations, construction of the West Dade well field, etc).

(3) Melaleuca Quarantine Facility: Federal and state agency efforts have been underway to identify a biological control of Melaleuca infestation. To date, the research has been performed in Australia, the native home of the trees. Congress has authorized the Corps, in consultation with the U.S. Department of Agriculture, to design and construct a quarantine facility required to complete the process of safely identifying and introducing insects to south Florida. Once constructed, the facility will be operated by the USDA.

(4) Manatee Protection: Manatees are a federally listed endangered species native to Florida. The operation of certain C&SF Project water control structures and locks has resulted in the death of manatees through crushing or drowning. A study is underway to design modifications to the structures to prevent injury to manatees.

(5) Homestead and Cape Sable Canals: These canals are located at the southern end of mainland Florida and are within ENP. They were constructed in the early l900s by local interests to drain wetlands. When ENP was established, the canals were plugged with earthen dams. Extreme wind tides, waves. and water velocities that

occurred as a result of Hurricane Andrew substantially damaged these plugs. Both plugs leak badly and are in danger of total failure. If the plugs fail, fresh water would drain from upstream shallow lakes and salt water would be allowed to intrude freshwater areas. The Corps is designing a plan for permanent repair of these plugs.

Plan Formulation for Projects to be Recommended for Authorization: Congress authorizes the Corps to study water resources problems to determine whether there is a federal interest in implementing a solution. Currently, there are two pre-authorization studies under way addressing environmental restoration in south Florida.

(l) C&SF Comprehensive Restudy: This study is reviewing the existing C&SF Project with a view towards determining whether it should be modified to benefit the environment. Flood control and water supply will also be evaluated. A reconnaissance study will be submitted in November 1994. It is anticipated that SFWMD will be the local sponsor. The Federal Interagency Task Force has played a major role throughout the study process.

(2) Coast of Florida Erosion and Storm Effects Study: This study is a multi-year, phased regional feasibility study examining the entire developed east coast ocean shoreline and west coast gulf shoreline. The objective is to develop a comprehensive understanding of the coastal processes and associated environmental resources to help in the development of enhanced shore protection projects while reducing negative project impacts. Geographic information system technology is being used in developing the associated databases which will provide comprehensive information on all associated natural and physical resources and processes in the region.

To help efficiently manage this study, the coastline has been sub-divided into five separate regions, based on distinctive characteristics. The first region of study, presently nearing completion, includes the Dade, Broward and Palm Beach County coastlines (Region III). Two of the primary environmental databases include identification and quantification of offshore hard grounds and sea turtle nesting information. Close to 1,000 new line miles of side scan sonargrams were used to complete the hard ground database. Sand bypassing and nearshore disposal/berm placement are two key alternatives under development in this region. Over 20 such potential projects are being assessed in Region III. Field investigation of the four central east county coastlines will be initiated during FY 95. The southwest coastline investigation is scheduled for initiation during FY 96.

OBJECTIVES

The Florida Working Group is expediting Corps projects that benefit the region's natural resources by insuring that necessary information has been developed, creating interagency project teams, and by installing and maintaining a hydrologic and ecologic monitoring system.

No changes in the respective interagency roles are necessary in expediting Corps restoration projects. The Corps of Engineers should continue to have the lead on these projects with support provided from other agencies as appropriate. There should be a

greater emphasis on interagency partnering continuously throughout the process. Of particular note is the need for greater involvement of U.S. Department of Highway Transportation in the execution of several restoration projects.

Central and South Florida Restudy Purpose

Find modification to restore the south Florida ecosystem while providing for other water-related needs for the area.

The Interagency Working Group was asked by the Corps to provide consolidated federal objectives of ecosystem restoration to the Corps' restudy team. Objectives were provided to the Corps and were presented at public workshops conducted by the Corps. Based on additional scientific information and public comments, they were refined by the Corps' Study Team into a set of planning objectives.

- Objective #1 - Increase the total spatial extent of wetlands.

- Objective #2 - Increase habitat heterogeneity: (a) reestablish at least the minimum threshold size of historic community types, (b) reestablish relative balance among historic community types, (c) reduce fragmentation within and among community types, and (d) reduce the extent of non-native plants and animals.

- Objective #3 - Restore hydrologic structure and function: (a) restore sheet flow, (b) increase dynamic storage capacity, (c) restore hydrologic linkages, (d) restore more natural hydroperiods, and (e) restore more natural water delivery characteristics to estuaries and bays.

- Objective #4 - Restore water quality conditions: (a) restore more natural salinity characteristics in estuaries and bays, and (b) restore more natural quality characteristics.

- Objective #5 - Improve the availability of water: (a) improve efficiency in water use, and (b) improve water supply.

- Objective #6 - Reduce flood damages and improve water quality on Seminole and Miccosukee tribal lands and deliver clean unpolluted water to the Everglades ecosystem.

The Central and South Florida project is multi-purpose:

- Flood control

- Water control

- Water supply

- Fish and wildlife conservation

- Water delivery to Everglades National Park
- Navigation
- Recreation

APPENDIX E:
WATER SUPPLY ISSUES --
AGRICULTURAL, URBAN AND ECOSYSTEM NEEDS

ISSUES/PROBLEMS

The increasing consumption of water by urban and agricultural areas and the resulting competition for available water resources with the natural system may be the most serious issue facing the south Florida ecosystem. The tremendous population growth in south Florida during the last century and the urban growth and agricultural activities have placed increasing demands on the region's water supply during the dry season. Dade County has historically had the most rapid population growth; other counties within the region are expected to experience greater future growth than Dade County, increasing fresh water demands.

An underlying critical issue is providing a mandated adequate fresh water resource base for restoration of wetlands and freshwater flow to Florida Bay and other estuarine areas, while accommodating water needs of agriculture and urban interests. A critical issue is providing for these water supply needs. Compounding the problem is the fact that pumps in agricultural areas are not metered. Therefore, valid data regarding actual volumes of water moving into and out of agricultural fields does not exist.

Ground water is the predominant source for public water supply in south Florida. Ground water resources are utilized for potable, municipal, industrial, and agricultural supplies virtually throughout the area. Surface waters are used for agricultural supply in the EAA and for potable supply in a few communities bordering Lake Okeechobee. The aquifers used for water supply are the Biscayne Aquifer in the southeast and surficial and/or intermediate aquifers elsewhere.

Freshwater resources have been viewed as being abundant within south Florida. Competition for the fresh water resources is of particular concern in those areas served by the Biscayne Aquifer and the C&SF Project. The primary competitive demand is the need for sufficient flow of water into the Everglades to support the unique wetland and aquatic habitats that exist in the WCAs, ENP, Big Cypress National Preserve and other natural resource assets. In the past, water supply was made a higher priority in decisions regarding allocation of fresh water resources in the study area. Rainfall, the primary source of all fresh water in the south Florida hydrologic system, is concentrated in May-October and November-April is relatively dry.

Intensified withdrawals have stressed the aquifers used for water supply. One result of these increased demands was an increase in salt water intrusion into fresh water aquifers. In the Biscayne aquifer, the C&SF system of canals and control structures was effectively used to minimize salt water intrusion from the ocean. Upward migration of mineralized waters from deeper formations has not had a sign)ficant impact on water quality in the Biscayne. In other areas' the surficial and intermediate aquifers have been affected both by

landward migration of seawater in coastal areas and the upward migration of mineralized waters from deeper formations in the interior. This trend will continue as these aquifers are more intensively used as a result of growth.

A major issue regarding water resource management practices in south Florida is conservation of the fresh water resource. Once conservation measures are in place, more effective management practices, especially for the purpose of environmental protection and/or enhancement, will be more easily implemented.

Water resources management activities have largely concentrated in the past on flood control and water supply. Management activities are much more intense and well-developed in the highly urbanized southeast coastline, the EAA, the WCAs, and the agricultural areas in the vicinity of Homestead and Florida City, including the lands managed by federal and state governments for their natural resource value, such as ENP.

Water supply practices in south Florida have the overall effect of diverting large volumes of fresh water from natural system demands. Historically, this diversion has been primarily from resources that might otherwise support hydrologic maintenance of wetland and aquatic habitats in the Everglades. The periods of the greatest diversion occur in the dry season when water resources are generally scarce and, therefore, when the potential for adverse impacts to wetlands and aquatic habitats are greatest. This trend is likely to increase in the foreseeable future, as major withdrawal points for water supply are moved farther inland, closer to the recharge areas in the Everglades, and farther away from the effects of salt water intrusion at the coastline, as in the Northwest well field, operational since 1984, and the proposed West Dade well field, both owned and operated by the Metro-Dade Water and Sewer Authority (MDWASA). These well fields are located immediately adjacent to the WCAs in the western part of Dade County. Increased agricultural pumpage in the East Everglades area will have a similar effect on the overall availability of water for maintenance of natural resources in the overall Everglades system. The Everglades Forever Act requires a 28 percent increase in the volume of water delivered to the Everglades as compared to the annual volume delivered from 1979 to 1988. In addition, Florida law requires the establishment of minimum flows and levels for the Everglades.

Flood control practices in the study area have had the effect of reducing the volume of fresh water storage in the overall system and of accelerating the movement and discharge of excess wet season flows. In some areas, storage has been reduced through lowering of the water table due to pumpage. In the EAA, subsidence of the land surface has occurred due to oxidation of organic soils when exposed to unsaturated conditions. Greater volumes of excess flow must therefore be routed to other storage points (the WCAs) or to discharge points into estuarine or marine environments. This effect, coupled with expanding urban and agricultural areas for which flood control must be provided, may necessitate the movement of increasing volumes (estimated to be up to 25 percent) into storage or discharge. This could accelerate the loss of fresh water resources from the system. Loss also occurs from evapotranspiration in the open WCAs and from the large volumes discharged to the marine environments.

South Florida's rich deposits of organic soils are subsiding at a rate that suggests that agriculture, as currently practiced in the EAA, is not sustainable. Maintenance of a low water table as part of farming operations results in oxidation of the soil, which is underlain by dense limestone rock. A review of research already conducted suggests it may be feasible to grow conventional crops profitably practicing a zero subsidence agriculture. A water management regime in phase with the seasonality of rainfall and more water-tolerant cultivars could be the key. Such a management regime, while extending the lifetime of agriculture in the area, could also be more hydrologically compatible with natural systems downstream and could improve water quality.

The effects of the C&SF Project are in essence no different from those associated with other flood control projects, and for that purpose the C&SF Project has functioned effectively. Additional purposes to which the C&SF system have been put, such as enhancing water supply and prevention of salt water intrusion, demonstrate the flexibility of the system in responding to emerging water resource issues within the southeast portion of the study area. The Mod)fied Water Delivery Plan (MWDP), a proposed alteration of the C&SF system of canals and control structures, has environmental enhancement as the main purpose. This will be achieved by facilitating the delivery of fresh-water flow into Shark River Slough, the major drainage feature of ENP. This is also a demonstration of the inherent flexibility of the C&SF project, in that system mod)fications are proposed for a purpose other than water supply or flood control.

Estuarine areas are impacted by freshwater releases from the C&SF Project. Large regulatory releases adversely affect the salinity regime in the St. Lucie and Caloosahatchee Estuaries. Estuarine areas, such as Florida Bay, have also been impacted by reductions of freshwater flow. The Mod)fied Water Deliveries to Everglades National Park Project, C-111 General Revaluation Report, and Taylor Slough Demonstration Project are examples of projects that could help improve freshwater flows.

Big Cypress Basin obtains ground water from unnamed surficial and intermediate depth aquifers. The surficial aquifers are unconfined and the intermediate aquifers are semi-confined to well-confined and all are vulnerable to contamination from surface sources. These aquifers are generally more susceptible to saltwater intrusion both from a landward migration of seawater and from up-welling of more mineralized waters from underlying geologic formations.

BACKGROUND

Historically, the Kissimmee-Lake Okeechobee-Everglades watershed was part of one large, hydrological and ecologically connected system. The watershed was a subtropical landscape featuring shallow lakes, meandering river channels, sloughs, floodplains, wetlands, and a gradual hydrologic gradient that moved water slowly from central Florida to Lake Okeechobee through the Everglades, and ultimately discharging to Florida Bay, Whitewater Bay, and the Gulf of Mexico.

The late 1800s brought the manipulation of the system to provide drainage, flood protection, and water supply needs. The most extensive changes to the system are the

result of construction of the Central & South Florida (C&SF) Project authorized by Congress in 1948, designed and largely constructed by the Corps of Engineers. As a result of the project, the existing hydrologic unit is a highly managed system of canals and levees, and six major impoundment areas including Lake Okeechobee, a large (about 740 square miles), shallow, subtropical lake with a marsh area of about 25 percent of the lake's surface. At the southern end of the watershed lie the components of the historic Everglades including the Everglades Agricultural Area (EAA), the Water Conservation Areas (WCAs) and Everglades National Park (ENP). This highly managed hydrologic system has been referred to as the lifeblood of south Florida.

Prior to drainage, the Everglades was up to 60 miles wide and stretched from Lake Okeechobee southward to the southern tip of the state between Florida Bay and the Ten Thousand Islands area. The EAA is a large (about 1100 square miles), highly productive agricultural area of organic peat or muck soils south of Lake Okeechobee. The three WCAs (located south and east of the EAA and west of the urbanized East Coast) make up an area of about 1350 square miles: a large segment of the original Everglades. The Everglades is an ecosystem that evolved under very limited nutrient supplies where minor increases in nutrient supply have been attributed to have major ecosystem impacts.

Immediately west of the Everglades is the 2,400-square-mile Big Cypress Swamp region. The Big Cypress National Preserve was established in 1974 and encompasses 574,000 acres (with an additional 146,000 acres authorized for acquisition).

The Florida Keys is a unique system composed of a string of islands 100 miles long that extends from Key Largo in Biscayne Bay southwesterly to Key West. The Keys are situated on the edge of an ocean shelf that separates the deep water of the Atlantic Ocean from the shallow waters of the Gulf of Mexico. Biscayne Bay, a shallow, subtropical ecosystem provides beauty, recreation, economic, and environmental benefits for south Florida.

OBJECTIVES

Manage the hydrological conditions in the remaining undeveloped and potentially restorable lands in a way that maximizes natural processes characteristic of the historic south Florida ecosystem (including water quality, quantity, distribution, timing, and biological integrity). Restoration of the natural system will be evaluated and implemented to maximize the benefits to the overall ecosystem.

Develop and manage the total hydrologic system to maximize ecosystem restoration while providing appropriate consideration to meeting the needs of urban, agricultural, and man-made components. It is recognized that future management of the system will require shared adversity where the full range of hydrologic needs cannot be fully met.

The Task Force, through the Interagency Working Group, needs to be an active participant with the Governor's Commission for a Sustainable South Florida to assure that water supply issues are compatible with development and growth management in south Florida.

APPENDIX F:
WATER QUALITY MANAGEMENT STRATEGIES

MAJOR ISSUES

Water quality throughout the south Florida ecosystem has been a major issue for many years. Nutrient enrichment has been identified as a concern for Lake Okeechobee, the Everglades, the Indian River Estuary, and the Caloosahatchee River. Anthropogenic nutrients or perturbations to nutrient cycling processes have been suggested by some as a possible cause for symptoms of ecological degradation observed in Florida Bay (seagrass die-off, algal blooms), the Florida Keys National Marine Sanctuary, and the coral reef system. Other water quality related issues include the widespread contamination of biota throughout the Everglades region with mercury of unknown source(s), the contamination of public drinking water supplies along the lower east coast with synthetic organic chemicals, contamination of the Miami River, concern about the integrity of the Dade County Water and Sewer Authority's Cross Biscayne Bay municipal sewer line, and seagrass loss due to poor water quality. Toxicological contaminants of concern in the system have included metals, organic compounds and pesticides.

BACKGROUND

The south Florida ecosystem contains varied aquatic natural resources, habitats, and biological communities. Each of these aquatic systems developed under specific water quality and hydrologic conditions. As such, the quality of the water in these aquatic systems is an important driving force in defining habitats and determining the suitability of a water for specific organisms.

The rapid and extensive urban and agricultural development in south Florida has had negative impacts on system water quality. Urban and agricultural activities in the watershed have affected the quality of water delivered to the natural resources of the downstream water receivers. Some of the potential contaminant sources include marinas, marine sewage, sanitary sewers, stormwater sewers, industrial effluents, and agricultural runoff. The Central and Southern Florida Flood Control Project (C&SF) has affected water movement and hydroperiod throughout much of the system. This in turn has affected water quality. The canal system also has the potential to serve as a conduit for the conveyance of pollutants to other portions of the system.

Any successful program to restore the south Florida ecosystem must view the system holistically. Water quality conditions and processes throughout the system have been greatly affected by modifications to the natural system over the past century resulting in loss of wetlands, loss of mangroves, loss of grass beds, loss of coastal upland communities, altered hydrology, and altered circulation in bays. Water quality conditions influence ecological integrity and have a direct bearing on the ability to achieve various objectives identified in the ecosystem restoration: habitat restoration strategy to address the ecological degradation of Florida Bay and the coral reef system, and strategies intended to provide

adequate habitat for native species of fauna such as wading birds. In addition, actions undertaken to address water supply concerns and structural or operational modifications to the C&SF Project may influence water quality.

Ground water contamination has impacted water supply activities in south Florida urban areas. Plumes of ground water contamination from old landfills, Superfund sites, leaking underground storage tanks and industrial activities have caused localized degradation in the Biscayne Aquifer (a federally designated Sole Source Aquifer under the Safe Drinking Water Act). Two major water supply well fields operated by the Metropolitan Dade Water and Sewer Authority were contaminated with volatile organic chemicals, presumably originating at nearby superfund sites. Numerous private wells were contaminated by a plume emanating from the old 58th Street Landfill in Dade County. Regional aquifers are highly vulnerable to contamination because of the lack of soil, high transmissivities, and the nearness of the water table to the ground surface. Because of widespread and increasing urbanization of the area, the incidence of ground water contamination is likely to increase.

OBJECTIVE

The objective is to assure that the quality of water found throughout the south Florida ecosystem is adequate for attaining ecosystem restoration, protection and maintenance.

APPROACH

A complex set of laws and institutions are in place to protect or restore the chemical integrity of surface water and ground water. The federal strategy relies heavily on state implementation and leadership. A suite of federal, state and local laws and regulations disperse implementation responsibility among various federal, state, and local agencies. Two concepts fundamental to any successful strategy are contaminant cleanup and pollution prevention. A number of significant state or federal efforts are underway to address water quality concerns throughout the south Florida ecosystem.

In general terms, components of an effective water quality management strategy must include:

- Appropriate water body classification;
- Development and adoption of water quality standards and criteria that are adequate for resource protection;
- Adequate regulatory and permitting programs including compliance determination and enforcement;
- Monitoring and research to define appropriate standards, identify status and trends, and determine compliance; and
- Public education and awareness.

Federal Activities: Federal agencies have various programs in place to address water quality issues. The objective of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Among federal agencies EPA has assumed the dominant role in directing and deeming water pollution control programs.

The Florida Keys National Marine Sanctuary (FKNMS) requires EPA and Florida, in consultation with NOAA, to develop a Water Quality Protection Program for the Sanctuary that addresses point and nonpoint sources of pollution to restore and maintain the chemical, physical, and biological integrity of the sanctuary, including restoration and maintenance of corals, shellfish, and fish and wildlife.

Monitoring and Research Programs: Federal agencies have invested much in water quality monitoring and research efforts throughout the ecosystem. Ongoing efforts include those of the USGS, NOAA, NBS, NPS and EPA. In addition Florida agencies such as SFWMD have significant monitoring efforts in place throughout the ecosystem.

State Activities: The state of Florida plays a critical role in water quality issues in south Florida. The Clean Water Act authorizes the states to establish ambient water quality standards and water quality management plans. Two Florida agencies that have a major influence on water quality in the south Florida ecosystem are the South Florida Water Management District and Florida Department of Environmental Protection.

Out of concern for the declining quality of Florida's surface waters, the Florida Legislature passed the Surface Water Improvement and Management (SWIM) Act of 1987. This act required SFWMD to prepare SWIM Plans for Lake Okeechobee, Biscayne Bay, and the Indian River Lagoon. Plans for these water bodies have been adopted. Nutrient enrichment problems in the Kissimmee River, Lake Okeechobee, and the Everglades have been difficult to resolve. For example, the issue of nutrient levels in the Everglades Agricultural Area and the eutrophication of the Everglades has been a focus of many state activities, including the Lake Okeechobee Technical Advisory Council (LOTAC) I (1985 1986), LOTAC II (1987-1990), The SWIM Act of 1987, the Marjory Stoneman Douglas Everglades Protection Act of 1991, and the SWIM planning process (1988-present). A SWIM Plan for the Everglades adopted by the SFWMD Governing Board in 1992 has been superseded by the Everglades Forever Act enacted in April 1994. The act requires BMP based reductions in phosphorus released from the EAA, wetlands constructed for phosphorus removal, and attempts to establish a method of payment.

A variety of water quality issues must be addressed by managers involved with south Florida ecosystem restoration. Some of the issues and approaches for addressing them include:

- The need to control urban stormwater runoff;

- The adequacy or inadequacy of voluntary BMPs in meeting water quality standards throughout the south Florida region (Should voluntary BMPs not result in attainment of water quality standards then appropriate regulation will be required.);

- The application of Total Maximum Daily Loads (TMDLs, section 303d of the Clean Water Act) for water bodies that are not in compliance with water quality standards;

- Numeric interpretation of the Class III narrative water quality standard for nutrients and the need for appropriate research to determine a numeric standard that is adequate for preservation intact of native flora and fauna ;

- Determining sources of and appropriate and effective remediation strategies for the contamination of biota throughout the Everglades region with mercury;

- Addressing the pumping of untreated urban water pumped directly into the Everglades through S-9 and untreated urban/agricultural drainage water pumped through S-332 and the C-111 basin;

- The rapid growth along the west coast of south Florida and water quality impacts on wetlands or coastal resources in this region;

- Agricultural expansion in the Big Cypress Watershed and potential water quality impacts on downstream water receivers;

- Effectively dealing with nutrient problems in the S-4 basin and the region immediately west of the EAA;

- Effective remediation of Superfund sites throughout the south Florida region;

- The potential problem of wading birds being adversely affected by parasites and the role nutrient enrichment may play;

- The cause of deformities found in fish in Biscayne Bay and other estuaries;

- Estrogen mimicking compounds and the effect that they may be having on South Florida faunal populations;

- The cumulative effects of pesticides on the environment, given the heavy use of a large number of pesticides for a variety of purposes, including agriculture, golf courses, mosquito control, aquatic plant control, right of ways and lawns; and

- The contamination of drinking water supplies with trihalomethanes.

APPENDIX G:
COMPREHENSIVE WETLAND PERMITTING AND MITIGATION STRATEGY

ISSUES

During the last century, about 50 percent of the wetland area within the south Florida ecosystem has been drained or filled and converted to agricultural, residential or industrial development. Critical peripheral short hydroperiod wetlands have been and continue to be diminished in spatial extent by development. This overall loss of wetland area has reduced, the habitat options for the region's fauna and incrementally removed or diminished the functions that these natural areas performed, such as water quality filtration, flood control, aquifer recharge, and habitat.

The Clean Water Act requires a specific permit to dispose of dredge or fill material in the nation's waters, including wetlands. This permit program is administered by the Corps of Engineers (Corps), subject to and using the Environmental Protection Agency's (EPA) Section 404(b) environmental guidelines. The Clean Water Act Section 404 wetland fill permitting is an ongoing federal program that has a major impact on the south Florida environment, and probably has as much of a cumulative impact as any ongoing federal program. It affects the ability to attain many ecosystem restoration objectives—maximize spatial extent to recover ecological function and structure, prevent further wetland loss, recover undeveloped degraded wetlands, restore linkages, restore sheet flow, reestablish biological corridors, halt exotic species spread, etc. It affects the ability to attain restoration success criteria (no further wetland losses, degraded wetlands restored, reinstatement of natural hydroperiods, wetland use permits stipulate requirements for enhanced hydrologic connectivity, water quality, and water storage, etc.). Wetland permitting and subsequent filling incrementally, and often irrevocably, reduces the land and natural resource bases available for ecological restoration. Viewing a 1970-era and a 1990-era satellite image of south Florida is illustrative. Resulting development often requires further infrastructure demands, results in increased water supply and flood control demands, and complicates water management decisions and ecological restoration alternatives.

Development: Development is proceeding faster than restoration planning and faster than the current ability of the federal agencies to assess the cumulative impact. The regulatory response has been to look at individual permit requests without a broader watershed or ecosystem view. The regulatory process is also reactive in that it comes after land-use plans are written and landowners make development decisions guided, in part, by those plans. There is pressure for continued development caused by the climate, natural and cultural amenities, and quality of life offered by south Florida. Development started on the coasts and has moved inland into wilderness areas, remnant natural habitats and wetlands. A significant and growing portion of the natural south Florida landscape has been developed. Development is not the concentric expansion of cities with the creation of urban metropolitan areas, but the march of large planned communities into undeveloped or

agricultural tracts remaining under single ownership. There is a unique clash of urbanization and relict wildlife populations.

Mitigation: The regulatory program currently requires mitigation to offset unavoidable functional loss, but that requirement is largely dependent on the circumstances of the individual permit. In the past, the ratios of impact area to mitigation area have varied widely over time and throughout the region, especially when compared with other parts of Florida. In a number of cases, past mitigation did not compensate for the loss of wetland functions. Often, there is an ongoing lack of a large strategic view for appropriate mitigation. There continues to be fragmentation of the ecosystem by the way the mitigation is established and by development patterns. Disagreement among agencies on the amount of mitigation necessary for a project, the value of on-site versus off-site mitigation and the appropriate type of mitigation (preservation, restoration, enhancement, and/or creation) continues. Fragmentation occurs when a wetland on a particular site is preserved or enhanced, but then is later disconnected from the overall fabric of the ecosystem by subsequent permit decisions.

Coordination: Federal level coordination has improved but needs further coordination, especially with Water Management Districts and counties. Coordination involves not only sharing of knowledge of the ecological resource, but also of knowledge of transportation and other social or economic needs. Building a consensus at the local or staff level on approaches to regulatory decisions is difficult due to different and, at times, conflicting regulations, policies, and implementation strategies. Wetland regulatory programs are fragmented, overlapping, and have duplicate authorities and responsibilities.

BACKGROUND

Regulatory Program: Section 404 of the Clean Water Act regulates the discharge of dredge and fill material into waters of the United States that include wetlands, lakes, estuaries, rivers, canals and borrow pits. The Jacksonville District of the Corps through its regulatory offices in Jacksonville and satellite offices in Miami, Fort Myers, Vero Beach, and the Keys, reviews and issues permits authorizing the fill. The EPA provides guidelines for discharge of fill and, through its Region IV office in Atlanta comments on the application of these guidelines for pending applications. The National Marine Fisheries Service (NMFS) Panama City office and satellite office in Miami, and the U.S. Fish and Wildlife Service (FWS) Vero Beach office, and their satellite office in Naples, comment on pending applications under the Fish and Wildlife Coordination Act and the Endangered Species Act. These agencies also have separate responsibilities under these acts. The EPA and the Corps cooperate in monitoring compliance with issued permits and enforcement of unauthorized discharges. The Corps also regulates any activity (fill, excavation, and structures) in navigable waters, including ocean areas to the limits of the territorial sea, Florida Bay, rivers, and canals to the limit of navigation. The scope of jurisdiction over the south Florida ecosystem has been refined over the years to now include land clearing, rock mining, rock plowing, isolated waters, and drainage projects.

For the purpose of this plan, permit is defined to include Individual Permits and General Permits (including Nationwide Permits).

The federal agencies involved in the wetland permitting program have yet to provide detailed summaries of the cumulative effect of the ongoing permitting activities on the south Florida environment. It is imperative that a database is developed that will allow these summaries to be prepared.

Permitting program decisions often are relevant to ongoing planning activities. South Florida wetland regulatory programs should be integrated with pertinent planning activities, such as the Corps ongoing C&SF Project reformulation study. Specific permitting actions may have direct bearing on reformulation study considerations, such as the buffer concept or water supply preserves.

Projects: Major types of projects include large residential developments that can encompass several thousand homes and often incorporate light commercial areas in a planned community concept, rock mining, and recreational complexes. Some areas where the land ownership was subdivided in the past are now experiencing the cumulative impacts of many small projects.

Ecosystem Impacts: The regulatory program has not entirely addressed or documented the loss of ecosystem wetland habitat caused by development or alleviated the pressure on the ecosystem. But in recent years the program has slowed the rate of habitat destruction and has increased mitigation requirements, an improvement based on the refinement of the regulatory jurisdiction. However, documenting these improvements is currently difficult. One of the greatest difficulties in determining the effectiveness of the south Florida wetland regulatory program is the lack of a comprehensive understanding of the system and the inability to assess the impacts from individual decisions. Geographic Information System (GIS) technology and data must be developed to accomplish this.

Data Management: One of the difficulties associated with coordinating and evaluating the various wetland regulatory programs, is that data, maps and other wetland information are fragmented, duplicative and inaccessible to the various regulatory agency personnel. This leads to case-by-case decisions with limited ability to address issues such as cumulative effects, loss of important corridors, and other ecosystem-level impacts. A tremendous amount of information, including GIS data, is available on the south Florida wetland communities. However, this information is located in a variety of federal, state, regional, and local agencies with limited coordination and no overall plan for assessing and managing the ecosystem or improving information exchange. The goal must be to ultimately put a system in place where the best available information (i.e. via GIS and improved wetland assessment methods) would be at the fingertips of those reviewing and deciding on individual permit applications.

Trends: There are several important trends that need to be recognized. In some areas, almost all the uplands are in some sort of use or developed condition. Development is encroaching inland from both coasts and south from Orlando. The rate of wetland loss related to individual permits has been reduced but there is increasingly more fragmentation of remaining wetlands. Because of the regulatory authority on wetlands, the regulatory program has pushed development into uplands. Some of these uplands are of very high quality and~are a limited resource in some areas, such as the Florida Keys. The only time

the regulatory program has been able to recognize and preserve uplands is when they are an exceptional habitat (such as for endangered species) and where the wetland loss was of lesser environmental impact than the loss of the uplands. This wetland loss is aggravated by the intrusion of invasive exotics. There continues to be a time lag, or at least a difficulty in assessing the impact of the time lag, between the occurrence of impact and the point when mitigation reaches full functionality. There are also problems with some mitigation actions-reaching full success or, in some cases, even being implemented as required by permit. Up-front mitigation by developers has not been regularly required by the permitting agencies.

OBJECTIVES

The overall objective is to develop a system-wide integrated wetland permitting, preservation and mitigation strategy, including coordination among all levels of government, which furthers south Florida ecosystem restoration. The following elements have been identified as necessary:

- Develop a pro-active regulatory approach;
- Develop a South Florida Wetland Conservation Plan that coordinates and prioritizes all regulatory and non-regulatory programs affecting wetlands at all levels of government, the private sector, conservation groups and the general public;
- Increase the speed of the planning process (shorten the time between recognition of a critical concern and implementation of a regulatory reaction);
- Promote greater involvement in the development and implementation of plans by agencies, the public, and by the regulated community;
- Conduct planning that spans all government levels that have an interest in, the resource to address, or the authority to act on a concern (horizontal coordination with federal and vertical coordination with state and local agencies);
- Promote mitigation strategies that work toward the overall goal of ecosystem restoration;
- Develop uniform functional assessment methodologies;
- Recognize when regulatory actions make an irreversible commitment that would preclude future options for ecosystem restoration;
- Eliminate fragmented or duplicative authorities and processes;
- Engender feedback that brings all viewpoints into the regulatory decision processes;

- Reduce the confrontational aspects of the program by emphasizing team building based on a uniform view of what south Florida should look like now and in the future; and

- Identify research and monitoring needs.

APPROACHES

Development and implementation of a South Florida Comprehensive Wetland Permitting and Mitigation Strategy (SFCWPM Strategy) will require improved coordination between federal resource agencies involved in the Section 404 program and increased interaction between the federal agencies and state/regional/local planning and regulatory agencies involved with wetlands. Reliable and scientifically valid wetland quality data bases must be developed to guide the wetland permitting and planning process. Within given watersheds, ecosystem-level wetland quality/restoration needs information is currently not available to enable analysis of cumulative impact assessments of individual wetland permit decisions. Currently individual wetland permit decisions are made with little or no data available to assess ecosystem impacts or the short- or long-term impacts of permit decisions on the larger south Florida ecosystem restoration goals.

It is imperative to develop the SFCWPM Strategy expeditiously. The administration's initiative on permitting is that decisions must be made in a timely manner upon receipt of an application. The best decision must be made using available information. Increased staffing and funding resources must be directed at the south Florida ecosystem area by the involved federal wetland regulatory agencies in order to accomplish SFCWPM Strategy objectives. Agencies must target resources based on the assumption that there are limits to the resources that can be devoted to south Florida. These resources need to be applied where the greatest need or benefit to the overall restoration plan will be realized. This means that (1) resources must be targeted where needed to provide intensive review on critical projects, (2) consensus must be reached quickly to free and direct some of the attention to (3) increase pro-active planning. The plan for permitting and mitigation must and will adapt as information and experience is gained.

The following approaches would facilitate development and implementation of a SFCWPM Strategy that furthers ecosystem restoration. Much of the following will require additional resources or significant reprogramming of existing resources.

Wetland Permitting Program Summaries: Beginning in 1994, the Interagency Working Group will submit to the Task Force an annual summary of the federal wetland permitting program in south Florida. This summary will include information by county for the number of permit applications received (includes individual, general and nationwide permits), number of permits denied, number of permits vetoed, number of permits approved, number of permits modified prior to approval, acreage of wetland to be filled in permit application, acreage of wetland filled in approved permit, and mitigation required. The development of these annual reports should be a high priority of the permitting program. The Corps, EPA and FWS will develop and maintain the wetland permitting

information database that makes this possible. This will require additional resources or reprogramming existing resources.

Interagency Coordination: A Wetland Interagency Coordination Group (WICG) will be formed.

South Florida Wetland Conservation Plan: This is a major element of the wetland permitting and mitigation strategy. A South Florida Wetland Conservation Plan (SFWCP) should be developed that coordinates and prioritizes all regulatory and non-regulatory activities affecting wetlands at all levels of government, private interests, conservation groups and the general public. Initial SFWCP tasks to be completed by September 1996 include:

- Identify and map all wetlands within the SFWMD on public and private lands.

- Designate the relative ecological functional value of all identified wetlands in high/medium/low functional quality categories. Landscape ecology concepts and GIS analysis will be used to perform the wetland functional assessments.

- Identify and prioritize wetland restoration/enhancement sites SFWMD-wide.

- Identify and prioritize wetland acquisition or preservation lands based on an ecological needs basis, independent of present Florida CARL and Save Our Rivers program lists. Acquisition or preservation could be through public or private means.

- Identify critical areas, wetlands where intense development pressures require further detailed wetland assessments to be performed as quickly as possible in order to assist the wetland regulatory program decision making process.

(Resources: The Corps and EPA intend to equally dedicate resources to accomplish this, however, additional resources will be required.)

Identify Critical Areas: These are wetlands of particular ecological significance. Their function should be assessed by the federal agencies involved in permitting processes.

- FWS contract for reports on changes in natural cover types over the years.

- FWS assess whether the total area of any one or more cover types is at the point where any further reduction would impact the species mix now found in the area. FWS identify cover types or topographic features that are remnant. That is, no longer provide full function and not part of the restoration plan.

- FWS prepare a document mapping these critical areas with an assessment that will be used in permitting decisions, including denial or determining mitigation requirements.

Increase Emphasis on Wetland Enforcement and Permit Compliance by EPA and Corps. EPA should increase emphasis on wetland enforcement and the Corps should increase emphasis on permit compliance to ensure that the wetland regulatory program and mitigation requirements are providing projected benefits.

- Corps expand funding of contracts now in use for monitoring compliance with issued permits and for surveillance for unauthorized activities.

- Corps distribute a synopsis document to the IWG describing techniques that have worked or failed.

Wetlands to be Protected: The Clean Water Act Section 404(c) can be used to stop projects with unacceptable impacts or to protect areas in advance of development. Projects that have unacceptable impacts can also be denied a permit. Both denial and 404(c) actions can be very labor intensive, are very project specific, and in the case of 404(c), is limited to the five factors in the law. Some permit denials could result in takings claims by applicants.

- Corps and EPA prioritize the importance that various geographical areas remain available and unchanged in order that restoration initiatives are not precluded. Priority may be based on their potential as a critical link in the ecosystem or their critical role or location as defined by planning activities. If appropriate, Corps deny a permit or EPA initiate a 404(c) to prevent irrevocable changes.

Watershed Management Plans and Advanced Identification: Watershed management plans and advanced identification of wetlands will encourage local government sponsorship and/or implementation through grants or contracts from EPA or Corps. Local governments will be involved with project planning, data gathering and analysis, and public outreach.

Prepare Watershed Management Plans (WMPs). WMPs would have the advantage of addressing cumulative impacts to wetland ecosystems, having a unified ecosystem approach that can cross watersheds, can be used to locate mitigation banks, and can result in a high level of predictability for the regulated community. However, they can be time and resource intensive, need to have the buy-in to avoid controversy, could cause the focus on some critical issues or portion of the watershed to be diffused, and is a relatively new approach so regulatory programs do not have experience in conducting them.

Expedite completion of Advanced Identification of Disposal Area projects (ADIDs). An ADID produce good resource information and simple, easily understood maps for public use. An ADID is flexible in the level of detail that is used to make the identifications, ranging from heavy reliance on aerial geographic information system (GIS) data for a large geographic area to more site specific studies. While this flexibility is an advantage, the result is that there is no overall clear statement of purpose for ADIDs in general, and therefore the purpose or goal must be defined individually at the start of each ADID. However, performing ADIDs can be a slow process due to the need for consensus building the need to ground truth information, and ADIDs have been perceived by some as only a

planning tool with little or no regulatory teeth. The time required for completion of some ADIDs is a concern. It is crucial that the completion of an ADID be expedited in order to increase its usefulness and timely application to the permitting process.

•EPA send representatives to expedite the interagency team to finish the ground truthing for the Florida Keys ADID.

•EPA expedite the preparation of the functional assessment for the Rookery Bay ADID.

•The Wetland Interagency Coordination Group will identify specific critical areas that require watershed management plans and recommend priorities. This will include identification of local players or sponsors.

•EPA provide grant money for gathering and interpretation of data.

• FWS and NMFS support habitat evaluations.

Delegation of Administration of General Permits: Delegation of some role in the regulatory process to non-federal agencies offers ways to increase efficiency of the program, has more local site specific input, reduces duplicative efforts, and generates cooperation among federal and other agencies. The potential exists for delegation of the administration of any General Permit. Federal oversight is important to ensure the achievement of preservation or restoration goals. Delegation will only be to entities that have demonstrated an interest in and commitment to ecosystem restoration.

Increase Local Presence in South Florida: Increasing the federal agencies' presence in South Florida would facilitate development of the wetland permitting and mitigation strategy, expedite permitting decisions, and facilitate coordination.

Wetland Assessment Methods: Wetland assessment approaches must be developed at two scales: landscape level and site-specific level. The landscape level wetland assessment method will be developed for all wetlands within the SFWMD boundary during the development of the South Florida Wetland Conservation Plan, which is to be completed by September 1996. This landscape level wetland assessment method will employ GIS analysis and landscape ecology concepts to evaluate the functionality of wetland areas into general high/medium/low functional categories. This information will be used in all future 404 wetland permitting decisions in the south Florida ecosystem.

With the site specific wetland functional assessment methodology, presently there are a number of different approaches to assessing development impacts and determining required mitigation. These include analyses based on ratios, by relative scoring values, or by an integrated matrix. There frequently is no continuity of assessment techniques among projects and difficulty in comparing results. There can be a wide disparity in the how a particular method is applied for the same project by different participants in the process, as well as among projects in the same area. There is a need to develop a consensus on a scientifically based approach and uniform set of assumptions for one or more assessment

methodologies. The methodology should be relatively easy and rapid to employ by professionals in the geographic area of application and must produce consistent assessments of wetland impacts as well as uniform determinations of mitigation requirements.

- WICG decide the scope of the assessment methodology. This could be (1) uniform approach for the entire ecosystem, (2) develop sub-regional methodologies, or (3) continue to create tailored made protocols for each project.

- Corps prepare a report to summarize current practices of assessment.

- EPA in cooperation with the WICG will assist in the development of the chosen assessment model to adapt it to the scope decided on.

National Environmental Policy Act Compliance: A Generic Environmental Impact Statement (GEIS) or other types of EIS, environmental assessments, or other National Environmental Policy Act (NEPA) documents that encompass a geographic or industry scope is a proven process that has the benefit of being proactive, very broad in scope, very flexible in the issues addressed, and encompass the participation of a wide variety of concerns including the regulated community, resource agencies, conservation groups, and the general public. However, the scope of a GEIS can be hard to define or limit and can be perceived as potentially slowing development in an area. It may be possible under NEPA to delay the processing of permit applications that are pertinent to a specific EIS.

State and local comprehensive planning: Increased involvement in state and local comprehensive planning can lead to good information exchange, avoid conflicts between state plans and federal regulation, engender federal support for local plans, and lend support to the local planning process. The FWS has already been involved in local planning efforts related to endangered species at the invitation of the local governments. However, there is some concern regarding the appropriate level of federal involvement in local planning.

Establishing Mitigation Banks: Mitigation banking has the advantage of a high level of predictability and quicker permit issuance and review, can set aside large blocks of land in advance of ecosystem impacts that include both wetlands and uplands, and can incorporate connectivity needs. Mitigation banks have a greater probability of success due to management expertise (can be placed in the hands of an ecosystem manager rather than a developer), but there have not been many banks in existence for an extended period of time so there is a concern about the long term success of biological maintenance and protection from development or development encroachment. Mitigation banking is a new industry ripe for entrepreneurial efforts. The potential for establishing a bank can add value to a property by providing another economic use for the land. However, mitigation banking can result in off-site or out-of-kind mitigation, but this can be used to restore the balance of vegetative communities or habitat lost in the ecosystem by previous development. Mitigation banking can give the perception that the regulated community is buying a permit but also could be viewed as a mechanism to better use the dollars committed to mitigation.

- The ITF could seek legislative authority to provide seed money or loan guaranty for the establishment of mitigation banks through a revolving fund or outright grants.

This would be available to the private entrepreneur as well as to conservation organizations, such as The Nature Conservancy, who have considerable volunteer and other expertise to implement a Bank but not the capital. The Department of Agriculture may be an appropriate entity to administer this new program since it already administers banking type programs for wetlands and soil conservation.

Return User Regulatory Fees and Fines to the regulatory program or the restoration effort.

APPENDIX H:
HARMFUL NONINDIGENOUS PLANTS AND ANIMALS

MAJOR ISSUES/PROBLEMS

Invasive plants and animals from other parts of the world are becoming established in south Florida's natural areas, altering landscapes, community structure, and food webs; and too little is being done in defense of the south Florida ecosystem, considering the magnitude and seriousness of the threat. Although a concerted effort is being made at manual, mechanical, and chemical control of melaleuca, biological control, an essential element in control of widespread, prolific pest plants such as melaleuca, is seriously under-funded. As a result, although promising control organisms have been found, implementation of biological controls for melaleuca and Brazilian pepper has been delayed. Although much attention is being given to the control of well established pests such as melaleuca, many other plants are invading natural areas with little or no human resistance.

Of possibly even greater concern is the lack of attention given to prevention. Virtually nothing is being done by any federal, state, regional, or local agency to prevent the propagation and distribution of the 126 plant species listed as invasive, problematic species in Florida by the Exotic Pest Plant Council (1993). It is possible to appraise the potential invasiveness of new species being imported (EPPC 1993, OTA 1993) and to use this information to establish appropriate regulations, however, neither the screening nor the regulation are presently being performed (OTA 1993). Meanwhile, new species with invasive potential continue to be imported, propagated, and distributed.

Within the state of Florida, some local, state, and federal agencies are actually encouraging the use of EPPC-listed species for landscaping. Agencies sometimes distribute, at no cost to homeowners, nonindigenous plants listed by EPPC as invasive (e.g., carrotwood). This practice is quite widespread and occurs in the face of the tremendous economic costs some of these same agencies are incurring in controlling species such as melaleuca.

In the name of water conservation, some agencies currently are promoting xeriscape programs in which many of the recommended species are nonindigenous and may compound the problem. Xeriscape species, because they tolerate extended periods of drought, may be more likely to escape cultivation in south Florida than landscape plants that require irrigation, so xeriscape programs should emphasize the planting of native species, many of which are adapted to periods of sustained drought and are not a threat to the ecosystem.

Some of the listed species are used in landscaping on government lands, including highway rights of way. In addition, there are few control programs for removal of invasive nonindigenous plants from government lands, except parks.

Laws controlling imports of harmful nonindigenous species, as administered, are ineffective in preventing the entry to this country of plants and animals potentially damaging to natural ecosystems. No screening mechanism and protocol exists for identifying imports not already present in this country that are potential threats to natural areas.

At the heart of the issue is the lack of awareness and knowledge of the potential damage that these species can cause. Education can be a means of reducing the threat from invasive nonindigenous species. People who are concerned about environmental degradation often will change their habits if they realize that what they are doing is having a negative environmental impact. But educational programs are not well organized and are poorly funded. An intensive effort is needed to reach the influx of newcomers to the state, including people from many different cultures.

The poor defense on all fronts against invasive nonindigenous species is partly a reflection of the lack of recognition by the public and government policy makers of the magnitude and seriousness of this problem. The insufficient education effort is part of the reason why the public is not more concerned.

One might say that the greatest obstacle in combating nonindigenous species is lack of funding and human resources to stay ahead of problems. But solutions are made more costly by failure to act promptly and effectively, once problems are recognized, and the lack of emphasis on preventive programs.

BACKGROUND

Nonindigenous species are those not native to a specific area but introduced anthropogenically. They are sometimes referred to as nonnative species or exotic species. Some of these species are also referred to as pest, nuisance, harmful, or invasive species.

Many such plant and animal species have escaped cultivation and become established in south Florida. Some have not only colonized disturbed sites, but also invaded natural lands that have been set aside for preservation of natural communities and landscapes. South Florida probably has more problems with aggressive nonindigenous species than any other state. The state as a whole has approximately 925 established nonindigenous plant species growing outside of cultivation (OTA 1993). Over 100 of these are listed as invasive in Florida by the Exotic Pest Plant Council (1993). At least 23 nonindigenous plants now are found in Florida's waters (McCann et al. 1994). Nonindigenous plants and land animals constitute about 25 percent of all species in the state (OTA 1993).

Many nonindigenous animal species have become established in Florida's aquatic systems: 83 fish, at least 26 insects since 1970, 2 amphibians, 3 birds, 1 mammal, 1 reptile, 5 mollusks, 1 crustacea and an unknown number of pathogens (McCann et al. 1994). Many nonindigenous terrestrial animals, particularly birds, reptiles, and amphibians, have escaped captivity and are reproducing in south Florida; 63 percent of the introduced nonindigenous bird species in the continental U.S. are found in Florida, which also has the

largest number of established nonindigenous amphibians and reptile species in the U.S. (OTA 1993).

Not all nonindigenous species are harmful. Many exotic plant species never escape cultivation. Nor are all those that spread beyond their planting site invasive. In south Florida, however, the potential for harm to natural areas from even one invasive plant species is enormous. The magnitude of the present and potential damage to south Florida's remaining natural areas from invasive nonindigenous species and the urgency for resolution are greatly under-recognized.

Problems Caused by Invasive Nonindigenous Species

Nonindigenous plant species cause severe ecologic, economic, and resource management problems in the state. Aquatic plants such as hydrilla, water lettuce and water hyacinth clog streams, canals, rivers and lakes. Aquatic weeds create a continual problem by obstructing navigable waterways throughout the Kissimmee-Okeechobee-Everglades system. Nonindigenous aquatic plants also interfere with recreation, natural vegetation, water flow, water quality and natural wildlife. By requiring control, they have been responsible for the release of tons of herbicides into south Florida canals and estuaries.

Invasive nonindigenous plants negatively impact natural areas by out-competing and replacing native species, decreasing natural diversity, decreasing local species richness, and altering topography and soils. *Melaleuca quinquenervia is* one of the key problems for the natural environment. Introduced in the early 1900s, melaleuca trees have rapidly expanded, in recent times showing a 50-fold increase; some 450,000 acres of south Florida are now infested to some degree (OTA 1993). Fire and water management have enhanced its spread. Melaleuca monocultures have replaced sawgrass marshes, sloughs, cypress stands, and other natural plant communities. By replacing native vegetation, dense melaleuca monocultures can decrease the availability of nesting and foraging habitat for endangered species such as the Snail Kite and Cape Sable Seaside Sparrow (OTA 1993).

Disturbed sites such as canal banks and fallow fields may be the first sites colonized by nonindigenous plant species escaping cultivation because the typical cover of such sites is nonnative species. The urban and agricultural development of south Florida has created many such sites where these species can become established. Water management practices that alter hydroperiods and water tables have created disturbed conditions that make natural areas vulnerable to invasions by nonindigenous plants. Catastrophic events such as hurricanes and fires increase the vulnerability of natural areas. Colonization of disturbed sites allows the nonindigenous species to develop the reproductive power with which to invade natural areas when disturbances make these areas more vulnerable. Nonindigenous species that escape cultivation can spread rapidly because the predators, parasites, or diseases that naturally control their growth and reproduction were left behind in their country of origin. Consequently, a virtually uncontrolled expansion of harmful nonindigenous plants is altering the south Florida landscape and natural biological integrity.

The potential threat of nonindigenous plant species to Florida's remaining natural areas has increased in the decades since melaleuca, Australian pine, and Brazilian pepper

trees were introduced. Ornamental plants from around the world are distributed in the nursery trade and used intensively in landscaping. Development has caused the acreage planted in nonindigenous species to greatly expand, while at the same time decreasing the acreage of native vegetation. Because of relative seed supply alone, the potential for nonindigenous species to colonize newly available sites in both disturbed and natural areas is much greater now than it was 40 or 50 years ago.

Some non-native plant species with invasive tendencies currently have larger populations in south Florida than many native plant species. For instance, while there now remains only about 8,000 to 10,000 acres of rock-ridge pine savanna community in south Florida (Doren et al. 1993), there currently exists over 700,000 acres of Brazilian pepper in nondeveloped areas and at least 50,000 to 60,000 acres of melaleuca growing as a monoculture (R. Doren, pers. comm.).

Several hundred species of nonnative animals are established in developed areas of south Florida (Robertson and Frederick 1994). Birds, herpetofauna, and fish are the most noticeable of these. The aquatic species appear to pose the most serious threat to natural areas. Many aquatic nonindigenous fish and invertebrate species are imported for sport, aquarium, or aquaculture purposes. Most are imported from tropical climates and are well adapted to the South Florida region. Accidental or intentional releases into canals, lakes, and other water bodies have resulted in the establishment of reproducing populations of a number of these species. The blue tilapia, walking catfish, black acara, oscar, Mayan cichlid, and the blackchin tilapia are the most problematic and widespread of nonindigenous tropical fishes. Almost nothing is known about the ecological effects of these nonindigenous fish and invertebrates on native populations. Prolific nonindigenous aquatic species may degrade the quality of habitat for native species, introduce diseases or pathogens, or out-compete or prey on native species. Nonnative herpetofauna such as *Anoles segrii* have displaced native congenitors such as *Anoles carolinensis.* Wild hogs are problems in some natural areas, causing extensive damage and disturbance in pinelands and hammocks, creating sites that are vulnerable to colonization by invasive nonnative plants.

Economic Consequences of Exotics

The economic costs of control of nonindigenous plants, once established in the ecosystem, are enormous. In 1992, almost $1 million was spent by three agencies to control melaleuca (OTA 1993). The cost to eradicate melaleuca from Water Conservation Area A alone is estimated at $12.9 million over 5 years, based on current rates of expansion (OTA 1993). Roughly $14 million and extensive labor are spent in Florida each year to reduce the impediment caused by aquatic weeds; $11 million alone is spent on hydrilla, water hyacinth, and water lettuce control (McCann et al. 1994).

On the other hand the economic costs of NOT controlling the harmful nonindigenous plants in south Florida are substantial. The estimated benefits of melaleuca removal, $168.6 million (OTA 1993), provide one estimate of the cost associated with melaleuca dominated landscapes. A study of Orange Lake in north central Florida indicated that tourism and recreational fishing amounting to $11 million annually is all but lost in years when hydrilla

covers the lake (OTA 1993). Brazilian pepper growing in proximity to croplands is believed to support large populations of vegetable damaging insects (OTA 1993).

Existing Control Efforts and Their Limitations

The extensive effort to control harmful nonindigenous species extends far beyond the federal realm to encompass state, local, private, and university initiatives. |

The Exotic Pest Plant Council (EPPC) is a nongovernmental group formed in 1982 to address the dilemma of invasive nonindigenous plants in Florida. One major activity of this group has been to develop an extensive, prioritized list of harmful nonindigenous plants. The list is updated every other year. Four nonindigenous plant species were suggested as the most sign)ficant concerns when the group was first formed: Melaleuca *(Melaleuca quinquenervia),* Giant Sensitive Catsclaw *(Mimosa pigra),* Australian Pine *(Casurina equisetifolia)* and Brazilian Pepper *(Schinus terebinthifolius).* The present list includes 126 problematic nonindigenous species.

The Melaleuca Task Force is composed of several concerned entities that have joined together to systematically eradicate melaleuca. Several control operations and methods are currently being researched and implemented. A complete explanation of these management programs and techniques is found in Melaleuca Task Force (1994).

The Florida Department of Environmental Protection and the Corps of Engineers contribute to and support numerous exotic removal programs. The South Florida Water Management District leads several exotic eradication efforts. The Florida Department of Transportation continually reduces and maintains invasive nonindigenous plants on right-of ways. National Wildlife Refuges, such as Ding Darling NWR, Florida Panther NWR, and Loxahatachee NWR and National Parks and Preserves, such as Big Cypress Preserve, Everglades and Biscayne National Parks, have implemented ongoing exotic elimination projects within their boundaries. On the local level, a persistent concern for the spread of the exotic Cogongrass *(Imperata cylindrica),* led to a campaign that class)fied it as a Noxious Weed in July 1993. Local county park and recreation departments' efforts have concentrated on removing invasive nonnative plants from natural areas throughout the south Florida region. The Dade County Park and Recreation Department has a multi-million dollar exotic control program under way in tropical hammock areas to help the park natural areas recover from invasions of nonindigenous plants and some prolific native vines after Hurricane Andrew.

The U.S. Department of Agriculture and the University of Florida are investigating various biological control organisms on several nonindigenous plants. Host-specific organisms are tested for their effectiveness as control agents and evidence for general safety. The introduction of host-specific insects, such as seed and sapling eaters, can safely and economically decrease the spreading of pest plants. Considerable progress has been made on the identification and testing of a biological control agent for melaleuca. At a proposed quarantine facility in Ft. Lauderdale, USDA plans to investigate the possibilities of using insects or plant pathogens to control or reverse the expansion of invasive nonindigenous plants such as melaleuca, but the quarantine facility is not fully funded.

Several federal laws deal with the importation of nonindigenous species. The Non indigenous Aquatic Nuisance Prevention and Control Act of 1990 and the Lacey Act authorize the U. S. Fish and Wildlife Service to issue regulations on aquatic and other nuisance species and restrict importations of exotic species. The U.S. Department of Agriculture (APHIS) also has responsibilities under the Lacey Act and administers the Federal Noxious Weed Act of 1974 and the Federal Plant Pest Act. USDA responsibility includes the identification of actual or potential noxious weeds and preventing their entry into the United States (OTA 1993). Neither the U.S. Fish and Wildlife Service nor the Department of Agriculture have been effective in preventing the importation of nonindigenous species potentially harmful to natural ecosystems. Under the Lacey Act, only a small number of organisms are considered nuisances: 2 families, 13 genera, and 6 species. The USDA/APHIS only inspects imported species that are risks to agricultural activities and does not screen for nonindigenous species that may be detrimental to natural communities (OTA 1993).

Recently a federal interagency group was formed entitled the Federal Interdepartmental Committee for Management of Noxious Weeds. Seventeen or 18 agencies within the Departments of Interior, Transportation, Energy, and Agriculture are involved. They are responsible for coordinating noxious weed management. They are attempting to reorient the emphasis of control efforts toward protecting natural lands and rangelands, not just croplands.

The Office of Technology Assessment report on harmful nonindigenous species (OTA 1993) is a major step forward because it provides an overview of the problem and the present institutional framework for addressing the problem and an evaluation of the current way the problem is--or is not-- being addressed. The Florida Department of Environmental Protection is planning to write a similar document specific to the state. The National Park Service is planning a similar report for the Park Service.

OBJECTIVES

The objectives of the South Florida Restoration effort, with respect to harmful nonindigenous species are to:

- Halt or reverse the spread of invasive species already widespread in the environment;
- Eradicate invasive species that are still locally contained; and
- Prevent the introduction of new invasive species to the south Florida environment, including both those now present in cultivation in south Florida and those that would be imported.

APPENDIX 1:
HABITAT RESTORATION AND MANAGEMENT STRATEGY THAT ADDRESSES THE DECLINE OF NATIVE FLORA AND FAUNA

ISSUES

The problems for wading birds and other natural flora and fauna are related to the diminishing size of the ecosystem itself. Much of the area eliminated was prime short hydroperiod habitat critically important to wading birds. The remaining wetlands are seriously degraded. The hydrologic character of the entire Everglades has been altered, consequently reducing habitat capacity and refugia. The distribution, timing, and quantity of water throughout the system have been disrupted, seriously constraining wading bird reproduction to narrow time frames subject to numerous drastic and catastrophic disruptive conditions.

In addition, excessive nutrient loading from agriculture has resulted in major vegetative conversions to both the macrophyte and periphyton communities in vast areas of the remaining Everglades: enormous areas in the Water Conservation Areas and the littoral system of Lake Okeechobee have been converted to monotypic stands of cattail and periphyton communities.

Although declining wading birds are indicators of system function, there is at present no dependable funding source for monitoring of animal groups including wading birds. A coordinated aerial wading bird census (systematic reconnaissance flights) has been underway in portions of south Florida for several years. Rookery counts and some nesting success information are collected in some areas by some agencies. Except for current small scale projects underway in the Everglades National Park and Loxahatchee National Wildlife Refuge, there has been only minimal effort to study the distribution, abundance, and trophic relations of forage fish and invertebrates that are important prey for wading birds and other vertebrate predators. Virtually nothing is known of the life history and requisite requirements of the apple snail that could be considered a keystone species to the system.

Upland habitats have been reduced to remnant areas, but still support a high diversity of native plants and animals, including several listed threatened or endangered species. Rockland pinelands in southern Dade County were heavily damaged by Hurricane Andrew and recovery has been impeded by invasion by non-native plants and a post hurricane invasion by pine bark beetles, which killed many pines. Only Long Pine Key within Everglades National Park survived relatively intact. The next largest stands are on publicly owned land (including federal property) for which the Dade County Park and Recreation Department has unsuccessfully sought funding from FEMA and the state. FEMA's unwritten policy is not to fund restoration of natural areas. The state did not appropriate requested funds in the recently passed budget. The opportunity to recover these pinelands may be lost. Loss of these pinelands could affect pineland dependent species in Everglades National Park.

BACKGROUND

The vast and heterogeneous wetland landscape that characterized the pre-drainage south Florida ecosystem supported enormous numbers of water birds, particularly wading birds. The whole system was a complex heterogenous mix of various extents of water depths and vegetative types. It was this vast heterogenous mix, maintained by fire, freezes, and rainfall extremes, that provided the habitat support for the production and survival of the diverse, yet immense populations of wading birds. The productivity, dispersal, and survival of these wildlife—the birds and their forage fish base—were regulated by the annual periodicity of the wet-dry cycles and rates of drying and flooding that concentrated the dispersed nutrient base of the system.

These wading birds represent a critical component in the trophic structure of the wetland landscapes that comprise the south Florida ecosystem. Because of their wide foraging range and their narrow foraging requirements in terms of water depth and concentrated prey, they reflect the health of the ecosystem, particularly in their ability to reproduce successfully.

Wading birds numbers have seriously declined concurrent with the drainage and development associated with the C&SF Project. The number of successful wading birds nesting throughout the system has declined more than 90 percent according to historical records. The wood stork, on the Federal Endangered Species list, is closely identified with the Everglades and its current status indicates the serious problems inherent in the entire Everglades system.

OBJECTIVES

In 1993 the federal interagency Task Force on the South Florida Ecosystem adopted several management objectives. These included:

- Restore and maintain the biodiversity of native plants and animals in the upland, wetland, estuarine and marine communities of the South Florida ecosystem;

- Provide for adequate natural habitats for native plants and animals; and

- Recover species that are threatened or endangered.

APPENDIX J:
MULTI-SPECIES RECOVERY PLAN

ISSUES

The south Florida ecosystem contains numerous listed species, many of which already have approved recovery plans. Each plan addresses only one species. A review of the plans indicates that depending on the ecological status of the species and the type of habitat they occupy, some plans are complementary and some may be at odds with one another. Thus, it may be possible to conduct an action that benefits one species while creating problems for another. The development of a comprehensive plan that looks at the ecosystem as a whole, rather than its parts, is needed. The importance of each part must be considered, but efforts need to be made to put all the parts together as a whole. Furthermore, there needs to be close coordination between the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (FWS) to ensure that the federalagencies assigned the responsibilities are working together.

Recovery plan development and implementation is further compounded because of the wide variety of land ownership and land uses. The variety of uses, management and owner expectations is even evident on public land. With a host of agencies charged with a multitude of purposes, it is difficult to arrive at mutually acceptable goals.

The problem is further compounded because of the degraded nature of many of the habitats. Large and expanding human populations, intensive agriculture, complex water control structures and invasion by a host of exotic species have made management of remnant natural systems extremely difficult.

Recovery can be a slow and difficult process where results are costly and sometimes not immediately obvious. Some of the problems associated with recovery are:

- The lack of funds available to conduct the most critical recovery actions.
- Lack of information on a species makes it difficult to design an effective recovery plan; research is necessary to answer some of the questions.
- Research will often produce unanticipated results and a new approach must be developed.
- Recovery is a very gradual process. Several generations of success may be needed before the FWS is confident that a species can be de-listed.
- Just as it took many years for a particular species to decline, it may take many years to reverse the decline.

BACKGROUND

A large number of federally listed threatened or endangered species occur within the south Florida ecosystem. One of the purposes of the Endangered Species Act of 1973 is to provide a mechanism to protect threatened and endangered species and provide a program for their conservation. Conservation is defined as bringing a species to the point where the measures outlined in the law are no longer necessary. The process of taking the species from its listed status to full conservation, that is reversing the decline and neutralizing the threats, is called recovery. A species restored to a healthy condition no longer needing the protection of the act is considered recovered. Our goal will be to recover all listed species in the south Florida ecosystem.

Section 4 of the Endangered Species Act requires that the Fish and Wildlife Service and the National Marine Fisheries Service develop recovery plans for all listed species. These plans are an integral part of the overall recovery program whose primary goals are:

- Identification of those ecosystems and organisms that face the highest degree of threat;

- Determination of the tasks necessary to reduce or eliminate the threats; and

- Application of the resources available to the highest priority recovery tasks.

The first step in the recovery process is the development of a recovery plan that delineates, just)fies, and schedules the research and management actions necessary to recover a species. The plans are comprehensive documents that identify all known recovery actions and anticipated costs. These plans serve as blueprints for private, federal, state, regional, and local interagency cooperation because they identify specific actions and the appropriate responsible agency.

Recovery plans serve as a catalyst to encourage all participants to work toward species recovery. They have been very effectively used as an impetus for budget formulation, agency policy review and development of agency management plans.

OBJECTIVE

The management objective is to recover species that are threatened or endangered. This recovery will involve restoring health to the entire ecosystem. Such an approach will prove beneficial to many other organisms in the ecosystem. Efforts will be focused on ensuring the protection of biodiversity emphasizing the importance of community associations and habitat protection and enhancement.

CURRENT ACTIVITIES AND APPROACH

The Fish and Wildlife Service and the National Marine Fisheries Service have developed individual recovery plans for most of the species in the south Florida ecosystem. These plans vary greatly in quality and some are in need of revision. Some species are

receiving funding attention and some are not. There are active recovery programs under way for a number of the more visible species.

The state of Florida is also actively involved in recovery efforts for many listed species. Through Section 6 of the Endangered Species Act (ESA), the Fish and Wildlife Service can provide funding on a three-to-one ratio to states that have a cooperative agreement. In Florida, the Florida Game and Fresh Water Fish Commission, the Florida Department of Environmental Protection (for marine species) and the Division of Forestry (part of the Florida Department of Agriculture and Consumer Services) have agreements with the Fish and Wildlife Service. These three agencies cover all listed species from marine mammals to plants. All three agencies are actively involved in recovery of listed species in south Florida and work closely with the services in accomplishing actions identified in approved recovery plans.

The services also use recovery plans and the actions they contain to make specific recommendations to federal agencies and applicants who are required to enter into consultation under Section 7 of the ESA. Through the Section 7 program federal agencies are required to consult with the Fish and Wildlife Service (and the National Marine Fisheries Service) on actions they authorize, fund, or carry out that "may affect" listed species or "destroy or adversely modify" critical habitat. The services conduct hundreds of consultations each year on federal agency actions which range from permits for wetland fill authorized by the Corps of Engineers to road and runway projects funded by the Federal Highway Administration and the Federal Aviation Administration. During these consultations the services make recommendations on how project impacts can be reduced or encourage actions to be taken to improve the status of listed species. The basis for most of these recommendations is approved recovery plans.

The vast array of recovery efforts and the development and implementation of recovery plans need to be coordinated in a cohesive manner. The goal is to develop a comprehensive, ecosystem wide-recovery/management plan that recognizes the needs of each species and is responsive to the varying objectives of the agencies charged with managing the land. It is hoped that we can develop a consolidated and unified strategy that, within the objectives of the Endangered Species Act, Nvould look at all endangered species and their habitats in the system and deal with them holistically rather than on an individual basis. Only a system-wide approach will ensure that all species are protected and none are protected at the expense of others. It must be recognized that actions to protect listed species associations will benefit many other life forms that occur in the same area. Threatened and endangered species do not exist as independent species, they are active components of the larger system. Responsible management actions that benefit listed species will in most cases benefit the overall ecosystem.

FUNDING AND LEAD AGENCY

The Fish and Wildlife Service, in close coordination with the National Marine Fisheries Service, will lead this effort. Staff of each agency will work together in a complimentary fashion. Funding may be supplied to the State agencies, universities or private consulting firms to carry out individual tasks. The goal is to have a comprehensive

plan that embraces all agencies and interest groups and solicits support from agriculture and business to federal, state, regional, county and city government.

It is estimated that the development and approval of a Multi-species Recovery Plan will take two years; one year to prepare a draft and one year of review and refinement. In order to meet the two year date it will require three full-time staff biologists with appropriate clerical support. These individuals will need to be experienced in the Recovery Program of the Fish and Wildlife Service and will be assigned this responsibility as their full-time job.

There will be additional costs associated with reproduction of plans, public meetings, etc. A comprehensive plan will be of great value to land owners and managers alike.

APPENDIX K:

HABITAT RESTORATION AND MANAGEMENT PLAN STRATEGY--FOR NEAR COASTAL WATERS INCLUDING FLORIDA BAY, THE FLORIDA KEYS AND THE CORAL REEF SYSTEM

MAJOR ISSUES

Much of the interest in south Florida ecosystem restoration has focused on the Everglades National Park and the historic Everglades terrestrial and freshwater ecosystems. While restoration efforts directed at the Everglades ecosystem may benefit the coastal, nearshore and offshore systems of south Florida, additional efforts will be necessary to restore these areas. Chronic losses in near-coastal waters have been amplified by recent dramatic events such as massive seagrass, mangrove, and faunal die-offs as well as other symptoms such as increased algal blooms, reduced fish landings, overall deterioration of fringe reef systems, and decreased species diversity in flora and fauna (aquatic and terrestrial).

Alteration of Freshwater Flow to Estuaries: The C&SF Project altered the quantity, timing and distribution of freshwater entering the estuaries. Hypersalinity in the bays, presumably resulting from the freshwater flow alterations, has been suggested as one causative factor in the seagrass and mangrove die-offs. Channelized freshwater flow, chronic, and episodic voluminous releases from control structures have caused marine faunal and floral mass mortalities and habitat loss.

Water Quality Degradation: Pollutant input, particularly excess nutrients, has contributed to the observed loss and degradation of nearshore and offshore habitats such as seagrass and coral reefs. Likely primary sources of pollutants include urban runoff within the Florida Keys and upstream, agricultural runoff and industrial runoff. Other possible sources include recreational and commercial boating activity and point/nonpoint source discharges from other countries which end up in ocean currents moving along the south Florida coastline.

Loss of Habitats to Development: Aquatic and terrestrial habitats have been affected directly and indirectly by the development boom. The resulting methods of sewage disposal (e.g. septic systems, shallow well injection, cess pits), lawn care, traffic, etc., also contribute as nonpoint sources of pollution, resulting in the degradation of local water quality and loss of habitat (seagrass, mangrove, "live" hard bottom) from dredge and fill activities.

Impacts to Habitats From Recreation and Commercial Activities: Boating impacts have caused significant damage to both seagrass and coral reefs. Over 10,000 acres of seagrasses have been destroyed by propeller scarring in the Florida Keys. An average of over 40 small vessel groundings occur each month in the FKNMS; many result in direct impact to coral reefs. Additional impacts occur from boats anchoring on corals, or improperly moored live-aboards that directly impact seagrasses and other important marine

habitats. Hard bottom habitats, coral rubble, and coral reef substrate that support a wide diversity of reef organisms are under increasing pressure from harvest as the demand for live rock in the aquarium industry increases. An increase in commercial sponging in the Keys has added additional pressure on the sponge community, another important component of the ecosystem. The cumulative impact of a wide range of commercial and recreational activities contributes to habitat and water quality degradation.

BACKGROUND

Coastal and nearshore communities are highly productive ecosystems that support a wide variety of species and provide economic and social benefits. Commercial and recreational fisheries, diving and snorkeling, wildlife observation, boating and swimming are just a few of the activities that contribute to the economic and social well being of south Florida. The continued health and productivity of these natural systems depend on maintaining a viable balance among their various components and the pressure of the human activities.

Local fishers and divers have noted subtle changes in south Florida's nearshore and offshore habitats for the past decade: changes in water color and transparency, reduced fisheries landings, and a general decline in the coral reef habitats. Symptoms of these ecological changes began in the early 1980s with fish die-offs, coral disease outbreaks, coral bleaching, and other changes in the health of the natural resources. This general degradation was dramatically illustrated in 1987 when Florida Bay began experiencing a sudden, massive die-off of seagrass. Around the same time, and in many of the same general areas, mangroves on wash-over islands also experienced die-offs. In addition, a coral bleaching event occurred along the length of the coral reef tract that parallels the Florida Keys. Some of the causes of degradation are obvious: increased development, boating activities, a proliferation of septic tanks and artificial canals, etc. However, there are disparate theories within the scientific community regarding the specific causes of many of these occurrences. Theories include reduced freshwater inflow to the estuaries due to the C&SF Project, excess nutrients from upland runoff and contaminants from upland runoff. Until specific causes of the degradation are identified, management of these habitats must depend on existing knowledge and best professional judgment.

OBJECTIVES

- Restore natural or near natural freshwater distribution to south Florida bays and estuaries, including Florida Bay.

- Provide adequate treatment of runoff from urban, agricultural and industrial areas to remove contaminants and excess nutrients (primarily nitrogen and phosphorus). Treatment activities should include Florida Keys upland areas as well as upstream areas on the mainland.

- Identify, reduce and eliminate pollution from septic systems, bilge pumps, "heads", foreign sources, etc.

- Achieve a no-net habitat loss due to development.
- Produce a net increase in value and function of existing habitats through restoration, enhancement and management.
- Restore historic fisheries productivity.
- Eliminate adverse impacts of recreational and commercial activities on existing habitats.
- Identify additional causes of ecosystem degradation.

GEOGRAPHIC SCOPE

For consistency, the geographic scope of this habitat restoration and management plan is the same as Subregion 8 for the Science Subgroup. It encompasses the coastal, nearshore and offshore areas from Biscayne Bay on the Atlantic Ocean, around the Florida Keys, and up to Rookery Bay on the Gulf of Mexico. Consideration may be given to expanding the scope at a later date to include all of the three "focus areas" identified in the U.S. Fish and Wildlife Service's South Florida Coastal Ecosystem Restoration Initiative (FWS Coastal Initiative). The three focus areas include Florida Bay/Florida Keys, Indian River Lagoon/Lake Worth and Charlotte Harbor.

APPENDIX L:
SUPPORT LAND BASED PROTECTION STRATEGY

ISSUES

Public protection of land values critical to sustainable environment and development in south Florida, is based in local, county, and regional land use plans and zoning. Compliance is achieved through information and education or through regulatory enforcement. While these plans usually reflect a good sense of community needs and interests, they often do not reflect clearly how to integrate into broader ecosystem based strategies of environmental restoration and sustainable economic development.

Significant efforts must be undertaken by federal agencies, coordinated through the ITF and its Florida-based IWG to offer and provide scientific and technical planning assistance to state, regional, county, and local comprehensive land-use planning efforts to fully integrate ecosystem-based sustainability objectives and conforming solutions. Successfully conforming a plan with provisions to assure its implementation should be met with authority for expedited clearance of required federal permits and approval necessary for implementation.

As effective as these efforts can be to accomplishing environmental protection and sustainable development strategies, public acquisition and direct management of critical land remains an important component of restoring environmental values and sustaining development and the population of the south Florida ecosystem. It is not the purpose of this appendix to propose specific lands for acquisition. This is being accomplished by several ongoing activities interwoven into the restoration effort. Existing approved public acquisition activities pertinent to sustainable ecosystem goals are identified in the Objectives segment of this appendix. We endorse the completion of these actions. Further, there are several strategies that pertain to land acquisition that need to be more fully developed. Among these are:

- A methodology or evaluation criteria for identifying and prioritizing specific types of lands that must be publicly acquired and directly managed to accomplish and sustain ecosystem restoration; some are critical, some important, others marginal;

- Responsibilities (who), scheduling and funding for land acquisition will need to be clarified; and

- Strategies for land acquisition need to be developed.

BACKGROUND

The general trend of water resource development in south Florida during the 100 years before the Central and Southern Florida Project had been more or less defined before Florida became a state. Leaders of the day had grand visions of extensive agricultural

development of the muck lands around the Kissimmee Valley lakes and Lake Okeechobee. On admission into the Union in 1845, the Florida Legislature instructed the senators and representative from the state to press upon the Congress the importance of reclaiming the Everglades.

In connection with all the activities revolving around the Everglades, one of the state's first two U. S. Senators, J. D. Westcott, proposed to the Congress that the United States grant to the state those lands lying south of a line from Sarasota on the west coast to Walton on the east coast (with certain exceptions) provided the state would undertake the reclamation of the lands. Senator Westcott introduced a bill making specific provision for the grant. The bill was referred to the Committee on Public Lands, which considered it in connection with other available information.

Largely as a result of Senator Westcott's activities, and that of other states, Congress, in 1850, passed what is generally referred to as the Swamp and Overflowed Lands Grant Act. The act granted to Florida those swamp and overflowed lands which remained unsold at the time of the passage of the act, with the stated purpose to enable the state to reclaim the swamp and overflowed lands. This donation included the major part of the peninsula, large areas of which were not wetlands or identified swamp and overflowed lands. At the time it was thought to be about 12 million acres, but was later discovered to be over 20 million acres, including the Everglades. An important stipulation in the act was that the sale of the lands to private interests should finance the necessary work of reclamation.

The fate of the lands in the Everglades then went through a series of events punctuated by the state's creation of the Trustees of the Internal Improvement Fund to sell the donated land; the Civil War; the era of Hamilton Disston, hired by the state to drain the Everglades; the Everglades Drainage District, created to take up where Disston left off; the opening of the area south of Lake Okeechobee to farming; the Florida land boom; the major hurricanes of 1926 and 1928 which led to the levees around Lake Okeechobee; the Great Depression; the creation of the Everglades National Park; and the Central and Southern Florida Flood Control Project in 1948.

The cumulative effect of these actions including the features of the Central & South Florida Project has succeeded in accommodating and supporting a 5.5 million population along with a large and diverse economy.

The state and the federal governments now find themselves in the position of having to repurchase or provide regulatory protection to large tracts of land included in the original land grant to preserve and restore critical hydrological and biological functions of the same Everglades considered 150 years ago to be "utterly worthless to the United States for any purpose whatever."

Other lands are being identified by state, county, and local governments for repurchase or zoning protection to ensure a clean and sufficient supply of water for a growing population and economy.

Significant contributions to these purposes are also being made voluntarily by some private landowners and non-governmental organizations.

The result is a mosaic of land uses, protection activities, and strategies across the south Florida ecosystem.

OBJECTIVES

Probably the best vehicle to tackle these issues would be the development of a multi agency land protection strategy. It would outline the land protection process from identification through management of acquired land.

- Development of evaluation criteria for the specific types of lands required for ecosystem restoration;

- Identification and inventory of all lands currently in public ownership, lands being and to be acquired by public entities, and lands identified in current reports which may be acquired by public entities. This would include lands owned by, to be acquired by, or identified by various federal, state, or local government agencies; including any lands identified by the Interagency Task Force and Working Group and sub-groups; by the Corps restudy; and any other source interested in Everglades restoration. This would be an iterative process, and would be included in the land protection strategy.

- Prioritization of identified lands. Determine which are the most important lands and types of lands with respect to restoration/availability; which are the least important.

- Determination of levels of title needed for various lands or types of lands identified for acquisition. Where would fee acquisition be needed, where would easements be adequate, where would zoning be appropriate, etc.

- Availability of land use mapping Using on-line GIS systems, county master plans, wetland mapping, etc.

- Existing mechanisms for land protection by responsible agencies, include:

    - negotiated free market acquisition;

    - eminent domain and/or necessary legislative authority;

    - funding sources (input from another sub-sub-group);

    - land swap potential;

    - zoning ordinances;

    - tax incentives in return for land donations;

- mitigation banking;
- private initiatives, such as the Trust for Public Lands;
- establishment of real estate arrangements to facilitate donation of private lands or private funds for restoration; and
- any other initiatives available to acquire interest in land.
- Development of a land management strategy for all lands acquired by federal, state, and local government agencies for ecosystem restoration to provide for consistency.
- Obstacles to land protection initiatives including mineral rights, tax losses, infrastructure changes, community acceptance, relocation services, ad infinitum.

The charge for the group would be to deliver a report that addresses all the issues identified herein, and all others that are determined at a later date. The end product would be a stand alone document that could be used by the task force, the Corps study team, and all other interested parties to understand the land acquisition ramifications of the restoration efforts.

APPENDIX M:
COORDINATED ECOSYSTEM BASED SCIENCE PROGRAM

INTRODUCTION

This Science Plan and its extended version is designed to provide scientific information to help guide the restoration. The Science Plan outlined here is directed at the following themes:

- Characterizing the pre-drainage system;
- Determining the key characteristics of the natural hydrologic system that supported the rich diversity and abundance of wildlife that has been lost;
- Predicting effects of alternative structural modifications and operational changes;
- Assessing the hydrologic and ecological results of these changes;
- Evaluating the impact of present and alternative urban and agricultural practices; and
- Recommending modifications of design and urban and agricultural practices.

PROJECT MANAGEMENT

The Science Sub-group is developing a detailed description of the scientific support required for the south Florida ecosystem restoration effort. The objective is to formulate an overall research plan, describe relevant ongoing efforts that will be integrated into the overall plan, and identify gaps. Interagency planning efforts are being initiated to ensure efficiency and integration of efforts. This approach involves broad involvement of the scientific community and appropriate peer review. Regular communication of progress will be scheduled to obtain essential feedback from primary constituents: restoration managers, environmental and economic interest groups, and the general public. Data management requirements for all projects follow the policies agreed to by the interagency U.S. Global Climate Change program to ensure data compatibility. A difficulty in achieving these goals is that management responsibilities for south Florida ecosystem restoration are currently fragmented. Ludwig et al. (1993) in the third principle of effective management states that scientists should be relied on to recognize problems, but not to remedy them, noting that individual scientists are heavily influenced by their discipline training and that interactions involving many disciplines are critical to solving ecosystem management problems. Ludwig also notes that individual scientists in management situations have often been subject to intense political pressure that influences their decisions, but without a broader community aware of the impact of such pressures. The Science Sub-group has attempted to deal with these issues by being a collective body with a significant mix of disciplines and interacting directly through the Interagency Working Group made up of agency managers with responsibilities for decision making.

The Florida Bay Science Plan has already been developed. Its management structure involves an interagency program management committee, an interagency technical advisory group, and a scientific panel of nationally recognized scientists.

COOPERATION

Research currently underway or planned at the South Florida Water Management District (SFWMD), Florida Department of Environmental Protection, the University of Florida, and the Florida Game and Fish Commission is a vital component of this Science Plan. For example, the existing hydrologic models (the South Florida Water Management Model [SFWMM] and its natural system corollary [NSM]) that will be the core of the proposed hydrologic modeling system were developed by SFWMD and already are undergoing considerable upgrading that will make them even more useful in restoration modeling. SFWMD also is developing a landscape model (Everglades Landscape Model [ELM]) that could be expanded in scope to be extremely useful to the restoration effort. SFWMD is engaged in other modeling, monitoring, and process-oriented studies in support of the Surface Water Improvement Act, the Everglades Forever Act, and the Settlement Agreement. These efforts are focused primarily on resolution of water quality problems, particularly phosphorus. Integration of all public and private activities with federal efforts into a South Florida Ecosystem Restoration Science Plan is essential to a successful restoration.

MONITORING

Monitoring is essential to the restoration process. It will provide necessary information for fine tuning the predictive models and ultimately evaluating the degree to which the restoration is successfully meeting its stated goals and objectives. Therefore, development and implementation of a comprehensive system-wide monitoring plan is a critical first step in the restoration process. Numerous on-going and planned monitoring programs exist throughout the region. The need to assess, coordinate, and integrate these programs into the South Florida Ecosystem Restoration Science Plan is absolutely imperative.

As a first step at integration and coordination of monitoring activities among the various interested agencies, representatives from the Science Sub-group, the Federal Geographic Data Committee (FGDC), the Florida Department of Environmental Protection, and the SFWMD have jointly arranged workshops to encourage the coordination, sharing, and mutual archival of all geo-spatial information regarding the Kissimmee-Okeechobee Everglades watershed. The workshops are preliminary to establishing a joint federal, state, and local geo-spatial data agreement that insures format QA/QCs, metadata protocols, and electronic retrieval-archival capabilities for coordination and data sharing. The workshops will be useful in identifying data gaps in terms of geographic areas and types of information not covered. They will highlight opportunities for further coordination and resource sharing (e.g., NBS GAP, NOAA C-CAP, USGS NAWQA, NWI Wetlands, and GFC Integrated Habitat Plan).

MODELING

Modeling activities include the design or adaptation of several categories of models. models of physical processes (hydrologic, hydrodynamic, transport, and meteorological models), ecosystem models (landscape and ecological models), and water quality models (models of nutrient uptake and cycling in waters, soils, and the biota—and models of the movements, chemical transformations, and bioaccumulation of contaminants such as mercury). One important task will be to integrate the models into an interactive capability.

An integrated hydrologic modeling system covering the entire south Florida ecosystem, developed from existing sub-regional models, is the critical first need of the restoration effort. The output of hydrologic models will drive all the other types of models. The hydrologic models will support model-based research related to natural resource rehabilitation, as well as agricultural and urban sustainability. Critical components of the hydrologic modeling system will be natural systems model versions in which all canals and other control structures have been removed and the pre-drainage topography has been reconstituted. Their output will provide the most objective view of the structure and function of the pre-drainage hydrologic system.

A present impediment to the development of system-wide modeling capability is that there is no mandate for any state or federal entity to model the entire south Florida restoration region. It is imperative that a group dedicated to this task be established.

Landscape and ecological models involving populations and communities will enable hydrologic information to be evaluated in terms of ecological effects. Since the landscape influences water flow and is subsequently shaped by it, hydrologic and landscape models eventually will be linked to allow two-way interactions so that the effect on water flow of long-term processes such as soil building and landscape pattern formation can be followed. Individual-based species models will assess the effect of changes in hydroperiods and hydro-patterns on the reproduction responses of populations such as colonial nesting wading birds. Because the foraging area of such species is so broad and foraging success is closely coupled with hydrologic patterns, modeled trends in abundance and recruitment in these populations will reflect trends in ecosystem function. In a parallel effort, statistically based habitat association models will be used to evaluate potential species responses to various conditions of changing hydropatterns, hydroperiods, and vegetation types.

Ecological model development will start at the beginning of the restoration effort. Only the development and application of ecological models, even with cursory data, can reveal the type of information that is necessary from hydrologic and hydrodynamic models and demonstrate why it is needed. Research and monitoring will be fully integrated with the modeling.

Estuarine hydrodynamic models will allow the output of hydrologic models to be translated into salinity and circulation patterns in estuaries. This information will help determine how proposed modifications in the C&SF Project will affect the estuarine resources in Florida Bay and, eventually, other estuaries. Fine-scale hydrodynamic and

transport models will enable the movement of nutrients and contaminants such as mercury in freshwater wetlands to be followed.

Meteorological modeling will be used to improve the grid of rainfall estimates needed as input to hydrologic models. South Florida's rainfall is so spatially variable that the current monitoring network may not adequately reflect the spatial pattern. Surface water and soil moisture influence rainfall and are required inputs to the meteorological model. Therefore, the meteorological model will eventually be used to determine the extent to which the C&SF Project and its predecessors may have affected south Florida's rainfall and evaluate restoration alternatives for their potential effect on rainfall. This will require linking the meteorological and hydrologic models so that two-way interactions can occur.

MODELING, MONITORING, AND RESEARCH

Hypothesis testing research must be closely linked to the modeling and monitoring effort. By conducting research, we can develop an understanding of the physical and ecological processes regulating the south Florida ecosystem status, test model predictions, and evaluate cause and effect relationships.

HYDROLOGIC PROCESSES

The hydrologic modeling effort has three parallel tracks: model improvement, model development, and model application. Models are used in conjunction with process studies and monitoring. Both water quantity and water quality issues can be addressed with hydrologic research because water movement influences water quality.

The first step in the hydrologic modeling effort will be to develop a hydrologic modeling system that covers the entire south Florida ecosystem land base. In the immediate term, existing models will be upgraded, models will be developed for areas not yet covered by appropriate hydrologic models, and the models will be integrated with one another.

Several areas of south Florida have no adequate existing models to assist restoration efforts. Spatially explicit models that include both surface and ground water do not presently exist for southwest Florida. Existing models do not have the topographic detail needed to adequately model freshwater flows to estuaries. Therefore, more detailed models for the coastal areas are needed. Such a model is particularly important to determining how to establish a more natural timing and volume of freshwater inflow to Florida Bay.

At the same time existing models are being improved, a more advanced and comprehensive modeling system will be developed. New models will take advantage of more powerful programming languages and support systems.

These are the fundamental steps of the hydrologic research plan for the entire south Florida ecosystem:

- Characterize natural hydrologic structure and function;

- Assess present-day conditions;
- Formulate specific restoration objectives that consider natural system requirements and societal demands
- Develop and evaluate alternative strategies for achieving the objectives;
- Define success criteria;
- Implement the above through the structure and operation of the C&SF Project system; and
- Evaluate implementation consequences using success criteria.

Process studies and measurements are needed to improve algorithms and parameters such as evapotranspiration, flow resistance, levee leakage, and seepage in the hydrologic models. With respect to associated water quality modeling, process studies will examine geochemical processes, nutrient cycling, and biological activity in the water column and sediments.

Hydrodynamic and transport models for wetlands may be needed to provide input to water quality models concerning nutrients and contaminants. These have not yet been defined. A meteorological model to provide improved rainfall estimates and interact with the hydrologic models is another model of physical processes to be used in the restoration effort.

HYDRODYNAMIC PROCESSES

Many of the major issues concerning Florida Bay could be better addressed by the use of a hydrodynamic model that simulates salinity patterns and circulation processes with the bay as a function of freshwater inflow, local precipitation, wind, and regional circulation processes. These regional processes need to be defined by regional circulation models of the eastern Gulf of Mexico and the Florida Straits. Therefore, the scope of the hydrodynamic modeling program must of necessity extend beyond the boundaries of Florida Bay to the processes influencing conditions along the boundaries of the bay.

A workshop sponsored by Everglades National Park and organized by the Florida Institute of Oceanography, in cooperation with NOAA, was held October 13-14, 1993.

LANDSCAPE PROCESSES

The tools to address landscape issues are landscape models, trend and gradient analyses, and paleo-ecological investigations. Some major questions of restoration can only be answered with landscape models. For instance, what processes shape landscape structure? How are these processes and landscape structure affected by barriers such as roads, levees, and canals? What are the landscape-scale ecosystem functions in this

system? How are landscape-scale ecosystem functions affected by barriers? How are these functions affected by water management?

Landscape modeling is dependent upon hydrologic modeling and needs to be fully integrated with hydrologic modeling studies. Landscape models, in combination with hydrologic models, are needed to address ecosystem-level questions concerning wildlife.

Models and paleo-ecological results can be mutually supportive.
The landscape model can be verified by imposing the C&SF Project on the pre drainage landscape and simulating the landscape change over time; the resulting landscape can then be compared to the present landscape.

A seascape model—for example, Florida Bay estuarine and Keys model that includes bottom topography and the overseas highway—is required to adequately model salinity and circulation patterns and nutrient/biota dynamics in Florida Bay and the Florida Reef Tract.

In addition to models, trend and gradient analyses in both a monitoring and research mode and retrospective paleo-ecological studies are required to support the modeling and to generate additional information.

ECOLOGICAL PROCESSES

Ecological models are an essential component of the South Florida Ecosystem Restoration Program. Ecological models that relate species, communities, and landscapes to the simulation outputs of hydrologic models are the only objective way to evaluate alternative water management strategies for their influence on landscapes, plant communities, and wildlife. These models must demonstrate how certain key features of the pre-drainage Everglades—large spatial extent, spatial heterogeneity, sheet flow, and dynamic storage—supported a healthy ecosystem. A quantitative explanation of the connections is needed to strengthen understanding about why these system attributes must be reinstated and to communicate this understanding to others.

Comparison of population trends, plant community succession, and various ecological processes simulated under present and pre-drainage conditions, given the same time series of rainfall, can be used to gain perspective on how the system has been changed, an understanding of the natural relationship of spatial and temporal patterns of hydrologic conditions with species, communities, and landscapes characteristic of South Florida, and an ecologically supportable, objectively determined, and relatively unbiased target for restoration efforts.

Models are needed for key categories of species. For example, Wood Storks and snail kites, which, because of their wide foraging area and specific foraging requirements, reflect ecosystem functioning at the landscape level in their recruitment. Pink shrimp, which, because of their position at the lower end of the food chain, represent the overall productivity of the ecosystem with their recruitment.

The capability to predict community-level responses to water management changes is needed. Important communities to examine include periphyton communities in the

freshwater Everglades, nuisance algal blooms in Florida Bay, freshwater macrophyte communities experiencing a change in species dominance, wading bird communities, and the fish communities supporting the birds. The need to control the spread of invasive non native species into native plant communities is another community-level concern that will be addressed by modeling.

Understanding the entry of mercury into the ecosystem, its transport, transformations, and accumulation in food chains requires models capable of integrating across several scales.

URBAN AND AGRICULTURE

The management goal is to recreate the overall hydrologic support functions for our remaining natural areas that, prior to drainage, were provided by the lands now occupied by urban and agricultural areas—while, at the same time, improving quality of life for human populations. Working to achieve this and related goals is a major scientific challenge.

The increased human population and human activity in south Florida have brought with them not only an increased need for water but also a decrease in water supply and deterioration in water quality. Issues of land use, routing of stormwater runoff, and disposition of treated waste water all relate to concerns for human water supply. Loads of nutrients, various contaminants, and total organic carbons associated with human alterations of the systems affect the quality of water vital to both human and natural systems. Several proposed science plan topics address these problems.

South Florida has productive agricultural systems that could contribute to—and benefit from ecosystem restoration. The EAA now contains a productive agriculture of major economic importance to the region. However, this agriculture is on organic soils that are losing depth, primarily due to microbial oxidation resulting from drainage. This continued loss of soil depth is a severe concern. The release of phosphorus and dissolved organic carbons into drainage waters are environmental concerns associated with soil subsidence. Previous studies suggest that a zero subsidence agriculture producing present crops and maintaining current harvest levels is an achievable goal through research. A research program is proposed with the objective of developing the technology for this zero subsidence system. It is possible that successful research would help modify the hydrologic function of the EAA, with respect to downstream natural ecosystems, to more closely resemble the hydrologic function of the area prior to drainage (i.e., providing dynamic storage and allowing conveyance of water from Lake Okeechobee). One of the following science plan initiatives relates to this topic.

In general, studies must address these questions: What are the critical feedbacks of the natural system to urban and agricultural systems and vice versa? How will the natural system and its support functions for humans be affected by different population levels and land-use configurations? What landscape combination will allow healthy natural systems and urban and agricultural systems to coexist?

APPENDIX N:
PUBLIC INFORMATION AND EDUCATION

ISSUES/PROBLEMS

While the public often recognizes the importance of the ecosystem and, according to a recent study, supports the clean-up of the Everglades, there are "strong doubts over government's ability to use the money for its intended purpose." The survey also reported that the public did not differentiate clean-up of the Everglades from restoration. During December 1993 public workshops for the C&SF restudy, opposition was expressed by many to restoration which meant loss of homes and businesses while others expressed opposition to a continuing degradation of the ecosystem to support the economy. This points out the need to present information and educate the public about restoration and sustainable development.

Litigation further complicates the scenario with parties filing suit over enforcement of water quality standards, payment for damages and clean-up, and to stop proposed restoration projects. Ongoing litigation and the threat of further litigation has fostered polarization of the stakeholders as well as a climate of distrust in south Florida.

The objective of the restoration effort is to develop and foster a coordinated, well supported, balance among the federal, state, regional, and local agencies; interest groups; and the public. This plan will be doomed to failure if the state agencies are not seated as full partners on the Interagency Working Group or the Task Force. Therefore, fulfilling the requirements of the Federal Advisory Committee Act (FACA) is necessary.

BACKGROUND

There are numerous stakeholders in restoration efforts in south Florida. These stakeholders have competing goals and expectations. Federal agencies' ongoing activities include the Central and Southern Florida (C&SF) Project restudy, the restoration of the Kissimmee River, and the Everglades Expansion Act land purchases. State agencies' plans and activities include the South Florida Water Management District's Save Our Rivers program which has acquired over 150,000 acres of land for public ownership, the Save Our Everglades plan which has acquired over 326,000 acres of land, and the South Florida Water Management District Lower East Coast Water Supply Study. The Everglades Construction Project under the state's Everglades Forever Act, will involve a massive construction effort. Special interest groups have also joined in the restoration efforts: the Everglades Coalition has published a Greater Everglades Ecosystem Restoration Plan. While restoration proceeds, development and water supply must keep pace for the rapidly expanding population of south Florida. The state provides 25 percent of the sugar grown in the United States (all from the south Florida ecosystem) and its citrus crops and winter vegetables contribute jobs and millions of dollars to the economy. The tourism industry which is in part dependent on fishing, beaches and diving contributes enormously to the economy and creates a wide variety of employment. The Miccosukee and Seminole Indian

Tribes make their home in South Florida and have an historical and legal interest in restoration.

Many Federal agencies have ongoing public information, education, and involvement activities that vary from minimal to very extensive. In many instances, they are project or issue specific, but are not usually multi-agency in their approach. Recently, there have been some efforts to develop more comprehensive public involvement strategies: The Corps of Engineers C&SF Project Comprehensive Review Study has attempted to involve a large segment of the public through the use of workshops.

SCOPE

Restoration activities of the Interagency Task Force and the Interagency Working Group will take place in the south Florida area and possibly impact natural resources and activities of local residents. Because the Everglades ecosystem is a resource that can positively impact the entire state, there is a need for the activities to be understood not only in south Florida, but in the entire state. Additionally, agencies will propose activities whose benefits will need to be communicated to Congress and national interest groups.

OBJECTIVES

The ultimate objective of public information, education, and involvement is to develop and foster a coordinated, well-supported, balanced restoration effort among the federal, state, regional, and local agencies; interest groups; and the public. The activities proposed will:

- Provide stakeholders and the public facts on the purposes, costs, and benefits of the activities of the Interagency Task Force and the Interagency Working Group so that informed decisions can be made;

- Increase public awareness of the importance of ecosystem restoration and actions that can possibly contribute to the restoration; and

- Provide a mechanism for input from stakeholders to the Interagency Task Force and the Interagency Working Group on proposed activities.

These activities should be coordinated by a Public Information and Education Working Sub-Group, made up of public information specialists at the member agencies.

The Public Information and Education Working Sub-group would be responsible for implementing the activities outlined in this public information, education, and involvement plan. In addition, each agency should ensure that its public information specialists coordinate activities with the Interagency Working Sub-group. The lead agency should be the Everglades National Park. As such, it should ensure that all provisions of FACA and NEPA are met insofar as public coordination of Working Group activities and reports are concerned.

APPENDIX O:
STATE, LOCAL, AND TRIBAL PARTNERSHIPS

BACKGROUND

There are myriad public agencies and private organizations working on various aspects of the restoration of the south Florida ecosystem. In the past year this altogether confusing array has distilled into major groups. The federal effort, made up of the Interagency Task Force and the Interagency Working Group and sub-groups, is only one focal point; others include:

- On the state level, the Florida Department of Environmental Protection Ecosystem Initiative;
- On a regional level, the South Florida Water Management District;
- The academic effort chartered as a case study through the Man and the Biosphere program;
- The Governor's Commission for a Sustainable South Florida that pulls together, in an advisory capacity, people representing all levels of the private sector—from agribusiness to the conservation community;
- Other organizations of government including the Seminole and Miccosukee Tribes as sovereign governments and the county land-use planning departments; and
- A wide range of private interests and concerns, such as the Everglades Coalition.

All of these entities have significant interests and responsibilities that can feed into one of the processes discussed in the report of the Interagency Working Group.

We feel that the myriad efforts and integrated systems associated with ecosystem management and sustainability need to work together toward unifying their visions for restoration in south Florida. The best mechanism for accomplishing ecosystem restoration seems to be a synthesis of all of these efforts. The federal Interagency Task Force is only one of a number of essential participants. Our mutual vision cannot be fully articulated or accomplished until all the participants are fully integrated.

PROPOSED ACTIONS

To date, while there has been communication and some effort at coordination among these groups, this in no way represents the development of an integrated process that must be the objective for the coming year. Further steps must be taken to:

- Schedule coordinated public meetings by the Interagency Working Group that provide regular opportunities for the major groups involved at the federal, state, and regional level in ecosystem management to communicate and coordinate with the Interagency Working Group (This has been started with the Governor's Commission on a Sustainable South Florida);

- Seek an amendment to the Federal Advisory Committees Act (FACA) to categorically exempt employees of other government agencies with responsibilities so they can work together on ecosystem strategies;

- Recommend the establishment of a federal advisory committee under FACA to provide a forum for other knowledgeable and interested individuals and organizations to provide expert opinion and recommendations to the Task Force and Working Group; and

- Support efforts to establish and maintain a publicly accessible electronic directory of all projects, organizations, and meetings related to ecosystem management and restoration.

APPENDIX P:
BUREAU OF INDIAN AFFAIRS PERSPECTIVE ON 1994 INTERAGENCY WORKING GROUP REPORT

Areas Having the Potential to Impact Both the Trust Resources and the Rights of the Seminole and Miccosukee Tribes:

WATER QUALITY MANAGEMENT

MAJOR ISSUES

- Surface water quality entering and leaving the Indian lands.
- Heavy metals (especially methylated mercury) in the surface water.
- Establishment of tribal water quality standards - impacts on the restoration efforts.
- Sludge disposal on nearby lands.
- Enforcement of current State and Federal Water Quality Standards.
- Pollution from the West Basin.
- Full tribal participation in all federal water quality management planning activities.
- Federal government's trust responsibility to protect tribal trust resources i.e., water and tribal rights to clean water.
- Protection needed for WCA-3A water quality at the same level as Everglades National Park and the Loxahatchee NWR.
- Establishment and enforcement of final numerical water quality standards necessary to save and restore the Everglades.
- Protection from sediment nutrient loading.
- Coordinated research and real time monitoring.
- Protection from eutrophication and resulting imbalance in flora and fauna.

BACKGROUND

The Seminole and Miccosukee Indian Tribes are federally recognized tribes and the federal government is the trustee of their lands and resources and the protector of their rights. Indian lands of the Seminole and Miccosukee Tribes are subjected to run-on of water

from upstream sources of surface water contaminated with high levels of nitrogen, phosphorous, heavy metals and other pollutants.

These pollutants are generally attributed to intensive upstream agricultural development and recently, possibly to the spreading of sludge from municipal waste treatment plants. This pollution has, over the years, resulted in contaminated fish and wildlife which tribal members consume as part of their traditional subsistence hunting and fishing lifestyle. Additionally, tribal lands have not been offered the trust resource protection that is required of the federal government, resulting in the lands being used as filters and treatment areas for polluted waters. This has resulted in the conversion of a large part of the wetlands to areas lacking natural floral and faunal diversity of the past.

Indian lands which are adversely impacted total approximately 462,000 acres including much of WCA-3A which is perpetually leased by the state of Florida to the Miccosukee Tribe. The traditional and modern lifestyles of approximately 2,500 tribal members are also adversely impacted.

OBJECTIVES

- Restoration of floral and faunal diversity in WCA-3A.
- Establishment and protection of the tribal rights to clean water.
- Elimination of heavy metal pollution.
- Reduction of phosphorous pollution to natural background levels.
- Restoration of dissolved oxygen levels (approx. 5mg/L).

APPROACH

- Development, implementation and enforcement of tribal water quality standards.
- Full tribal participation tn all federal water quality management planning activities.
- Conducting of essential research (coordinated) and development of real-time systems for the reservations which will be capable of monitoring both water quality and quantity.

COMPREHENSIVE WETLAND PERMITTING AND MITIGATION STRATEGY

MAJOR ISSUES

- National Pollution Discharge Elimination System (NPDES) permitting of STAs with non-degradation standards.

- Moratorium on permitting within the Everglades buffer strip pending analysis of cumulative impacts on restoration efforts.

- Establishment of minimum flows and levels.

BACKGROUND

The Seminole and Miccosukee tribal lands have been adversely impacted by both reduced quantity and quality of available surface water. The degradation of these trust resources is principally due to non-tribal agricultural/commercial/residential and infrastructure development within the historic boundaries of the Everglades Ecosystem. No one knows how much more development can be sustained without (if it already has not happened) rendering the Everglades completely dysfunctional and beyond feasible restoration.

OBJECTIVES

Protection of the Everglades and tribal lands from further and possibly irrevocable degradation caused by further development of wetlands in the buffer zone.

APPROACH

•Require that significant development be permitted in areas on the eastern coast buffer strip to the Everglades ecosystem, only after an Environmental Impact Statement is prepared in accordance with the National Environmental Policy Act.

•Provide Bureau support for maintaining the requirement that STAs must have NPDES permits that contain non-degradation standards and feasible compliance schedules.

SUSTAINABLE DEVELOPMENT

MAJOR ISSUES

- Continued development, without enforcement of numerical non- degradation water quality standards, will continue to further degrade tribal trust water resources.

- Tribal economic and social needs (especially the Miccosukee Tribe) are tied directly to and are dependent upon the quality of the Everglades environment much more so than the average citizen of Florida.

- The federal government is obligated to support the development of tribal lands as long as there are no significant adverse environmental impacts. There is concern that as more development occurs outside of Indian lands, the probability of significant impacts is increased i. e., the tribes will not be able to rightfully develop their land because it is needed for resource protection.

- No one knows how much development can be sustained without a complete and irreparable breakdown of the Everglades ecosystem.

BACKGROUND

There will be continued pressure to develop the remaining areas of the Everglades buffer zone etc. Without proper assessment, the cumulative impact of development and the breaking point of the system are not known. Current trends in the Everglades ecosystem indicate that environmental quality continues to decline. Additional development around the fringes will further restrict the opportunities for system restoration and make it more difficult to reverse the negative trend. Serious restoration efforts to reverse the trend may not work with the limited area currently available - the trend should become positive before more Everglades area is lost to development.

Additionally, the long term problem of restricting tribal development rights because of the cumulative impacts of surrounding development, must be addressed. The federal government, unlike the State of Florida, has an obligation to protect these rights.

Tribal populations can be expected to increase with time as will the need for housing, infrastructure, and economic development. Tribal population growth is slow and from within. Tribal members live on the reservation because it is their traditional homeland and their sovereign nation as established by Congress. There are no options for them to move elsewhere. Their right to grow and prosper and utilize their resources for the benefit of their people must be protected and be a high priority when limitations on sustainable development are addressed.

OBJECTIVES

- Protection of the Everglades ecosystem from the negative impacts of excessive further development.

- Protection of tribal development rights.

APPROACH

Assure that tribal development rights are a key component of any federally approved sustainable development plans or recommendations.

HABITAT RESTORATION AND MANAGEMENT PLAN ADDRESSING THE DECLINE OF NATIVE FLORA AND FAUNA

MAJOR ISSUES

- Polluted surface water entering Indian lands has caused areas to become cattail monocultures.

- Indian lands which are subject to a flowage easement in the Everglades and WCA-3A should receive the same consideration for protection and restoration as parks and preserves.

- Protection of tribal hunting and fishing rights in WCA-3A.

BACKGROUND

As stated in Water Quality Management and additionally that approximately 353,000 acres of tribal land, including all of WCA 3A, should receive environmental equity with the parks and preserves. Existing cattail monoculture occupies portions of Indian lands.

APPROACH

- Restoration of cattail areas to traditional floral and faunal diversity after phosphorous levels are reduced to normal.

- Environmental equity for Indian lands and WCA-3A.

STRATEGY

- Full tribal participation in the planning and restoration process.

- Assertion of federal trust responsibility by all federal agencies to protect tribal trust resources from degradation.

COORDINATING AGENCY POSITIONS AND ACTIONS

MAJOR ISSUES

Are any of the currently implemented activities designed to improve the ecosystem showing success as measured by success criteria?

- The Indian tribes are only seeing continued system degradation with resultant adverse impacts to trust resources.

- Individual uncoordinated agendas are the rule for restoration efforts without conducting a complete cumulative impact analysis.

- How are we going to know when the feasible restoration efforts have been completed?

BACKGROUND

As stated by the Miccosukee Tribal Elders "The snakes are dead;

the turtles are dying; we cannot eat the frogs and the fish. Are we Indians next to perish in the Everglades? You (BIA) do something about it." From the Native American perspective the visible degradation of the Everglades and its wildlife resources is adequate measure that nothing is yet working. A statement by a tribal elder fifty, one-hundred or two-hundred years from now reflecting worse or hopefully better conditions will still be an accurate reflection of the condition of the Everglades. To go beyond a personal reflection will require a coordinated effort by federal, tribal, state, and local agencies; industry; agricultural interests; and environmental groups to monitor the health of the entire Everglades ecosystem. The problem is less one of determining indicators than it is of coordination.

OBJECTIVES

- To establish, on a real-time basis, changes in the health of the Everglades ecosystem.

- To know, from a management standpoint, when enough is enough be it restorative action or development that degrades the ecosystem.

APPROACH

- To develop a real-time remote sensing system for the tribal lands which will monitor environmental conditions as restoration efforts progress.

- To be part of a coordinated effort to determine the overall health of the ecosystem.

- To be a full partner in the ongoing restoration planning and implementation process.

APPENDIX Q:
INTEGRATED FINANCIAL PLAN

ISSUES/PROBLEMS

Multiple Possible Funding Source: It is possible that, upon an individual agency's budget request reaching the Office of Management and Budget (OMB), the level of priority for funding of that individual agency's efforts towards the restoration initiative may or may not be the same priority accorded other involved agencies. If all the involved OMB examiners consider the restoration initiative efforts of the agency under their review to be a high priority for that agency it would reduce the possibility of individual agency funding gaps that could delay the project. Obviously, if one or more agencies having responsibility for work products that are on the overall critical path should not receive sufficient funding for their required effort, the entire restoration initiative could be delayed.

In preparing individual agency budget requests for the initiative, a high degree of coordination and cooperation from all involved agencies will be necessary. This will be required not only to ensure that there is not an overlap in work to be performed, thereby increasing costs, but to be sure that funds will be available for a particular agency's individual efforts at the time they are required. Proper coordination may result in the individual agency requests being adequate for the proposed future work, however, this is by far no solid indication that the budget request will be approved, either in its entirety or partially. Once an individual agency's budget comes before its appropriation | subcommittees and/or committees, funding for the South Florida Ecosystem Restoration may not be viewed with the same priority. For this reason, it would be beneficial to have each agency’s budget request for the South Florida Ecosystem Restoration initiative be reviewed by a single examiner at OMB.

BACKGROUND

Agencies signatory to the Interagency Agreement on South Florida Ecosystem Restoration are funded through five separate federal appropriations bills. In addition, funds, lands, work-in-kind, etc., may be received/required by the state of Florida, the South Florida Water Management District, and numerous private corporations, trusts, and concerns. Signatory agencies and their respective appropriation bills are shown in the following table along with other possible non-federal sources of funding:

AGENCY	APPROPRIATION BILL
U.S. Department of Agriculture	Agriculture
U.S. Department of the Army	Energy - Water Development
U.S Department of Commerce	Commerce-Justice-State
U.S. Department of the Interior	Interior
U.S. Department of Justice	Commerce-Justice-State
Environmental Protection Agency	VA-HUD-Independent Agencies

State	State of Florida
Local	South Florida Water Management District
Private	Private Corporations, Trusts, Concerns

At present, each agency requests its own funding through its own standard procedures.

OBJECTIVES/APPROACH

Budgeting Options: There are three budgeting alternatives that could be used to obtain necessary federal funding for the south Florida ecosystem restoration initiative. The first is to maintain the status quo and let each department/agency compete for funding independently. The second alternative would be to proceed with a cross-cut approach whereby each agency attempts to receive its own funding through their respective appropriation process after coordinating requirements within the Task Force. The third alternative would be to have all required funding requested by a single lead agency.

Status Quo: Each agency would be responsible for requesting and obtaining the funds required for its particular items of work. This option does not allow for any. synergistic savings and runs the risk of dealing with various OMB examiners.

Cross-Cut: A high level of cooperation and coordination would be needed to ensure that agencies know what work items would be required of their agency, when the particular work would be taking place, and an accurate estimate of the cost of the work to be performed. Lead time for a budget request would normally be about 18 months prior to actually receiving funding.

Intense coordination at the working group level would be required to the maximum extent practicable in order to ensure adequate funding requests without duplication of work by two or more involved agencies. The agencies would then submit their budgets through normal channels. Once budgets had reached the departmental level, a meeting of Task Force members would be held to review the requests of the separate agencies portion related to the South Florida Ecosystem Restoration efforts. After any changes, the budget would then be submitted individually to OMB.

With numerous federal agencies involved, the South Florida Ecosystem Restoration initiative should be reviewed by a single examiner at OMB. In this way, it may be possible to prevent funding delays by any particular agency whose work efforts may be on the critical path for the restoration effort. With all the various agency requirements looked at by the same examiner, the funding stream could be more fluid and prevent delays in desired efforts.

Each participating agency should use a common accounting system for the funds provided for and used on the South Florida Ecosystem Restoration initiative. A standard system that all agencies could readily understand should be used to provide an accurate accounting of all initiative expenditures. A single agency should be appointed as the lead

for financial reporting of ecosystem efforts. All involved agencies would submit monthly financial information to the lead financial agency for consolidation and compilation of data and statistics.

Lead Agency Budgeting: A possible benefit of having one agency budget for necessary funding would be to help reduce the possibility of any particular agency not receiving necessary funding for the initiative, thereby possibly delaying the entire effort.

Additionally, if one agency, as the lead, were to request funding for all the major agencies involved in the initiative, it would be necessary that the budget ceilings for the affected agencies be adjusted downward accordingly. It should be obvious that the other programs of the budgeting lead agency should not be penalized by the fact that the agency is requesting funding that will be sent to other agencies, thereby effectively reducing the lead agency's other programs' ability to receive adequate funding because part of its budget authority was used for funding that is for the other agencies. It also stands to reason that the agencies receiving the funding from the lead agency should have their budget ceiling reduced by the amount of funding they receive from the lead agency.

In most agencies, the lead time for submitting an initial budget request and receiving actual funding is between 16 and 18 months. During this time many unforeseen problems and/or circumstances can arise which provides either a surplus of required funds or a need for additional funds in the budgeted fiscal year. It is possible that this scenario could happen for the South Florida Ecosystem Restoration Initiative. A particular agency may experience a delay creating a funding surplus or encounter some unforeseen circumstances that would require funding beyond the level available to them. Some agencies may have authorities which permits the reprogramming of funds from one project or study to another, thereby offsetting or even reducing the shortfall. These authorities in and of themselves may not prevent a shortfall from delaying work as there can be no assurance that surplus funds would be found from another project. In more likelihood, in this ever competitive environment for federal funding, it will be more and more difficult to make up for funding shortfalls in this manner. Another possible solution may be a cooperative effort among participating agencies. Coordination among these agencies may help to alleviate such a funding problem by having agencies experiencing a funding surplus do additional work that would have been done by an agency experiencing a funding shortfall.

TRANSFERS

Currently, the Jacksonville District requests additional Department of the Interior funds for the Modified Water Deliveries Project from their Washington headquarters. Additional approval is required through the Department of the Interior chain of command beginning in Atlanta. The ability to transfer the required funding from the one agency to another should reside at the lowest level possible. This would help to ensure that there would be no unnecessary delays in an agency receiving necessary funds.

DISCRETIONARY FUNDING

Authority and appropriation for the expenditure of $5 million per annum by the South Florida Ecosystem Restoration Task Force would be requested. These funds would only be used on the initiative and could help fill funding gaps for unseen work or unexpected situations that might develop. Monies could be appropriated piecemeal to each agency or in a lump sum to a lead agency and distributed as needed.

FUNDING LEVELS

It is our intention to list an integrated system of financial requirements characterizing the level of activities occurring and the efforts to undertake the recommendations in this report. From the statement of needs, individual agencies can make decisions for the future funding on an agency-by-agency basis along programmatic categories. Attached is a sample matrix.

RECOMMENDATION

It is recommended that individual agencies continue to budget for the ecosystem restoration effort through their normal budgeting procedures using the cross-cut approach. Coordination as discussed above, would be required at the Working Group and Task Force level to ensure adequate funding for individual agencies needs.

Tables and Maps

(Pages 117-125)

Not available at this time.

LIST OF ACRONYMS

ADID	Advanced Identification
AF	acre-feet
APHIS	Animal and Plant Health Inspection Service
ARS	Agricultural Research Service
ATLSS	Across Trophic-Level System Simulation Model
BIA	Bureau of Indian Affairs
BMP	best management practice
CARL	Conservation and Recreational Lands Program
cfs	cubic feet per second
COE	Corps of Engineers
COP	Coastal Oceans Program
COVER	Colloqui of Vegetation Everglades Research
DEIS	Draft Environmental Impact Statement
DEP	Florida Department of Environmental Protection
DOA	Department of Army
DOC	Department of Commerce
DOI	Department of Interior
DOT	Department of Transportation
EA	environmental assessment
EAA	Everglades Agricultural Area
EIS	Environmental Impact Statement
ELM	Everglades Landscape Model
ENP	Everglades National Park
EPA	Environmental Protection Agency
EPCC	Exotic Pest Control Council
ESA	Endangered Species Act
ET	evapotranspiration
FACA	Federal Advisory Committee Act
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FG&FWFC	Florida Game and Fresh Water Fish Commission
FKNMS	Florida Keys National Marine Sanctuary
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GAP	Gap Analysis Program
GEIS	Generic Environmental Impact Statement
GIS	geographic information system
IFAS	Institute of Food and Agricultural Sciences
ITF	Interagency Task Force
IWG	Interagency Working Group
LOTAC	Lake Okeechobee Technical Advisory Committee
MDWASA	Metropolitan Dade Water and-Sewer Authority

mg	milligram
mad	million gallons per day
mg/L	milligram per liter
MP	management plan
MWDP	Modified Water Delivery Plan
NAWQA	National Water Quality Assessment
NBS	National Biological Service
NEPA	National Environmental Policy Act
NGO	non-governmental organization
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
NPS	National Park Service
NSM	natural system model
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
OMB	Office of Management and Budget
OOAR	Office of Oceanic and Atmospheric Research
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
QA/QC	quality assurance/quality control
SCS	Soil Conservation Service
SFCWPM	South Florida Comprehensive Wetlands Permitting and Mitigation Strategy
SFWCP	South Florida Wetlands Comprehensive Plan
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SJRWMD	St Johns River Water Management District
SOR	Save Our Rivers
SRF	Systematic Reconnaissance Flights
STA	stormwater treatment area
SWIM	Surface Water Improvement and Management Plan
TMDF	total maximum daily flow
TMDL	total maximum daily load
TMP	Technical Mediated Plan
TOC	Technical Oversight Committee
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WCA	Water Conservation Area
WES	Waterways Experiment Station, COE
WICG	Wetland Interagency Coordination Group
WMP	watershed management plan
WQPP	Water Quality Protection Program

BIBLIOGRAPHY

Anonymous. 1992. Catastrophic mortality of sponges affects juvenile spiny lobster populations. The Lobster Newsletter 5(2):1-2.

Bancroft, G. T., W. Hoffman, R. J. Sawicki, and J. C. Ogden. 1992. The importance of the Water Conservation Areas in the Everglades to the Endangered Wood Stork (Mycteria americana). Conservation Biology 6:392-398.

Brooks, J. E. and E. F. Lowe. 1984. U.S. EPA Clean Lakes Program, Phase I. Diagnostic feasibility Study of the Upper St. Johns River Chain of Lakes. Vol. 2: Feasibility

Study. St. Johns River Water Management District, Technical Publ. SJ84-15, Palatka, Florida.

Browder, J. A. 1976. Water, wetlands, and Wood Storks. Ph.D. Dissertation. University of Florida. Gainesville.

Browder, J. A. 1978. A modeling study of water, wetlands, and Wood Storks. Wading Birds, Research Report #7, National Audubon Society.

Browder, J. A. 1984. Wood Stork feeding areas in southwest Florida. Florida Field Naturalist 12:81-116.

Browder, J. A. 1985. Relationship between pink shrimp production on the Tortugas grounds and water flow patterns in the Florida Everglades. Bull. Mar. Sci. 37:839-856.

Browder, J. A., P. J. Gleason, and D. R. Swift. 1994. Periphyton in the Everglades: spatial variation, environmental correlates, and ecological implications. In: S. M. Davis and J. C. Ogden (Eds.). Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, Florida.

Browder, J. A., D. B. McClellan, D. E. Harper, M. G. Kandrashoff, and W. Kandrashoff. A major developmental defect observed in several Biscayne Bay, Florida, fish species. Environmental Biology of Fishes 37: 181 - 188.

Browder, J. A., J. Wang, J. Tashiro, E. Coleman-Duffie, and A. Rosenthal. 1989. Documenting estuarine impacts of freshwater flow alterations and evaluating proposed remedies. Proc. Int. Wetland Symp. 5-9 July, 1989, Charleston, S.C. The Association of Wetland Managers. Berne, NY.

Burns, L. A. 1975. Water quality renovation by natural floodplain marshes: systems analysis and computer simulation. Report to Florida Department of Administration, Division of State Planning, Tallahassee, Florida.

Burns, L. A. and R. B. Taylor, III. 1979. Nutrient-uptake model in marsh ecosystems. Journal of the Technical Councils, ASCE 105(TC1):177-196.

Carroll, J.D., and A. Banner. 1991. Kissimmee River Restoration Project Revised Draft Fish and Wildlife Coordination Act Report. U.S. Fish and Wildlife Service, Vero Beach, Florida.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. Laroe. 1979. Class)fication of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS-79/31.

Davis, J. H., Jr. 1943. The natural features of southern Florida, especially the vegetation and the Everglades. Florida Geological Society Bulletin No. 25., Tallahassee.

Davis, S. M. 1990. Sawgrass and cattail production in relation to nutrient supply in the Everglades. pp. 325-341 In: R. R. Sharitz and J. W. Gibbons (Eds.). Freshwater wetlands and wildlife. Department of Energy Symposium Series No. 61. U.S. Department of Energy, Office of Scientific and Technical Information, Oak Ridge, Tennessee.

Davis, S. M. and J. C. Ogden. 1994. Toward ecosystem restoration. In: S. M. Davis and J. C. Ogden (Eds.). Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, Florida.

Davis, S. M., L. H. Gunderson, W. A. Park, J. Richardson, J. Mattson. 1994. Landscape dimension, composition, and function in a changing Everglades ecosystem. In: S. M. Davis and J. C. Ogden (Eds.). Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, Florida.

Enos, P. and R. D. Perkins. 1977. Quaternary sedimentation in South Florida. Geological Society of America Memoir 147.

Fennema, R. J., C. J. Neidrauer, R. A. Johnson, W. A. Perkins, and T. K. MacVicar. 1994. A computer model to simulate natural south Florida hydrology. In: S. M. Davis and J. C. Ogden (Eds.). Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, Florida.

Fleming, D. M., J. Schortemeyer, W. Hoffman, and D. L. DeAngelis. In press. The importance of landscape heterogeneity to Wood Storks in the Florida Everglades. Environmental Management.

Fleming, D. M., W. F. Wolff, and D. L. DeAngelis. In review. Colonial wading bird nesting in the pre and post drainage landscapes of the Everglades. Oecologia.

Fleming, D. M. Submitted. American alligator nest distribution, nest abundance, and reproductive performance in the southern Everglades. Ecology.

Fong, P. and M. A. Harwell. In press. Modeling seagrass-communities in tropical bays and estuaries: a mathematical synthesis of current hypotheses. Bull. Mar. Sci.

Gray, J. D., T. L. King, and R. L. Colura. 1991. Effect of temperature and hypersalinity on hatching success of spotted seatrout eggs. The Progressive Fish-Culturist 53:81-84.

Gunderson, L. H. and C. S. Holling. 1991. Central and Southern Florida Ecosystem Modeling Reconnaissance Study. Results of July 1991 Workshop sponsored U.S. Army Corps of Engineers and Everglades National Park. University of Florida, Gainesville.

Harper, D. E. 1993. The spiny lobster monitoring report on trends in landings, CPUE, and size of harvested lobster. NOAA/NMFS/SEFSC Miami Laboratory Contribution MIA 92/93-92.

Hoffman, W., G. T. Bancroft, and R. J. Sawicki. 1990. Wading bird populations and distributions in the Water Conservation Areas of the Everglades, 1985 through 1988. Report to the South Florida Water Management District.

Iversen, E. S. and A. W. Moffett. 1962. Estimation of abundance and mortality of a spotted seatrout population. Trans. Am. Fish. Soc. 91:395-398.

Ives, J. C. 1856. Memoir to accompany a military map of the peninsula of Florida south of Tampa Bay. Wynkoop, Book and Job Printer, New York.

Kinne, O. 1971. Marine Ecology Vol. I, Part 2. Wiley Interscience, New York.

Klein, H. K., M. C. Schroeder, and W. F. Lichtner. 1964. Geology and ground water resources of Glades and Hendry Counties, Florida. Florida Geological Survey Report of Investigations No. 37. Tallahassee, Florida.

Klein, H., W. J. Schneider, B. F. McPherson, and T. J. Buchanan. 1970. Some hydrologic and biologic aspects of the Big Cypress Swamp drainage area, southern Florida. Open-File Report 70003. U.S. Geological Survey, Tallahassee.

Lambou, V., et al. 1991. Mercury Technical Committee Interim Report to the Florida - Governor's Mercury in Fish and Wildlife Task Force and the Department of Environmental Regulation. Center for Biomedical and Toxicological Research and Waste Management, Florida State University, Tallahassee.

Loftin, M.K., L.A. Toth, and J.T.B. Obeysekera. 1990. Kissimmee River Restoration Alternative Plan Evaluation and Preliminary Design Report. South Florida Water Management District, West Palm Beach, Florida.

Loftus, W. F., R. A. Johnson, and G. H Anderson. 1992. Ecology reduction of groundwater levels in short hydroperiod marshes of the Everglades. pp. 199-208 in: J. Stafford and J. Simons (Eds.). Proc. First International Conference on Groundwater Ecology. Convened by the Environmental Protection Agency (EPA) and the American Water Resources Association (AWRA), Bethesda, Maryland.

Loftus, W. F., J. D. Chapman, and Roxanne Conrow. 1986. Hydroperiod effects on Everglades marsh food webs, with relation to marsh restoration efforts. G. Larson and M. Soukup (Eds.). Fisheries and Coastal Wetlands Research Vol. 6, Proc. Conference on Science in the National Parks, July 13-18, 1986, Ft. Collins, Colorado.

Lowe. 1986. The relationship between hydrology and vegetational pattern within the floodplain marsh of a subtropical Florida Lake. Florida Scientist 49:213-233.

Maul, G. A. and D. M. Martin. 1993. Sea level rise at Key West, Florida, 1846-1992: America's longest instrument record?: Geophysical Research Letters V. 28:1955-1958.

Mazzotti, F. J., L. A. Brandt, L. G. Perlstine, W. M. Kitchens, and T. O'breza,. F. C. Depkin, N. Morris, and C. E. Arnold. 1992. An evaluation of regional effects of new citrus development on the ecological integrity of wildlife resources in southwest Florida. Final Report to the South Florida Water Management District. WPB.

McIvor, C. C., J. A. Ley, and R. D. Bjork. 1994. A review of changes in freshwater inflow from the Everglades to Florida Bay including effects on biota and biotic processes. In: S. M. Davis and J. C. Ogden (Eds.). Everglades: The Ecosystem and Its Restoration. St. Lucie Press, Delray Beach, Florida.

Ogden, J. C. 1993. Comparisons between wading bird nesting colony patterns: 1931-1946 and 1974-1989, as indications of ecosystem change in the southern Everglades. Manuscript, Everglades National Park.

Paul, R. T. 1977. Banding studies of the White-crowned Pigeon in Florida and the Bahamas. pp. 25-31 In: Proc. Int. White-crowned Pigeon Conference, Bahamas National Trust, Nassau, Bahamas.

Rogers, B. D., W. H. Herke, and E. E. Knudsen. 1992. Effects of three different water control structures on the movements and standing stocks of coastal fishes and macrocrustaceans. Wetlands 12: 106- 120.

Rutherford, E. S., E. B. Thule, and D. G. Buker. 1982. Population characteristics, food habits and spawning activity of gray snapper, Lutjanus griseus, in Everglades National Park. SFRC-83/02. Everglades National Park, South Florida Research Center, Homestead, Florida.

South Florida Water Management District. 1989. Surface Water Improvement and Management Plan for Biscayne Bay.

South Florida Water Management District. 1992. Surface Water Improvement and Management Plan for the Everglades.

South Florida Water Management District. 1989. Interim Surface Water Improvement and Management Plan for Lake Okeechobee.

South Florida Water Management District. 1993. Draft Working Document in Support of the Lower East Coast Regional Water Supply Plan. Planning Department Staff. West Palm Beach, FL.

Stephens, J. C. 1984. Subsidence of organic soils in the Florida Everglades--a review and update. pp. 375-384 in: P. J. Gleason (Ed.). Environments of South Florida Present and Past II. Miami Geological Society, Coral Gables, FL.

Skinner, R. H. and W. Japp. 1986. Trace metals and pesticides in sediments and organisms in John Pennekamp Coral Reef State Park and Key Largo national Marine Sanctuary. Florida Department of Natural Resources Report.

Strong, A.M., R.J. Sawicki, and G.T. Bancroft. In press. A population estimate of White Crowned Pigeons based on flight-line counts. Journal of Wildlife Management.

Stephens, J. C. 1984. Subsidence of organic soils in the Florida Everglades--a review and update. pp. 375-384 in: P. J. Gleason (Ed.). Environments of South Florida Present and Past II. Miami Geological Society, Coral Gables, Florida.

Swain, E. D. in prep. Documentation for the USGS Modbranch Model for southeastern Florida. USGS Open-File Report.

Tabb, D. C. 1967. Prediction of estuarine salinities in Everglades National Park, Florida, by the use of groundwater records. Ph.D. Dissertation, University of Miami, Coral Gables, Florida.

Thayer, G. W. and A. J. Chester. 1989. Distribution and abundance of fishes among basin and channel habitats in Florida Bay. Bull. Mar. Sci. 44:200-219.

Thomas, T. M. 1974. A detailed analysis of climatological and hydrological records of South Florida with reference to man's influence upon ecosystem evolution: pp. 82-122 In: P. A. Gleason (Ed.). Environments of South Florida: Present and Past, Miami Geological Society Memoir 2.

USACE. 1991. Final Integrated Feasibility Report and EIS: Environmental Restoration of the Kissimmee River, Florida.

USDA Soil Conservation Service. 1981. Agricultural Handbook 296: Land Resource Regions and Major Land Resource Areas of the United States.

USFWS 1986. North American Waterfowl Management Plan: A Strategy for Cooperation. U.S. Department of the Interior, Washington, D.C.

USFWS. 1993. U.S. Fish and Wildlife Service Action Plan for South Florida Ecosystem Restoration. July 1993.

Van Lent, T. J. and R. J. Johnson. (Submitted). Water management for Taylor Slough, Everglades National Park, Florida. ASCE Journal of Water Resource Planning and Management.

Walters, C., L. Gunderson, and C. S. Holling. 1992. Experimental policies for water management in the Everglades. Ecological Applications 2:189-202.

Zieman, J. C., J. W. Fourqurean, and R. L. Iverson. 1989. Distribution, abundance, and productivity of seagrasses and macroalgae in Florida Bay. Bull. Mar. Sci. 44:292-311.