CENTRAL AND SOUTHERN FLORIDA PROJECT

COMPREHENSIVE EVERGALADES
RESTORATION PLAN

Program Management Plan for
Adaptive Assessment and Monitoring
(AA&M)

Fiscal Years 2001-2010

U.S. Army Corps of Engineers
Jacksonville District

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1.0 Introduction

The Comprehensive Everglades Restoration Plan (CERP or Comprehensive Plan) provides a blueprint for the restoration and preservation of the south Florida ecosystem, while providing for other water-related needs of the region, including water supply and flood protection. The CERP contains over 60 projects that will create approximately 217,000 acres of reservoirs and wetland-based water treatment areas. Implementation of the plan will vastly increase water storage and supply for the natural system and for urban and agricultural needs, while maintaining current Central and Southern Florida (C&SF) Project purposes. The CERP will restore more natural flows of water, including sheetflow; improve water quality; and establish more natural hydropatterns in the South Florida ecosystem.

This nationally and internationally known ecosystem has deteriorated significantly over the past 50 years, and the outlook for the future, without implementation of the Comprehensive Plan, shows further degradation. Construction and operations of the C&SF Project have disrupted the natural timing, quantity, quality and distribution of water to the natural system. The size of the remaining natural system has been substantially reduced as a result of development in south Florida. Prior to the C&SF Project Comprehensive Review Study, referred to as the Restudy, a comprehensive look at the water management system had not been conducted since the projects first authorization in 1949.

The Restudy was authorized by Congress in 1992 to conduct a system-wide review of the C&SF Project with an eye towards recommending structural or operational changes to the project to restore and protect the south Florida ecosystem while maintaining, and in some cases enhancing, other authorized project purposes. The Restudy culminated with the Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (USACE and SFWMD 1999), which was transmitted to Congress on July 1, 1999. With the enactment of WRDA 2000 on December 11, 2000, Congress approved the CERP and provided the USACE with the authority to conduct studies and implement projects, utilizing an adaptive management strategy, for the CERP. This Congressional direction makes it clear that an adaptive assessment and monitoring program is considered essential for ensuring the incorporation of new scientific and technical information into the Comprehensive Plan. An adaptive assessment and monitoring program will also help refine and improve the design and operation of the CERP throughout its implementation and determine whether the CERP achieves its primary objectives of recovering healthy and sustainable ecosystems throughout South Florida while providing for other water-related needs of the region.

The Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (USACE and SFWMD 1999) identified a program known as “Restoration Coordination and Verification” (RECOVER) to ensure that a system-wide focus is maintained throughout the ongoing planning and implementation of the plan.
RECOVER was established by the USACE and the South Florida Water Management District (SFWMD) to conduct assessment, evaluation, and planning and integration activities using the best available science that support implementation of the Plan with the overall goal of ensuring that the goals and purposes of the Plan are achieved. RECOVER accomplishes its activities through partnerships among federal, state and local agencies, and tribal governments. RECOVER affords the opportunity to participate in an ongoing process of evaluation, assessment and refinement of the Comprehensive Plan. Additionally, RECOVER provides opportunities for stakeholders to participate in the review of RECOVER work products.

This document serves as a new CERP program management plan (PMP) that will be prepared throughout the CERP implementation process to address Adaptive Assessment and Monitoring (AA&M) responsibilities. It satisfies the requirement of the Master Program Management Plan (USACE and SFWMD 2000a) that all CERP programs be guided by approved management plans. This document is a companion to the general RECOVER PMP.

1.1 Role of RECOVER

The role of RECOVER is to organize and apply scientific and technical information in ways that are most effective in supporting the objectives of the CERP, and to ensure that the system-wide goals and purposes of the CERP are achieved. While RECOVER is an interdisciplinary, interagency body, responsibility for RECOVER rests jointly with the USACE and the SFWMD, as the sponsoring agencies. RECOVER links science and the tools of science in three broad missions of system-wide evaluation, assessment, and planning and integration. RECOVER’s three missions are as follows:

- **Evaluation** - assist the CERP Project Delivery Teams in ensuring that project design and performance is fully linked to the goals and purposes of the Plan and incorporate, as appropriate, information developed for Project Implementation Reports into the Plan

- **Assessment** - conduct credible scientific assessments of hydrological, water quality, biological, ecological, water supply, and other responses to the Plan.

- **Planning and Integration** – conduct planning and integration activities in support of the adaptive management program as a basis for identifying opportunities for improving the performance of the Plan.

The topic of this PMP centers on the assessment and monitoring missions of the CERP RECOVER program. Although the RECOVER work effort spans the entire implementation period of the Comprehensive Plan, this management plan will focus, for budgetary purposes, on fiscal years 2001-2010.
1.2 Authority over Adaptive Assessment and Monitoring

The Restudy resulted in an authorization in the Water Resources Development Act (WRDA) of 2000 that provides the U.S. Army Corps of Engineers (USACE) with the authority to conduct studies and implement projects, utilizing an adaptive management strategy, in the CERP. This Congressional direction makes it clear that an AA&M program is considered essential for ensuring the incorporation of new scientific and technical information into the Comprehensive Plan. An AA&M program will also help refine and improve the design and operation of the CERP throughout its implementation and determine whether the CERP achieves its primary objectives of recovering healthy and sustainable ecosystems throughout South Florida while providing for other water-related needs of the region.

The authority and mandate for AA&M activities can be found in the following documents:

- *Master Program Management Plan* (USACE and SFWMD 2000a)
- *Design Agreement between the Department of the Army and South Florida Water Management District for the Design of Elements of the Comprehensive Plan for the Everglades and South Florida Ecosystem Restoration Project* (USACE and SFWMD 2000b)
- Programmatic Regulations for the Comprehensive Everglades Restoration Plan; Final Rule (DOD 2003).

1.2.1 Water Resources Development Act (WRDA) of 2000

The federal Water Resources Development Act provide the USACE with the authority to conduct studies and implement projects. Section 601 of WRDA 2000 pertains to the CERP (U.S. Congress 2000). The following three subsections of Section 601 apply to RECOVER activities.

Subsection (b)(2)(C) provides specific authorization for the following:

(xi) Adaptive Assessment and Monitoring Program, at a total cost of $100,000,000, with an estimated Federal cost of $50,000,000 and an estimated non-Federal cost of $50,000,000.\(^1\)

Subsection (h)(3)(C) directs that programmatic regulations be developed and specifies that these regulations:

\(^1\) It should be noted that this congressional authorization applies to the first 10 years of adaptive management activities.
(i) IN GENERAL- Programmatic regulations promulgated under this paragraph shall establish a process--

(II) to ensure that new information resulting from changed or unforeseen circumstances, new scientific or technical information or information that is developed through the principles of adaptive management contained in the Plan, or future authorized changes to the Plan are integrated into the implementation of the Plan; and

(III) to ensure the protection of the natural system consistent with the goals and purposes of the Plan, including the establishment of interim goals to provide a means by which the restoration success of the Plan may be evaluated throughout the implementation process.

Lastly, subsection (l) requires the following:

Beginning on October 1, 2005, and periodically thereafter until October 1, 2038, the Secretary and the Secretary of the Interior, in consultation with the Environmental Protection Agency, the Department of Commerce, and the State of Florida, shall jointly submit to Congress a report on the implementation of the Plan...Such reports shall include a description of planning, design, and construction work completed, the amount of funds expended during the period covered by the report (including a detailed analysis of the funds expended for adaptive assessment under subsection (b)(2)(C)(xi)), and the work anticipated over the next 5-year period.

1.2.2 Design Agreement

The Design Agreement between the Department of the Army and South Florida Water Management District for the Design of Elements of the Comprehensive Plan for the Everglades and South Florida Ecosystem Restoration Project, referred to as simply the Design Agreement, was executed in May 2000, between the Department of the Army and the SFWMD (USACE and SFWMD 2000b). It provides a definition of “design” that includes the authorization for RECOVER activities:

(6) during the period of design, activities related to restoration, coordination, and verification as identified in the Comprehensive Plan, which includes, but is not limited to, adaptive assessment, monitoring, peer review, development and refinement of system level analytical model tools, and continuing review and refinement of the Comprehensive Plan, (Article I (b)).

1.2.3 Master Program Management Plan

The Master Program Management Plan (USACE and SFWMD 2000a) describes the framework and process to be used by the USACE and the SFWMD for managing and
monitoring implementation of the Comprehensive Plan. The Master Program Management Plan provides a definition for program-level activities, including RECOVER and AA&M activities. The Master Program Management Plan calls for the development of management plans for all such activities.

1.2.4 Programmatic Regulations for the Comprehensive Everglades Restoration Plan

The Programmatic Regulations for the Comprehensive Everglades Restoration Plan; Final Rule (DOD 2002) establishes processes and procedures that will guide the USACE and its partners in the implementation of the CERP. The processes and procedures that will be performed for adaptive assessment and monitoring activities by RECOVER are included in Section 385.20 of the final rule:

(e) RECOVER shall perform assessment...activities as described in this paragraph.

   (1) Assessment activities. In accordance with §385.31, RECOVER shall conduct credible scientific assessments of hydrological, water quality, biological, ecological, water supply, and other responses to the Plan. The Corps of Engineers and the South Florida Water Management District will ensure that these assessments incorporate the best available science and that the results are provided for external peer review, as appropriate, and are made fully available for public review and comment. RECOVER shall conduct assessment activities, including, but not limited to:

   (i) Developing proposed assessment performance measures for assessing progress towards the goals and purposes of the Plan;

   (ii) Developing a proposed monitoring plan to support the adaptive management program;

   (iii) Conducting monitoring and assessment activities as part of the adaptive management program to assess the actual performance of the Plan;

   (iv) Developing recommendations for interim goals in accordance with §385.38;

   (v) Assessing progress towards achieving the interim goals established pursuant to §385.38;

   (vi) Developing recommendations for interim targets in accordance with §385.39;

   (vii) Assessing progress towards achieving the interim targets established pursuant to §385.39; and
(viii) Cooperating with the independent scientific review panel and external peer review in accordance with §385.22.

(f) In carrying out the functions described in this section, RECOVER shall consider the effects of activities and projects that are not part of the Plan, but which could affect the ability of the Plan to achieve its goals and purposes.

(g) As appropriate, the Corps of Engineers and the South Florida Water Management District shall seek external peer review of RECOVER activities in accordance with §385.22(b).

1.3 CERP Applied Science Strategy

To establish and maintain an effective link between science and the CERP, the C&SF Project Restudy Team created a process known as the "applied science strategy". RECOVER is responsible for the coordination and application of the components of the applied science strategy during the multi-year implementation of the Comprehensive Plan. The major components of the science strategy are conceptual ecological models, performance measures and restoration targets, a system-wide monitoring program, and an adaptive assessment protocol. The overall purpose of the strategy is to effectively apply current and future scientific understandings of natural and human systems to the planning, evaluation and assessment phases of the Comprehensive Plan. This science strategy provides the framework for an Adaptive Management Program in support of the goals of the CERP.

Applied Science Strategy

![Diagram of Applied Science Strategy]

**Figure 1: Applied Science Strategy**
2.0 Scope of Adaptive Assessment and Monitoring

2.1 Assessment Mission of RECOVER

The primary AA&M tasks under the assessment mission of RECOVER, are summarized below. Many of these tasks have been underway since the initiation of the CERP and they will continue until implementation of the CERP is completed and beyond. The assessment tasks are as follows:

- Develop proposed assessment performance measures for assessing progress towards the goals and purposes of the Plan
- Develop a system-wide monitoring and assessment plan to support the adaptive management program
- Conduct monitoring and assessment activities to assess the actual performance of the Plan
- Assess progress towards achieving the interim goals
- Develop recommendations for interim targets and assess progress toward achieving the interim targets
- Conduct annual assessments of system-wide responses to the Comprehensive Plan

2.2 RECOVER Technical Teams

To meet RECOVER objectives and to ensure the successful application of all elements of the applied science strategy, RECOVER is currently organized into a leadership group and six task teams (Figure 2-1). While the leadership group is led by the two sponsoring agencies, the USACE and the SFWMD, the organization of all of these teams is both interagency and interdisciplinary for maximum effect in applying the strength of scientific, technical and operational expertise that exists throughout the federal, state and local resource agencies, and the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida during the implementation of the CERP. Each task team is jointly led by tri-chairs. The tri-chairs consist of a staff member from each of the sponsoring agencies, the USACE and the SFWMD, and a staff member from another federal or state agency. The two RECOVER teams involved with AA&M activities for RECOVER are the Adaptive Assessment Team (AAT) and the Water Quality Team (WQT).
Figure 2-1: RECOVER Technical Teams

While this management plan is a management document between the sponsoring agencies (USACE and SFWMD), the importance of the resources provided to RECOVER teams by participating agencies and tribal governments are also crucial components in RECOVER’s success in carrying out its mission.
2.3 Elements of a Successful Monitoring Plan Implementation

Those elements or functions necessary for successful Monitoring and Assessment Plan (MAP) implementation include (1) data collection, (2) data management, (3) data analysis, (4) reporting, and (5) quality assurance (Figure 2-1). A description of what these functions generally entail and other important considerations is provided below:

**Data collection** is the first step in the sequence of activities involved in the implementation of a monitoring program. Data collection involves obtaining field measurements and/or samples of indicators from the ecosystem components being monitored.

**Data management** is the second sequential step in the implementation of a successful monitoring program. Data management involves the transfer and storage of field measurements and sample data obtained from data collection activities. The major function of data management is to provide efficient access to the collected data and related information (e.g., historical trends data, research data, model outputs, data summaries). The CERP Data Management System is being developed to accommodate management and retrieval of environmental data generated from all CERP activities including MAP implementation.

**Data analysis (Assessment)** is the third sequential step in monitoring program implementation. Assessment involves the query and retrieval of data stored or accessible from a centralized data retrieval system, followed by the application of statistical and other analytical techniques to the retrieved data sets. The goals of the assessment process is to summarize and simplify the collected data, test for change and differences, generate and examine premises and hypotheses, determine the consequences of observations, and evaluate the uncertainty associated with conclusions drawn from the data.

**Reporting** is the fourth sequential step in the implementation of a monitoring program, and it represents a critical link to decision makers. The results of monitoring programs, especially regional programs, should be disseminated to a range of scientists, managers, and stakeholders that provide insight and guidance at different technical and managerial levels.

**Quality Assurance** is a critical element of all monitoring programs (USEPA 1984). A quality assurance program is a system of activities undertaken to ensure that the type, amount, and quality of data collected are adequate to meet study objectives. Quality assurance measures must also be applied to data management, data analysis, and reporting activities to ensure monitoring program integrity.
2.4 Previously Completed AA&M Activities

Activities completed by the AAT and WQT during FYs 01-03 are listed below.

**Water Quality Team Accomplishments 2000-2003:** Itemized below are some of the more significant accomplishments of the WQT.

- Preparation and distribution to Project Delivery Teams (PDTs) of a document entitled “Comprehensive South Florida Water Quality Monitoring Plan” for use in developing project-level monitoring plans
- Development of the draft water quality component of the CERP Quality Assurance System Requirement (QASR) document
- Development of water quality assessment and evaluation performance measures
- Development of the water quality component of the MAP
- Development of a water quality strategy paper for Design Coordination Team (DCT) (future CERP Guidance Memorandum (CGM))
- Development of a Draft CERP protocol for mercury and pesticides (future CGM)
- Development of Water Quality Questionnaire to Guide PDTs
- Development of Water Quality Evaluation Outline for PDTs
- Development of Water Quality Model Survey Results for PDTs

**AAT Accomplishments 2000-2003:** Itemized below are some of the more significant accomplishments of the AAT:

- Preparation and distribution of the initial draft Monitoring and Assessment Plan (MAP), Part 1 to interested CERP parties
2.5 MAP Implementation

In January 2004 the MAP, Part 1 was released in final form. This document describes in detail the monitoring components and supporting research of the MAP and briefly summarizes the assessment process. In developing a system-wide monitoring plan, the MAP, Part 1 is designed to provide a monitoring program that will measure how well the CERP is meeting its performance objectives as well as provide a mechanism for the RECOVER program to fulfill its responsibility to design and implement the system-wide monitoring, assessment and data management program needed to support the CERP. Information gathered from monitoring described in the MAP, Part 1 will provide necessary information to determine if responses to implementation of the Plan are desirable, if Interim Goals and Interim Targets are being or are likely to be achieved, to evaluate if revisions and refinements to the Plan are needed to improve performance, and prepare regular reports on the monitoring program including an annual CERP report card to the public.

Preparation of the MAP, Part 1 involved participation by numerous individuals from federal, state, and local agencies, tribal governments, stakeholders, interest groups, and the public. Refinement and enhancement of the MAP will be a continuous and iterative process. Formal reviews of the MAP will occur no less frequently than once every three years, with informal reviews occurring annually. The Adaptive Assessment Team has the lead responsibility for developing and updating the MAP and providing guidance for its implementation. This lead responsibility is closely coordinated with the Water Quality Team which has the responsibility to ensure that the water-quality strategy is implemented parallel to the other MAP components. The MAP reports represent key components of the CERP Adaptive Management Program, which is being implemented to address program uncertainties and to make appropriate adjustments to improve program performance.

No single agency can carry out the full suite of biological, hydrologic or water quality monitoring tasks contained within the MAP due to logistic challenges, budgetary constraints, and distribution of interagency scientific expertise. Although the lead responsibility for implementing this monitoring program is held by the Corps and the SFWMD, the success of the program will depend on the long-term participation of a number of South Florida federal and state agencies and non-governmental organizations that are currently conducting monitoring programs in South Florida.

Central to the success of MAP implementation is the establishment of a MAP coordinator who will be responsible and accountable for the overall coordination and implementation.
of the MAP. This position is currently being filled on an interim basis by a Contractor. The MAP Coordinator is expected to ensure that there is overall consistency and standardization of processes, common systems and technology, and programmatic practices among the regional monitoring program participants. Although the MAP implementation organization as currently proposed involves a strong centralization of data management, data analysis, and reporting functions, it is proposed that data collection activities be conducted largely through intra- and interagency agreements as well as contractual arrangements with universities and private sector contractors.
3.0 Adaptive Assessment and Monitoring Work Breakdown Structure

A work breakdown structure represents the basic elements of a project - in this case the AA&M component of RECOVER, a program-level activity for implementing the Comprehensive Plan - that flows from the top element - RECOVER - through the Adaptive Assessment and Water Quality Teams and ultimately to work products. The underlying philosophy of a work breakdown structure is to ultimately get to the layer of division where work products are assigned and accountability can be expected with respect to milestones and budget.

The work breakdown structure is developed from the AA&M program scope, and leads to the development of a schedule, a budget, and a list of tasks. The following work breakdown structure details the AA&M portion of RECOVER activities. It should be noted that most of the tasks carried out by RECOVER are the products of two or more teams working in concert and some tasks may overlap.

AA&M costs incurred from FY01-FY03 are documented in Appendix A. The schedule and budget for AA&M tasks for FY04-FY06 is provided in Appendix B. Appendix C contains general cost estimates for completion of AA&M activities for FY07-FY10. The costs (Table B-2) correspond to the tasks necessary to support the Congressionally-authorized AA&M Program and the science-based strategy for implementing the CERP, including the extensive system-wide monitoring program.

The costs shown in Appendices A-C are for the USACE and SFWMD only, and do not reflect the contributions of the other participants. What follows in this section is a breakdown of each AA&M task by functional area. The assignment of tasks between the USACE and the SFWMD are also provided in Appendices A-C.

3.1 Conceptual Ecological Models

Conceptual Ecological Models (CEMs) are the foundation for the development of the majority of assessment performance measures (PMs) (Ogden and Davis 1999), which will in turn determine the design of the system-wide monitoring program. The CEMs illustrate the links among societal actions, environmental stressors, and ecological responses (USEPA 1998) and provide the basis for selection and testing the set of causal hypotheses that best explain why the natural systems in South Florida have been altered (Gentile et al. 2001). Comparisons between predicted responses among stressors and attributes as well as the actual responses measured by the monitoring program provide an opportunity to improve the conceptual ecological models and the performance measures, and to more effectively predict future responses to implementation of the CERP projects and are one of the major components of the applied science strategy of RECOVER.

Conceptual ecological models developed for the major physiographic regions in South Florida (Northern Estuaries, Southern Estuaries, Lake Okeechobee, Greater Everglades, and Lake Okeechobee and Lower East Coast Service Areas) provide the scientific basis
for the development of the CERP system-wide monitoring program and adaptive assessment process. The conceptual ecological model process provides a planning tool for translating the overall restoration goals of the CERP into the specific performance measures that will be used to plan, design, and assess the success of the Plan.

**Task 3.1 Develop, refine and revise conceptual ecological models and recommend research needs.** The Adaptive Assessment and Water Quality Teams will periodically review and improve the conceptual ecological models to reflect new information and improved hypotheses. They will identify the specific hydrological, ecological, water quality and biological measures of restoration success. The Adaptive Assessment Team will maintain current documentation for all models. The Water Quality Team will periodically review and improve the conceptual ecological models to ensure water quality is being accurately addressed. Conceptual models will be revised or additional ones developed as necessary to complete the understanding of the natural system based on new information and improved hypotheses.

The Adaptive Assessment and Water Quality Teams will recommend research needed in support of the Plan. The conceptual ecological models will be used as a basis for recommending research that will lead to improved design and interpretations of the system-wide monitoring program. The tri-chairs of both teams, after consultation with their respective team members, will meet as needed to select for funding and execution those research items with highest priority needs.

**3.2 Assessment Performance Measures**
Performance measures have been defined and continue to be developed as a means to assess the system-wide performance of the CERP. They have been developed by the RECOVER Adaptive Assessment and Water Quality Teams primarily from the attributes and stressors in the conceptual ecological models, but also from input from the Restudy and direction provided by law, regulation, and policy. The performance measures have undergone several reviews using a series of criteria to ensure that they would measure system responses directly related to CERP implementation and could be interpreted in the context of the CERP. The performance measures are defined by indicators that are assessed using measurable parameters with quantitative targets or assessed by trends, i.e., directions of change.

**Task 3.2 Develop, refine and revise assessment performance measures and maintain the current set of performance measures for system-wide assessments.** The Adaptive Assessment and Water Quality Teams will develop assessment performance measures and restoration targets and performance indicators in regions where they do not currently exist, and review and improve the current set of assessment performance measures and targets. The Adaptive Assessment and Water Quality Teams will systematically update the set of assessment performance measures and other assessment criteria used to assess the performance of the CERP at a system-wide scale. The Adaptive Assessment Team has the lead responsibility for
developing and refining biological/ecological performance measures while the Water Quality Team has the lead for water quality assessment performance measures. The teams will create and maintain updated documentation for all assessment performance measures used in RECOVER as part of the adaptive assessment process.

3.3 Monitoring

The MAP, Part 1, as discussed in Section 2.5, is the primary tool by which the RECOVER program will assess the performance of the CERP. The scientific and technical information generated from the MAP implementation will be organized to provide a process for RECOVER to evaluate CERP performance and system responses and to produce assessment reports describing and interpreting the responses.

The CERP MAP consists of numerous biologic, hydrologic, and water quality components. No single agency can carry out the full suite of monitoring tasks due to logistical challenges, budgetary constraints, and the distribution of interagency expertise. Although lead responsibility for funding and implementing this monitoring program is held by the Corps and the SFWMD, the success of the program will depend on the long-term participation of a number of South Florida agencies, tribal governments, and other stakeholders that are currently conducting monitoring programs in South Florida.

The goal in developing and implementing the MAP is to have a single, integrated, system-wide monitoring and assessment plan that will be used and supported by all participating agencies and tribal governments to track and measure system-wide responses to the implementation of the CERP. In general, monitoring has four broad objectives:

1. Establish a pre-CERP reference state including variability for each of the performance measures
2. Provide the assessment of the system-wide responses of CERP implementation
3. Detect unexpected responses of the ecosystem to changes in stressors resulting from CERP activities
4. Support scientific investigations designed to increase ecosystem understanding, establish cause-and-effect relationships, and interpret unanticipated results

Addressing these objectives will help determine how CERP’s implementation affects the physical, biological, and chemical components of the South Florida ecosystem and will increase scientific understanding of how this system works. Knowledge of how the South Florida ecosystem is changing in response to CERP implementation combined with investigations of cause-effect relationships will contribute to the refinement of CERP projects through the adaptive management program. In this way, restoration objectives set by the performance measures have a greater opportunity to be met.
This monitoring plan does not include all of the measures necessary to document the long-term restoration of the South Florida ecosystem. It is not within the scope of the CERP to contain all the elements necessary to achieve full restoration. CERP’s primary focus is the restoration of the natural system’s hydrology, while continuing to provide for water supply and flood protection for the built (human) system. The MAP provides a focused, critical set of measures for those systems directly affected by CERP and seeks to supplement and fill the gaps in ongoing relevant monitoring efforts. Other important anthropogenic factors that interact with the South Florida ecosystem, including population growth, water demand increases, and land use changes, will be tracked through RECOVER planning processes. Additionally, each CERP project implementation report will contain a separate, project-specific monitoring plan to assess the local responses to the implementation of individual CERP projects.

The CERP MAP is organized into five main sections. *Section 1*, Purpose and Scope of the CERP Monitoring and Assessment Program, provides background information and a broad overview of the purpose of the monitoring plan. *Section 2*, Development of the Monitoring Plan, describes the processes through which the MAP was developed. Because much of the focus of this document is on the content and design of the system-wide monitoring program, *Section 2* also describes the CERP Adaptive Management Program, which includes a performance assessment component. *Section 3*, Integrated Monitoring Requirements, describes the actual monitoring plan for the initial six integrated monitoring modules:

- Greater Everglades Wetlands
- Southern Estuaries (Florida Bay, Biscayne Bay, and Southwest Florida Coast)
- Northern Estuaries (Caloosahatchee Estuary, St. Lucie Estuary, Indian River Lagoon, Loxahatchee River Estuary, and Lake Worth Lagoon)
- Lake Okeechobee
- South Florida Hydrology Monitoring Network
- South Florida Mercury Bioaccumulation

These monitoring modules have been designed to evaluate the performance of the CERP as it is implemented and to test the working hypotheses in the conceptual ecological models. *Section 4*, Quality Assurance/Quality Control and Data Validation, Management, Evaluation, and Reporting, details how environmental data and information developed through the adaptive management process must (1) withstand scientific review and legal scrutiny; (2) be used to develop scientific and technical consensus among agencies; and (3) must be fully utilized and integrated into CERP. *Section 5*, Implementation Strategy for the CERP MAP, contains an overview of a proposed implementation strategy. *Appendix A* contains the eleven CEMs covering the major physiographic regions of South Florida and *Appendix B* contains a summary of the direct and indirect effects of projects as they relate to modules.

During the development of the MAP, the Adaptive Assessment Team relied upon two key assumptions that are critical to the success of the performance assessment process:
• Existing monitoring will continue with existing funding sources (i.e., the MAP should not replace ongoing agency efforts that are essential to the plan implementation).

• Partnering agencies will contribute funding and/or will participate in implementation of the MAP

RECOVER is cognizant of the uncertainty inherent in these assumptions, due to the annual cycles of agency budgeting and funding constraints. Since these ongoing monitoring efforts are recognized as a critical foundation for the MAP, cooperative agreements and other mechanisms will need to be developed to ensure critical linkages within and among participating agencies.

Monitoring data collected by the MAP will be used for six broad purposes in support of the CERP:

1. Assess and document progress towards meeting performance measure targets and interim and long-term goals

2. Detect undesirable system responses as early as possible in order to minimize the adverse effects of these responses

3. Provide a basis for identifying options for improvements in the design and operation of CERP projects and components

4. Develop reports on the status and progress of the CERP for the agencies involved, the public, Congress, the Florida Legislature, and stakeholders

5. Evaluate CERP hypotheses and performance measures and revise conceptual ecological models as appropriate

6. Enhance predictive ability through improvements in simulation models before and after project construction

Activities will include assessing existing monitoring efforts and networks, as well as identifying opportunities to integrate monitoring components with existing monitoring and water management infrastructure. Research needs have also been identified to support key uncertainties that have been identified in the conceptual ecological models.
**Task 3.3.1 Continue to develop, refine, and revise the Monitoring and Assessment Plan.** The Adaptive Assessment and Water Quality Teams will periodically update the system-wide MAP in support of the Comprehensive Plan. Although, the Adaptive Assessment Team has the lead responsibility for developing and updating the MAP and providing guidance for its implementation, the Water Quality Team will co-lead this activity as it pertains to water quality components.

**Task 3.3.2 Implementation of the system-wide MAP (AAT, WQT).** The Adaptive Assessment Team and the Water Quality Team will work closely together in implementing the MAP. Implementation of the MAP will consist of three major tasks: (1) establishment and operation of the Monitoring and Assessment Program; (2) management and quality assurance and/or quality control (QA/QC) of RECOVER data in collaboration with the CERP Data Management Program; and (3) assessment and reporting of the monitoring data.

**Task 3.3.3 Monitoring components and supporting research.** This task involves designing and implementing a monitoring network and identifying key supporting research projects to assess the system responses to implementation of the CERP.

### 3.4 Data Management

An essential component of this system-wide monitoring program is the creation of an efficient, integrated, and quality assured data management system that can be used for storing, retaining, organizing, and accessing data generated by the MAP’s proposed monitoring and research activities. This will ensure effortless and efficient retrieval and analysis to facilitate effective interpretation of CERP performance and ecosystem responses, production of periodic assessment reports describing and interpreting the responses, and evaluation of the overall success of the restoration effort.

The types of quality-assured data that will likely be archived in the resulting AA&M environmental data management system include 1) geospatial, time series, and operations data with corresponding metadata and 2) technical documents (such as those that describe methods, conceptual ecological models, performance measures, costs, quality assurance/quality control [QA/QC] etc.). The data may either be existing and collected from multiple sources (federal, state and local government agencies, tribal governments, universities, and other entities) or generated from both the system-wide and project-level monitoring programs. Also, there is a considerable amount of data that continue to be generated from a number of ongoing monitoring and research programs that will also need to be acquired, organized, validated, formatted, and evaluated following appropriate protocols outlined herein. This information will be used to establish and characterize baseline conditions for the broad array of performance measures, identify monitoring and
data gaps, and plan any additional monitoring and investigations to support the performance evaluation of the CERP.

It should be noted that AA&M data management system will be part of a centralized CERP shared data and information network infrastructure that will be managed by the CERP Data Management Program (SFWMD and USACE 2002, 2003). RECOVER will coordinate and provide guidance on a continuous basis with the CERP Data Management Program assisting with these efforts to ensure the system and tools are adequately tested, are successfully implemented, and meet user needs.

Task 3.4 Data Management. This task will entail the design, construction, testing and implementation of a centralized AA&M database to archive and retrieve the data generated from the system-wide monitoring program. Other tasks will include identifying and collecting data from various sources that may be useful to RECOVER in assessing the current status of the system and its future performance as each component of CERP is implemented.

3.5 Assessment

Natural and human system responses during and following CERP implementation will be compared to the trends or targets established for each performance measure. These comparisons will serve as a basis for evaluating and assessing how the implementation of CERP projects, individually and collectively, are meeting the overall goals and objectives of the CERP. The combined responses from the full set of performance measures will determine CERP’s overall success.

Part 1 of the MAP describes in detail the monitoring components and supporting research of the MAP and briefly summarizes the assessment process. A detailed assessment process for interpreting the information collected by the implementation of this plan is under development at this time by the Adaptive Assessment and Water Quality Teams. This process will be documented in Part 2 of the MAP.

In addition, an Assessment Guidance Memorandum (GM) is being prepared which addresses the process of adaptive assessment. This Assessment GM provides general directions for the conduct of RECOVER assessment activities as required by the CERP Programmatic Regulations. The GM lays out a strategy for conducting assessments of the Everglades ecosystem to aid in understanding the influence of CERP on the environment.

The Assessment GM presents strategies for: (1) establishing ecological (hydrology, biology, and water quality) reference (baseline) conditions in the system; (2) determining the ability to detect changes in the parameters of interest; (3) assessing ecosystem performance at a hierarchy of scales; (4) assessing MAP hypotheses; (5) incorporating assessments of indicators of Interim Goals and Interim Targets; (6) making adaptive changes in the overall assessment process; and (7) evaluating if corrective actions to improve CERP performance should be considered. Additionally, the GM also provides a framework for assessment reporting mechanisms, including the preparation of the
Technical Report called for in the Programmatic Regulations. Finally, it presents guidance on resolving technical disputes at the lowest level possible and the role of peer review in the assessment process.

The Integrative Assessment Sub-Team (IAT), a sub-team with membership from the Adaptive Assessment and Water Quality Teams, is also preparing an Integrative Assessment Guidance (Guidance) document. This document will help ensure that the sampling designs for the MAP monitoring components have the power to detect measurable change in hydrologic, water quality, and ecosystem indicators. It will also supply a systematic framework for analyzing the data generated from the MAP and other relevant monitoring data, detecting and assessing changes in performance measures, assessing progress toward achieving Interim Goals and Interim Targets, and evaluating the status of module and system-wide hypotheses. The objective of this analysis is to characterize the pre-CERP reference conditions and conduct scientifically rigorous analyses of CERP MAP hypotheses and changes in PMs. This Guidance is applicable to all adaptive management-monitoring tasks within CERP (e.g., Module Groups, PDTs, contracts, etc.). In so doing, the Guidance will provide consistency and comparability in the analysis of data, minimize debates on "how the analyses were performed" and allow decision-makers to focus on the interpretation of the results.

The IAT Guidance also represents a vital part of the Assessment GM for “general directions for the conduct of the assessment activities of RECOVER” as required by the Programmatic Regulations [Section 385.31(a)(2)(iv)].

**Task 3.5.1 Develop assessment protocols including pre-CERP reference state characterization (AAT, WQT)**. The Adaptive Assessment and Water Quality Teams will jointly develop a document detailing a monitoring data assessment protocol to assess the information collected and analyzed from the system-wide monitoring in support of the adaptive management strategy. The assessments will be used to develop assessment reports that identify opportunities for improvements to the Comprehensive Plan. The focus of the protocol will be on how RECOVER will assess the performance of the CERP, and identify opportunities to improve the performance of the CERP based on monitoring and research data.

**Task 3.5.2 Conduct assessments of system-wide responses to the Comprehensive Plan (AAT, WQT)**. The Adaptive Assessment and Water Quality Teams with assistance from the Operations Planning Team will interpret the responses by natural and human systems during implementation of the CERP. These assessments will be used by the Comprehensive Plan Refinement Team as a basis for identifying opportunities for refining the CERP and for developing any necessary changes that would produce the desired achievement of CERP goals. Periodic technical assessment reports on system-wide responses to the CERP for each of the parameters being monitored will be issued as necessary, but at least every five years. The
reports will describe how well the CERP components are meeting their targets, based upon system-wide responses measured against restoration targets and compared against the pre-CERP reference state. This task will support development of the annual report card.

Sub-Task 3.5.2.1 Develop a process for preparation of assessment reports.
This task will involve the development of a process for preparation of technical assessment reports. The Adaptive Assessment and Water Quality Teams will jointly finalize a process for the efficient production of these reports including the coordination of input from other RECOVER teams.

Sub-Task 3.5.2.2 Final assessment report format.
The Adaptive Assessment and Water Quality Teams will jointly finalize the report format for assessments based on results of the ongoing RECOVER initiated task to determine the best method for presentation of RECOVER assessment results.
3.6 Reporting

In addition to validation and management of the data, another key component that supports RECOVER’s ability to interpret system-wide responses in the context of restoration targets is the evaluation and reporting of the quality-assured data. Data and information generated from the MAP are to be quality assured, interpreted, and assessed with results reported on a periodic basis.

The Adaptive Assessment and Water Quality Teams will determine the requirements for the data evaluation process for each of the performance measures and the required formats for reports. A significant amount of time and resources will be required to synthesize, analyze, and publish all the data collected from this effort. The resources required to analyze the large volumes of data generated from this monitoring program and make such data available and understandable to management and other stakeholders as part of the adaptive assessment process are critical elements of a science program and must be explicitly planned and adequately funded. Monitoring data will be presented in specified reporting formats that best illustrate the status and trends, patterns of variability, and probable responses to the effects of the CERP for each of the performance measures.

As discussed above, a technical report shall be prepared by RECOVER whenever it is deemed necessary, but at least every five years, that presents an assessment of whether the goals and purposes of the Plan are being achieved, including whether interim goals and interim targets are being achieved. RECOVER will work with CERP Public Outreach to convert these technical assessment reports into formats effective for public use, selecting a subset of the indicators that are defined in the Performance Measure Documentation Report (RECOVER In prep) and that will be monitored and assessed through the MAP to create an annual CERP report card. Also, using a subset of indicators from the Performance Measure Documentation Report (RECOVER In prep), a CERP Interim Goals Report will be developed, as required under the Programmatic Regulations (DOD 2003).

*Task 3.6 Reporting* (There are currently no tasks identified for FY04).

3.7 Standardization and Quality Control of Monitoring Protocols

Implementation of the MAP will require rigorous Quality Assurance and Quality Control (QA/QC) programs for the data management program for the CERP. The Quality Assurance Oversight Team, a sub-team of the Water Quality Team, will oversee the generation of QA/QC protocols. RECOVER has adopted the following principles in developing these programs. The QA/QC programs must do the following:

- Withstand scientific review and legal scrutiny
- Be used to develop and support scientific and technical consensus
- Be fully integrated into the CERP
This QA/QC effort will provide consistency to the information collected by the many different agencies and tribal governments involved in the implementation of the CERP. This effort will also establish operating standards for the design, collection, and analyses of a variety of data types recommended in this MAP and for all of the CERP projects and components. The QA/QC Program is designed to meet the following requirements:

- **Standardized Procedures** – ensure the consistency and comparability of data using standardized procedures across agencies or organizations
- **Accuracy and Precision Criteria** – provide guidance to those involved in the CERP monitoring activities to establish accuracy and precision criteria for each data type
- **Degree of Confidence** - provide for the efficient and effective analysis of data collected by the various organizations in South Florida and provide users of these data with some degree of confidence that the data were collected with similar accuracy and processing standards across agencies
- **Guidance for New Monitoring Stations** – provide guidance on accuracy and precision requirements to agencies and organization involved with establishing new monitoring stations

Further detail on the QA/QC procedures can be found in the *Draft CERP Quality Assurance System Requirement Manual* (QASR) (RECOVER 2003).

**Task 3.7 Standardization and quality control of monitoring protocols.** This task involves developing a CERP quality assurance system requirement manual to establish operating standards for the design, collection and analyses of data for CERP Projects. A defined system of quality control practices and standard operating procedures is critical in order to ensure that data and measurements are of the appropriate type and quality, and are scientifically sound and defensible.

### 3.8 Adaptive Management

One definition of Adaptive Management (Blann and Light 2003) is as follows: “Adaptive management applies scientific methods to complex resource management challenges with the objective of designing robust policies for dealing with uncertainty and surprise inherent in such context.” The Committee on Restoration of the Greater Everglades Ecosystem (National Research Council 2003) further defines adaptive management as consisting of “(1) clear restoration goals and expectations, (2) a sound conceptualization of the system, (3) an effective process for learning about future management actions, and (4) explicit feedback mechanisms for refining and improving management based on the learning process.”

Basic components and purposes of the CERP Adaptive Management Program are described in the Programmatic Regulations for the Comprehensive Plan (DOD 2003). The Adaptive Management Program is designed to maximize the success of the CERP by refining the Plan during its implementation to respond to new information or technologies to ensure that the goals and purposes of the Plan are fulfilled. These uncertainties include
unpredicted and undesired responses and events in the natural and human systems of South Florida that result from CERP implementation or from non-CERP projects and programs. A successful adaptive management program will provide early warnings of undesired impacts and a process that will allow decision makers (1) to effectively integrate science and management to ensure that the CERP goals and purposes are fulfilled and (2) to seek continuous improvements of the CERP. The tasks associated with this work activity are presented below.

**Task 3.8.1 Conduct adaptive management workshops.** The AAT and other members of RECOVER will conduct a series of workshops to assist in the development of an adaptive management strategy for the CERP and establish the framework for the adaptive management process. Adaptive management principles will be authored as part of this task.

**Task 3.8.2 Prepare and Implement Adaptive Management Strategy.** Successful application of the Adaptive Management Program will require the interaction of the interagency RECOVER teams, policy and decision makers, and the public in addressing the opportunities identified by the performance assessment protocol. The adaptive management strategy will ensure that operational flexibility will maximize opportunities for adaptive management and minimize the potential need for retrofits.

**Task 3.8.3 Prepare Guidance Memorandum for Conduct of Adaptive Assessment.**

### 3.9 Project-Level Monitoring Plans

The Adaptive Assessment and Water Quality Teams of RECOVER will review project-level monitoring plans for consistency with the system-wide monitoring plan in the RECOVER MAP and other relevant RECOVER documents (such as the RECOVER QASR). Current versions of these documents are available at [www.evergladesplan.org](http://www.evergladesplan.org). The purposes of this consistency review are to:

1. Ensure the design and implementation of the project-level monitoring plan components are consistent with the MAP and the QASR,
2. Identify any duplication of monitoring efforts or reliance on the MAP by the PDTs and
3. Identify potential information developed by the PDTs that may be incorporated into future system-wide assessment reports.

The Quality Assurance Oversight team (QAOT) will conduct a separate and detailed review of the project-level monitoring plan; however, QAOT comments related to general consistency with the QASR will be provided as part of the RECOVER report.

**Task 3.9. Review project-level monitoring plans (AAT and WQT).** The Adaptive Assessment and Water Quality Teams will review the project-level monitoring plans for consistency with system-wide performance monitoring plans and will provide the results of these reviews to project delivery teams.

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2 The PDT is responsible for determining if the project-level monitoring plans are scientifically sound and supported by project goals and objectives and for documenting this determination.
3.10 Assessment Management

The Adaptive Assessment and Water Quality Teams must manage a number of coordination activities to achieve AA&M objectives. Management tasks anticipated for FY04 - FY06 are listed below.

**Task 3.10.1 Workshops and coordination activities.** The Adaptive Assessment and Water Quality Teams will accomplish their tasks through collaboration and coordination. Workshops and meetings will be important ways of accomplishing development of assessment performance measures, providing venues for discussing project assessments, reviewing project-level assessment performance measures, developing strategies for activities, and coordinating with other RECOVER teams. The Adaptive Assessment and Water Quality Teams will coordinate their activities with the project liaisons (discussed further in Section 3.4.2). Contractor(s) will provide support, facilitation, coordination and documentation services for the workshops and meetings, as appropriate.

**Task 3.10.2 Ensure appropriate public and agency review and coordination of assessment documents.** The Adaptive Assessment and Water Quality Teams are responsible for the development of many scientific and technical tasks that will be essential for measuring the effects of the CERP implementation such as the development of a system-wide monitoring and assessment plan for the CERP. Review and coordination of documents produced by these technical teams by the public, stakeholders, tribes and agencies will be crucial to the overall successful implementation of the CERP. This activity will be coordinated with the program-level public outreach program, as necessary.

**Task 3.10.3 Resolve technical issues.** The Adaptive Assessment and Water Quality Teams will maintain a list of unresolved scientific and technical issues pertaining to assessment aspects, establish priorities for issue resolution, and take steps to resolve these issues. The teams will develop issue resolution reports describing the steps taken to resolve each issue, and the solutions that were reached. This may require drafting issue papers and setting up workshops or other technical meetings. The overall strategy for resolving conflicting technical opinions will be guided by the RECOVER Leadership Group.
Appendix A: FY2001 – FY2010 Expenditures and Scheduled Costs
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